KARNATAK LAW SOCIETY'S

GOGTE INSTITUTE OF TECHNOLOGY

UDYAMBAG, BELAGAVI-590008

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

(APPROVED BY AICTE, NEW DELHI)

Department of Electronics and Communication Engineering

Scheme and Syllabus (2016 Scheme)

3rd to 8th Semester B.E.

INSTITUTION VISION

Gogte Institute of Technology shall stand out as an institution of excellence in technical education and in training individuals for outstanding caliber, character coupled with creativity and entrepreneurial skills.

MISSION

To train the students to become Quality Engineers with High Standards of Professionalism and Ethics who have Positive Attitude, a Perfect blend of Techno-Managerial Skills and Problem solving ability with an analytical and innovative mindset.

QUALITY POLICY

- Imparting value added technical education with state-of-the-art technology in a congenial, disciplined and a research oriented environment.
- Fostering cultural, ethical, moral and social values in the human resources of the institution.
- Reinforcing our bonds with the Parents, Industry, Alumni, and to seek their suggestions for innovating and excelling in every sphere of quality education.

DEPARTMENT VISION

The Electronics & Communication Engineering department shall impart quality technical education and entrepreneurship skills to develop creative individuals to face changing global scenario.

MISSION

To augment the national talent pool,withElectronics and Communication Engineers having all-encompassing technical knowledge, principled practices and nationalistic outlook.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. The graduates will acquire core competence in basic science and Electronics and Communication Engineering fundamentals necessary to formulate, analyze, and solve engineering problems and to pursue advanced study or research.
2. The graduates will engage in the activities that demonstrate desire for ongoing personal and professional growth and self-confidence to adapt to rapid and major changes.
3. The graduates will maintain high professionalism and ethical standards, effective oral and written communication skills, work as part of teams on multidisciplinary projects under diverse professional environments, and relate engineering issues to the society, global economy and to emerging technologies.

PROGRAM OUTCOMES (POs)

1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.
3. **Social Engineering:** Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions.
4. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.
5. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.
6. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.
7. **Ethics:** Graduates shall imbibe the professional and ethical responsibilities of their profession.
8. **Collaboration:** Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.
9. **Soft skills**: Graduates shall possess proficiency in oral and written communication skills.
10. **Entrepreneurship**: Graduates shall imbibe project management and finance skills to pursue entrepreneurial endeavours.
11. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions.
12. **Self-motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Understanding and applying the mathematical and scientific concepts, for analysis and design of basic Electronics and Communication systems.
2. Developing critical thinking abilities coupled with competence in use of computational tools for professional growth;complimented with communication skills and leadership attributes.
3. Identifying societal needs and sensitizing individuals towardsfinding innovative solutions to contemporary issues with multidisciplinary outlook.

Scheme of Teaching
Semester III (Regular)

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE	Marks Total
1.	16MAT31	Statistical – Numerical – Fourier Techniques	BS	3 – 1– 0	4	4	50	50	100
2.	16EC32	Analog Electronics	PC1	3 – 1 – 0	4	4	50	50	100
3.	16EC33	Digital Electronics	PC2	3 – 1 – 0	4	4	50	50	100
4.	16EC34	Signals and Systems	PC3	3 – 0 – 2	3	5	50	50	100
5.	16EC35	Network Analysis	PC4	3 – 0 – 0	3	3	50	50	100
6.	16ECL36	Analog Electronics Lab	L1	0 – 0 – 3	2	3	25	25	50
7.	16ECL37	Digital Electronics Lab	L2	0 – 0 – 3	2	3	25	25	50
8.	16ECL38	Network Analysis Lab	L3	0 – 0 – 3	2	3	25	25	50
		Total		**15 - 3 - 11**	**24**	**29**	**325**	**325**	**650**

***SEE: SEE (Theory exam) will be conducted for 100marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA**

- **Courses with L-T-P: 3-0-2: SEE – Theory (Lab related questions shall be set with 80T:20L)**
- **#Courses with L-T-P: 0-0-3: SEE- Laboratory (Only Lab Exam with 1 (a) Software &/or 1 (b) Hardware)**

Scheme of Teaching
Semester III (Diploma Lateral Entry)

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE	Marks Total
1.	16DIPMAT31#	Calculus, Fourier Analysis and Linear Algebra	BS	4 – 1 – 0	5	5	50	50	100
2.	16EC32	Analog Electronics	PC1	3 – 1 – 0	4	4	50	50	100
3.	16EC33	Digital Electronics	PC2	3 – 1 – 0	4	4	50	50	100
4.	16EC34	Signals and Systems	PC3	3 – 0 – 2	3	5	50	50	100
5.	16EC35	Network Analysis	PC4	3 – 0 – 0	3	3	50	50	100
6.	16EC36	Analog Electronics Lab	L1	0 – 0 – 3	2	3	25	25	50
7.	16ECL37	Digital Electronics Lab	L2	0 – 0 – 3	2	3	25	25	50
8.	16ECL38	Network Analysis Lab	L3	0 – 0 – 3	2	3	25	25	50
		Total		**16 – 3 – 11**	**25**	**30**	**325**	**325**	**650**

*** SEE: SEE (Theory exam) will be conducted for 100marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA**
#Only for Diploma lateral entry students

- **Courses with L-T-P: 3-0-2: SEE – Theory (Lab related questions shall be set with 80T:20L)**
- **#Courses with L-T-P: 0-0-3: SEE- Laboratory (Only Lab Exam with 1 (a) Software &/or 1 (b) Hardware)**

Scheme of Teaching
Semester IV (Regular)

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE*	Marks Total
1.	16MATEE41	Partial Differential Equations, Sampling Techniques and Transforms	BS	3 – 1– 0	4	4	50	50	100
2.	16EC42	Computer Organization & Architecture	PC1	3 – 1 – 0	4	4	50	50	100
3.	16EC43	Control Systems	PC2	3 – 0 – 2	3	5	50	50	100
4.	16EC44	Engineering Electromagnetics	PC3	3 – 1 – 0	4	4	50	50	100
5.	16EC45	Communication Theory and Techniques	PC4	3 – 0 – 0	3	3	50	50	100
6.	16ECL46	Linear Integrated Circuits Lab	L1	2 – 0 – 2	2	4	25	25	50
7.	16ECL47	Communication Lab	L2	0 – 0 – 3	2	3	25	25	50
8.	16ECL48	Digital Design using HDL Lab	L3	2 – 0 – 2	2	4	25	25	50
9.	16ECL49	Electronics and Computer Workshop	ES	0 – 0 – 3	2	3	25	25	50
		Total		**19 – 3 – 12**	**26**	**34**	**350**	**350**	**700**

*** SEE: SEE (Theory exam) will be conducted for 100marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA**

- **Courses with L-T-P: 3-0-2: SEE – Theory (Lab related questions shall be set with 80T:20L)**
- **Courses with L-T-P: 2-0-2: SEE – Laboratory (Theory Questions shall be set 40T:60L)**
- **Courses with L-T-P: 0-0-3: SEE- Laboratory (Only Lab Exam with 1 (a) Software &/or 1 (b) Hardware)**

Scheme of Teaching
Semester IV (Diploma Lateral Entry)

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE*	Marks Total
1.	16DIPMATM41^	Vector Calculus, Laplace Transforms and Probability	BS	4 – 1 – 0	5	5	50	50	100
2.	16EC42	Computer Organization & Architecture	PC1	3 – 1 – 0	4	4	50	50	100
3.	16EC43	Control Systems	PC2	3 – 0 – 2	3	5	50	50	100
4.	16EC44	Engineering Electromagnetics	PC3	3 – 1 – 0	4	4	50	50	100
5.	16EC45	Communication Theory and Techniques	PC4	3 – 0 – 0	3	3	50	50	100
6.	16ECL46	Linear Integrated Circuits Lab	L1	2 – 0 – 2	2	4	25	25	50
7.	16ECL47	Communication Lab	L2	0 – 0 – 3	2	3	25	25	50
8.	16ECL48	Digital Design using HDL Lab	L3	2 – 0 – 2	2	4	25	25	50
9.	16ECL49	Electronics and Computer Workshop	ES	0 – 0 – 3	2	3	25	25	50
10.	16EC49A#	Environmental Studies (CIV)	ES	1 – 0 – 0	Mandatory Non-credit	1	25	25	50
		Total		**21 – 3 – 12**	**27**	**36**	**375**	**375**	**750**

***SEE: SEE (Theory exam) will be conducted for 100marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA**
^Only for diploma lateral entry students.
 # Pass in this course is mandatory for the award of degree, only for diploma lateral entry students.

- **Courses with L-T-P: 3-0-2: SEE – Theory (Lab related questions shall be set with 80T:20L)**
- **Courses with L-T-P: 2-0-2: SEE – Laboratory (Theory Questions shall be set 40T:60L)**
- **Courses with L-T-P: 0-0-3: SEE- Laboratory (Only Lab Exam with 1 (a) Software &/or 1 (b) Hardware)**

Scheme of Teaching
Semester V (Regular)

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE	Marks Total
1.	16EC51	Digital Communication	PC1	3 – 0 –2	4	5	50	50	100
2.	16EC52	Advanced Processors	PC2	3 – 1 – 0	3	4	50	50	100
3.	16EC53	DSP and Architecture	PC3	3 – 0 – 2	4	5	50	50	100
4.	16EC54	CMOS VLSI Design	PC4	3 – 1 – 0	3	4	50	50	100
5.	16EC55x	Elective – I	PE – I	3 – 0 – 2	3	5	50	50	100
6.	16ECL56	Advanced Processors Lab	L1	0 – 0 – 3	2	3	25	25	50
7.	16ECL57	VLSI Lab	L2	0 – 0 – 3	2	3	25	25	50
8.	16ECL58	Advanced C and C++ Lab	L3	2 – 0 – 2	2	4	25	25	50
9.	16EC59	Design Thinking and Innovation		0 – 0 – 2	2	2	50	0	50
		Total		**17 – 2 – 16**	**25**	**35**	**375**	**325**	**700**

Course Code	Elective –I
16EC551	Power Electronics
16EC552	Image and Video Processing
16EC553	Soft Computing
16EC554	Cryptographyand Network Security

- **Courses with L-T-P: 3-0-2: SEE – Theory (Lab related questions shall be set with 80T:20L)**
- **Courses with L-T-P: 2-0-2: SEE – Laboratory (Theory Questions shall be set 40T:60L)**
- **Courses with L-T-P: 0-0-3: SEE- Laboratory (Only Lab Exam with 1 (a) Software &/or 1 (b) Hardware)**

Scheme of Teaching
Semester V (Diploma Lateral Entry)

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE	Marks Total
1.	16DIPMATM51	Partial Differential Equations, Z – Transforms and Stochastic Processes	BS	4 – 1 – 0	5	5	50	50	100
2.	16EC51	Digital Communication	PC1	3 – 0 –2	4	5	50	50	100
3.	16EC52	Advanced Processors	PC2	3 – 1 – 0	3	4	50	50	100
4.	16EC53	DSP and Architecture	PC3	3 – 0 – 2	4	5	50	50	100
5.	16EC54	CMOS VLSI Design	PC4	3 – 1 – 0	3	4	50	50	100
6.	16EC55x	Elective –I	PE – I	3 – 0 – 2	3	5	50	50	100
7.	16ECL56	Advanced Processors Lab	L1	0 – 0 – 3	2	3	25	25	50
8.	16ECL57	VLSI Lab	L2	0 – 0 – 3	2	3	25	25	50
9.	16ECL58	Advanced C and C++ Lab	L3	2 – 0 – 2	2	4	25	25	50
10.	16EC59	Design Thinking and Innovation		0 – 0 – 2	2	2	50	0	50
		Total		**21 – 3 – 16**	**30**	**40**	**425**	**375**	**800**

Course Code	Elective –I
16EC551	Power Electronics
16EC552	Image and Video Processing
16EC553	Soft Computing
16EC554	Cryptographyand Network Security

- **Courses with L-T-P: 3-0-2: SEE – Theory (Lab related questions shall be set with 80T:20L)**
- **Courses with L-T-P: 2-0-2: SEE – Laboratory (Theory Questions shall be set 40T:60L)**
- **Courses with L-T-P: 0-0-3: SEE- Laboratory (Only Lab Exam with 1 (a) Software &/or 1 (b) Hardware)**

Scheme of Teaching
Semester VI

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE	Marks Total
1.	16EC61	Management and Entrepreneurship	HS	3 – 0 –0	3	3	50	50	100
2.	16EC62	Microwave & Antenna Engineering	PC1	3 – 1 – 0	3	4	50	50	100
3.	16EC63	Information Theory and Coding	PC2	3 – 0 – 2	4	5	50	50	100
4.	16EC64	Operating Systems	PC3	3 – 0 – 2	4	5	50	50	100
5.	16EC65	Transducers and Sensors	PC4	3 – 0 – 2	4	5	50	50	100
6.	16EC66x	Elective – II	PE – II	3 – 0 – 0	3	3	50	50	100
7.	16ECL67	Microwave and Antenna Lab	L1	0 – 0 – 3	2	3	25	25	50
8.	16ECL68	Data Structures Lab	L2	2 – 0 – 2	3	4	25	25	50
9.	16EC69	Constitution of India, Professional Ethics and Human Values	HS	2 – 0 – 0	2	2	25	25	50
		Total		**22 – 1 – 11**	**28**	**34**	**375**	**375**	**750**

Course Code	Elective - II
16EC661	Automotive Electronics
16EC662	Requirements Engineering
16EC663	Consumer Electronics
16EC664	Heterogeneous Computing

Scheme of Teaching
Semester VII

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE	Marks Total
1.	16EC71	Computer Communication Networks	PC1	4 – 0 –0	4	4	50	50	100
2.	16EC72	Wireless and Mobile Communication	PC2	4 – 0 – 0	3	4	50	50	100
3.	16EC73	GPS and IoT	PC3	3 – 0 – 2	4	5	50	50	100
4.	16EC74	Optical Fiber Communication	PC4	3 – 1 – 0	4	5	50	50	100
5.	16EC75x	Elective – III	PE – III	3 – 0 – 2	3	5	50	50	100
6.	16EC76x	Elective – IV	PE – IV	3 – 0 – 2	3	5	50	50	100
7.	16ECL77	Communication and Networking Lab	L1	0 – 0 – 3	2	3	25	25	50
8.	16ECL78	Wireless and Mobile Communication Lab	L2	0 – 0 – 3	2	3	25	25	50
9.	16EC79	#Seminar on Project synopsis	PC	0 – 0 – 2	2	2	25	0	25
		Total		**20 – 1 – 14**	**27**	**35**	**375**	**350**	**725**

Project batches and guide allocation to be done before the end of sixth sem.

Course Code	Elective – III
16EC751	Electronic System Design
16EC752	Satellite Communication
16EC753	ASIC Design
16EC754	Data Base Management System

Course Code	Elective – IV
16EC761	Low Power VLSI
16EC762	Ad Hoc and Sensor Networks
16EC763	Real Time OS
16EC764	Multimedia Communication

Scheme of Teaching
Semester VIII

S. No.	Code	Course		Credits L – T - P	Total credits	Contact Hours/ week	Marks CIE	Marks SEE	Marks Total
1.	16EC81	Internship			2	2	50	0	50
2.	16EC82	Intellectual Property Right and Cyber law	SS	Self Study	2	2	50	0	50
3.	16EC83	Professional Certification - 1			0	1	25	0	25
4.	16EC84	Professional Certification - 2			0	1	25	0	25
5.	16EC85	Minor Project on Social Responsibility	HS	0 – 0 – 2	2	1	25	0	25
6.	16EC86	Project Phase -1	PC		2	2	50(25+25)	0	50
7.	16EC87	Project Phase -2	PC		2	4	50(25+25)	0	50
8.	16EC88	Project Phase-3 (Final Viva Voce)		Final	2	7	0	100	100
		Total			**12**	**20**	**275**	**100**	**375**

Project Phase -1 and 2: CIE- 50 marks (25 marks –Internal guide + 25 marks - presentation)
Intellectual Property Right and Cyber law: Syllabus will be provided. CIE marks will be based on the IA tests.

Statistical – Numerical – Fourier Techniques
(Common to all branches)
(ONLY FOR REGULAR STUDENTS)

Course Code	16MAT31	**Credits**	4
Course type	BS	**CIE Marks**	50
Hours/week: L-T-P	3-1-0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives(CLO's)

Students should

1. Learn Numerical methods to solve Algebraic, Transcendental and Ordinary Differential Equations.
2. Understand the concept of Fourier series and apply when needed.
3. Get acquainted with Fourier Transforms and its properties.
4. Study the concept of Random variables and its applications.
5. Get acquainted with Joint Probability Distribution and Stochastic processes.

Pre-requisites :

1. Basic Differentiation and Integration.
2. Basic Probabilities.
3. Basic Statistics.

Unit - I **8 Hours**

Numerical solution of Algebraic and Transcendental equations:
Method of false position, Newton- Raphson method (with derivation), Fixed point iteration method (without derivation).
Numerical solution of Ordinary differential equations: Taylor's Series method, Euler and Modified Euler's method, Fourth order Runge–Kutta method

Unit - II **8 Hours**

Fourier Series: Convergence and Divergence of Infinite series of positive terms (only definitions), Periodic functions. Dirichlet's conditions, Fourier series, Half range Fourier sine and cosine series, Practical examples, Harmonic analysis.

Unit - III **8 Hours**

Fourier transforms: Infinite Fourier Transform and Properties. Fourier Sine and Cosine Transforms Properties and Problems.

Unit - IV **8 Hours**

Probability: Random Variables (RV), Discrete and Continuous Random variables, (DRV,CRV) Probability Distribution Functions (PDF) and Cumulative Distribution Functions(CDF), Expectations, Mean, Variance. Binomial, Poisson, Exponential and Normal Distributions. Practical examples.

Unit - V **8 Hours**

Joint PDF and Stochastic Processes: Discrete Joint PDF, Conditional Joint PDF, Expectations (Mean, Variance and Covariance).Definition and classification of stochastic processes. Discrete state and discrete parameter stochastic process, Unique fixed probability vector, Regular Stochastic Matrix, Transition probability, Markov chain.

Books

Text Books

1 B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012 and onwards.

2. P.N.Wartikar&J.N.Wartikar– Applied Mathematics (Volume I and II) Pune VidyarthiGrihaPrakashan, 7th Edition 1994 and onwards.
3. B. V. Ramana- Higher Engineering Mathematics, Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
2. Peter V. O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011 and onwards.
3. Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Use Numerical methods and Solve Algebraic, Transcendental and Ordinary differential equations.	L3
2. Develop frequency bound series from time bound functions using Fourier series.	L3
3. Understand Fourier Transforms and its properties.	L2
4. Understand the concept of Random variables, PDF, CDF and its applications	L2
5. Extend the basic probability concept to Joint Probability Distribution, Stochastic processes.	L2
6. Apply Joint Probability Distribution, Stochastic processes to solve relevant problems.	L3

Program Outcome of this course (POs)	**PO No.**
1. An ability to apply knowledge of Mathematics, science and Engineering.	1
2. An ability to identify, formulate and solve engineering problems.	5
3. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	11

Course delivery methods	**Assessment methods**
1. Black Board Teaching	1. Internal Assessment
2. Power Point Presentation	2. Assignment
3. Scilab/Matlab/ R-Software	3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / Mathematical/ Computational/ Statistical tools	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE: Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**

3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Analog Electronics

Course Code	16EC32	**Credits**	4
Course type	PC1	**CIE Marks**	50
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Study basic semiconductor diode parameters and equivalent circuits. Design circuit applications that involve diodes such as clippers, clampers etc. Explore into various transistor bias configurations; formulate expressions to establish the location of the quiescent point; describe methods for further maintaining the quiescent point stable.
2. Study the ac operation of the transistor at low and high frequencies via transistor modeling for all three configuration types.
3. Explain the construction and operation of JFETs and MOSFETs. Look into the various FET-biasing techniques.
4. Study the operation of FETs via small signal modeling and further apply it to design FET amplifier networks. Discuss the effects of varied factors that affect the nature of thefrequency response of general amplifiers.
5. Study the various feedback connection types and discuss the effects of feedback on amplifier parameters. Explain the basic principle of operation and design of RC, LC and crystal oscillators. Differentiate between a range of power amplifiers based on their operation,efficiencyand distortions.

Pre-requisites :

1. Basic Electronics (15ELN15/25).
2. Basic Electrical (15ELE13/23).

Unit – I **8 Hours**

Semiconductor Diode and Applications*:* Diode Resistance, Diode equivalent circuits, practical Vs ideal diode, Transition and diffusion capacitance, Diode AC equivalent circuits, Clippers and clampers.
Transistor Biasing*:* Operating point, Fixed bias circuit, Emitter stabilized biased circuits, Voltage divider bias, DC bias with voltage feedback, Bias stabilization.
Self learning topics: Miscellaneous biasing circuits, Stability factors (S) derivations

Unit – II **8 Hours**

BJT AC Analysis*:* BJT transistor modeling, Hybrid equivalent model, r_e transistor model, Hybrid pi model, AC analysis using h parameter models (case study: CE Voltage-divider bias circuit) , two port system approach, cascaded systems, Introduction to Darlington connection and feedback pair, current mirror circuits.
Amplifier Frequency Response*:* General frequency considerations, Miller effect capacitance, Single stage RC coupled amplifier.

Unit - III **8 Hours**

Feedback and Oscillator Circuits: Feedback concept, feedback connection types, oscillator operation, Phase shift Oscillator, Tuned Oscillator circuits, Crystal Oscillator.
Power Amplifiers: Definitions and amplifier types, Class A amplifier circuits, Class B amplifier operation, Class B Push – Pull amplifier, Amplifier distortions, Class C and Class D amplifier.
Self learning topics: Study of harmonic distortions as applied to power amplifiers.

Unit – IV **8 Hours**

Field Effect Transistors: Introduction, Construction, basic operation and characteristics of: JFET, Depletion-type MOSFET, Enhancement-type MOSFET, CMOS technology.

FET Biasing: Introduction, Fixed biased circuit for FETs.

Unit – V **8 Hours**

FET Amplifiers: Introduction, FET small signal model, Depletion-type MOSFET ac equivalent model, Enhancement type FET ac equivalent model, Comparison of BJT and FET.

Text Books

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI/Pearson Education. 9th Edition, and onwards.
2. Jacob Millman& Christos C. Halkias, "Integrated Electronics", Tata-McGraw Hill, 2nd Edition, 2010 and onwards.
3. David A. Bell, "Electronic Devices and Circuits", PHI, 4th Edition, 2004 and onwards.

Reference Books

1. A.S. Sedra& K.C. Smith, "Microelectronic Circuits", Oxford Univ. Press, 5th Edition, 1999 and onwards.
2. Thomas L. Floyd, "Electronic devices", Pearson Education, 2002 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Develop and employ circuit models for elementary electronic components, e.g. diodes.	L3
2. Infer the terminal behavior of the devices such as diode, BJT & FETs, also identify the region of operation with its equivalent circuit model.	L3
3. Develop the capability to analyze and design simple circuits containing elements such as BJTs and FETs using the concepts of load lines, operating points and device modeling.	L3
4. Identify the need for small signal operation and evaluate the small signal model and the performance parameters of the device.	L1, L3
5. Understand the concepts of feedback in electronic circuits and compare the performance parameters of various feedback topologies. Design various types of oscillator circuits applying the concepts of positive feedback.	L2, L3
6. Differentiate and compare the types of power amplifiers depending on their working principle and conversion efficiency.	L2

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Engineering Cognizance: G**raduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
3. **Design of Experiments**: Graduates shall imbibe the professional and ethical responsibilities of their profession.	7
4. **Soft skills**: Graduates shall possess proficiency in oral and written communication skills.	9

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Simulations	3. Quiz
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Digital Electronics

Course Code	16EC33	**Credits**	4
Course type	PC2	**CIE Marks**	50
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To study the various Boolean minimization techniques applied to digital circuits.
2. To gain knowledge in the design of combinational circuits with performance parameters.
3. To gain knowledge in the design of sequential circuits with the fundamental study of flip-flops.
4. To understand the design of sequential circuits using finite state machine diagram.
5. To analyze and design Mealy and Moore machines.

Pre-requisites :

1. Basic Electronics (15ELN15/25).

Unit – I 8 Hours

Design of combinational logic circuits: Review ofNumber systems and Codes, Boolean algebra, Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables,Karnaugh maps- 4 and 5 variables, Incompletely specified functions (Don't Care terms), Map entered variables,Quine-McCluskey minimizationtechnique, Realization of Boolean functions.

Unit – II 8 Hours

Elements of Combinational Logic System: Adders and Subtractors,Cascading full adders, Carry look-ahead adder,Analysis & design of-Encoders, Decoders, Multiplexers,Comparators.

Unit – III 8 Hours

Elements of Sequential Circuits: Basic bi-stable element, Latches, The gated latches, Master-Slave Flip-Flops, Edge triggered flip-flops, Characteristic Equations.

Unit – IV 8 Hours

Sequential Logic Circuits: Registers, Counters (Ripple, Synchronous counters), Counters based on Shift Registers, Design of Synchronous counters using JK, D, T, and SR flip flops.

Unit - V 8 Hours

Design of Sequential Circuits: Mealy and Moore models, State machine notation, State equivalence, State reduction, State reduction of incompletely specified state tables.

Text Books

1. Donald D. Givone, "Digital Principles and Design", McGraw-Hill, 1st Edition, 2002and onwards.
2. John M Yarbrough, "Digital Logic Application and Design", Thomas Learning, 2001and onwards.

Reference Books

1. Thomas L. Floyd, "Digital logic fundamentals", Pearson Education, 11th Edition, 2014and onwards.
2. Ronald J. Tocci, Neal S. Widmer, Greg Moss, "Digital System Principles and Applications", Pearson Education, 11th Edition, 2010 and onwards.
3. Donald P. Leach, Albert Paul Malvino, GoutamSaha, "Digital Principles and Applications", McGraw-Hill, 2009and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Recognize the need of Boolean algebra and apply methods to simplify logical expressionsfor solving real time problems logically.	L2,L3
2. Apply the fundamentals of digital electronics to design optimal combinational logic circuits for the given specifications.	L3
3. Explain and illustrate the concepts of flip-flops at the gate level.	L2,L3
4. Paraphrase the concept of flip-flops and apply them in the design of sequential circuits.	L2,L3,L6
5. Design of sequential circuits using the concept of finite state machine.	L6

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiment:** Graduates shall posses the ability to design and conduct experiments, analyze and interpret data.	2
3. **Engineering Cognizance: G**raduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Soft skills**: Graduates shall possess proficiency in oral and written communication skills.	9
5. **Self motivated learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Simulations	3. Quiz
4. MOOC (Massive Open Online Courses) links	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**

3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Signals and Systems

Course Code	16EC34	**Credits**	3
Course type	PC3	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To Understand the fundamental characteristics of signals and systems.
2. To Learn to solve problems involving convolution.
3. To study the representation of LTI systems using differential equations.
4. To appreciate the use of Z-transforms in system representation.
5. To Learn to transform the time domain signal into frequency domain and study the sampling theorem.

Pre-requisites :

1. Engineering Mathematics.

Unit – I — 8 Hours

Introduction: Definitions of a signal and a system, Classification of signals, Basic Operations on signals, Elementary signals, Systems viewed as Interconnections of operations, Properties of systems.

Lab Experiments:

1. Composite signal generation, scaling and shifting of signals using MATLAB.
2. Study of the signal properties using hardware.

Unit – II — 8 Hours

Time-domain representations for LTI systems-I: Convolution, impulse response representation, Convolution Sum and Convolution Integral.

Lab Experiments:

1. Convolution of given sequence using MATLAB.
2. Demonstration of convolution of signals using JAVA Applets.

Unit – III — 8 Hours

Time-domain representations for LTI systems- II: Properties of impulse response representation, Differential and difference equation Representations, Block diagram representations.

Lab Experiments:

1. Impulse response of system using MATLAB.
2. Solution of differential equation using MATLAB.

Unit – IV — 8 Hours

Z-Transforms: Introduction, Z – transform, properties of ROC, properties of Z – transforms, Inversion of Z transforms (Derivation of IZT using Contour integration): Transform analysis of LTI Systems, unilateral Z- Transform and its application to solve difference equations.

Lab Experiments:

1. Z-Transform of a given sequence and basic signals using MATLAB.
2. Inverse Z-transform using MATLAB with long division method.

Unit - V **8 Hours**

Fourier representation for signals: Discrete and continuous Fourier transforms and their properties, Sampling theory in time and frequency domain and Nyquist Criterion.

Lab Experiments:

1. Generation of square wave in frequency domain components using MATLAB.
2. Demonstration of sampling theorem using MATLAB.

Text Books

1. Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley & Sons, 2001, Reprint 2002and onwards.

Reference Books

1. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002 and onwards**.**
2. H. P Hsu, R. Ranjan, "Signals and Systems", Schaum's outlines, TMH, 2006and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Classify signals and systems and apply basic operations on signals [L2].	L2
2. Classify systems based on their properties and determine the response of LTI system using Convolution	L2
3. Analyze the systems using Differential and Difference equations.	L3
4. Analyze system properties based on impulse response and Fourier Transforms.	L3
5. Apply the Z- transform to analyze discrete-time signals and systems.	L3

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Simulations	3. Quiz
4. Videos	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Network Analysis

Course Code	16EC35	**Credits**	3
Course type	PC4	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand the three primary circuit elements (resistors,capacitor,inductor) series, parallel star and delta connections.
2. To understand DC and AC circuit analysis using Mesh and Node analysis techniques.
3. To study the network theorems.
4. To study resonance in RLC circuits.
5. To study Two port networks open and Short circuit parameters.

Pre-requisites :

1. Basic Electronics (15ELN15/25).
2. Basic Electrical (15ELE13/23).

Unit – I 8 Hours

Fundamentals: Resistive network reduction using Star-Delta transformation, Practical sources, source transformation, Mesh and node analysis for networks with DC, AC and dependent sources, Concepts of super mesh and super node. Concepts of Network Topology(Definitions of Graph,Tree and Co-tree, Incidence matrix,Tie set and Cut-set Schedule).

Unit – II 8 Hours

Network Theorems: Superposition theorem, maximum power transfer theorem, Thevinin's theorem, Norton's theorem,Millman's theorem, Reciprocity and Tellegen's theorem.

Unit – III 8 Hours

Introduction to resonance: Q-factor, Cut-off frequency, Bandwidth, Series and parallel resonant circuits - derivation of resonant frequency for each and problems solving.

Unit – IV 8 Hours

Transient Analysis: Behavior of circuit elements under switching condition, Evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations.

Unit - V 8 Hours

Two port parameters: Impedance (Z) and Admittance(Y) parameters, Introduction to Hybrid and Transmission parameters.

Text Books

1. D. Roy Choudhury, "Networks and Systems",New Age International. , 1st Edition, 1998and onwards.
2. P. M. Chandrashekharaiah, "Network Analysis",Rajeshwari Publications, 5th Edition,2007and onwards.
3. M. E. Van Valkenburg, "Network Analysis", Prentice-Hall, 1964and onwards.

Reference Books

1. Franklin Kuo, "Network Analysis and Synthesis", 2nd edition, Wiley International, 2008and onwards.
2. A. Chakrabarti, "Circuit Theory", 3rd edition, Dhanpat Rai and Sons, 2004and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain series, parallel star and delta connection of resistors and their simplification.	L1
2. Discuss Application of Mesh and Node Voltage techniques to DC and AC circuits.	L2
3. Apply the knowledge of Network theorems in circuit simplification and circuit analysis.	L3
4. Explain the Resonance phenomenon in RLC circuits.	L5
5. Measure two port network parameters.	L4, L5
6. Design/solve real life networks.	L6

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Simulations	3. Quiz
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Analog Electronics Lab

Course Code	16ECL36	**Credits**	2
Course type	L1	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To acquaint with all the equipment necessary to conduct the experiments duringthe entire lab course.
2. To provide hands-on experience in the design, analysis, testing, and comprehension of electronic circuits comprising of diodes, BJTs and FETs.
3. To introduce principles of circuit design for practical applications.
4. To identify the significance and inter-dependency of the circuit elements for each circuit application.
5. To design and verify the expected outcomes as per the given specifications.

Design of experiments on

1. Half wave rectifier circuit with and without Capacitive filter.
2. Full wave bridge rectifier circuit with and without Capacitive filter.
3. Clipping Circuits.
4. Clamping Circuits.
5. BJT RC coupled amplifier.
6. BJT Colpitts oscillator.
7. Class B push-pull amplifier.
8. Characteristics of JFET.
9. Characteristics of MOSFET.
10. FET amplifier.

Text Books

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI/Pearson Education. 9th Editionand onwards.
2. A.S. Sedra& K.C. Smith, "Microelectronic Circuits", Oxford Univ. Press, 5th Edition, 1999and onwards.
3. David A. Bell, "Electronic Devices and Circuits", PHI, 4th Edition, 2004and onwards.

Reference Books

1. Jacob Millman& Christos C. Halkias, "Integrated Electronics", Tata-McGraw Hill, 2ndEdition, 2010and onwards.
2. Thomas L. Floyd, "Electronic devices", Pearson Education, 2002and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Emphasize diode rectifier fundamentals and justify the importance of capacitor in rectification process.	L3
2. Demonstrate diode applications such as clippers and clampers, design, analyze and explain its working.	L2, L3
3. Demonstrate diode applications such as clippers and clampers, design, analyze and explain its working.	L2, L3
4. Demonstrate the characteristics of JFET and MOSFET.	L3

5. Design a phase shift oscillator using BJT for specified frequency L3

	Program Outcome of this course (POs)	PO No.
1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2.	**Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3.	**Soft skills:** Graduates shall possess proficiency in oral and written communication skills.	9
4.	**Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Test
2. Quiz
3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4.

Initial write up	10 marks	50 marks
Conduct of experiments, results and conclusion	20 marks	
Viva- voce	20 marks	

5. **Viva-voce shall be conducted for individual student and not in a group.**

Digital Electronics Lab

Course Code	16ECL37	**Credits**	2
Course type	L2	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Verify the fundamental circuits using basic gates and TTL IC's.
2. Design and implement Combinational Logic Circuits.
3. Design and implement Sequential Circuits.

Design of experiments on

1. Adders and Subtractors.
2. Code converters.
3. Multiplexers and de-multiplexers.
4. Comparators.
5. Flip-flops.
6. Synchronous counters.
7. Asynchronous / Ripple counters.
8. Shift registers.
9. Sequence generators.
10. Sequence detectors.

Enhanced Learning with Simulation:
Experiments on combinational and sequential circuits with truth table and FSM entry may be conducted to analyze the performance parameters namely timing, delay and area using simulation tools (Mentor Graphics HDL designer, Questasim / NI Multisim / LabVIEW).

Text Books

1. Donald D. Givone, "Digital Principles and Design", McGraw-Hill, 1st Edition, 2002and onwards.
2. John M Yarbrough, "Digital Logic Application and Design", Thomas Learning, 2001and onwards.

Reference Books

1. Thomas L. Floyd, "Digital logic fundamentals", Pearson Education, 11th Edition, 2014and onwards.
2. Ronald J. Tocci, Neal S. Widmer, Greg Moss, "Digital System Principles and Applications", Pearson Education, 11th Edition, 2010and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Interpret IC data sheets to build digital circuits**.**	L2
2. Design digital circuits and verify using digital IC Trainer kit**.**	L3
3. Analyze design problems and implement to meet specification**.**	L3
4. Simulate digital circuits using simulation tool**.**	L3
5. Measure and record the experimental data, analyze the results and prepare a formal laboratory report.	L4
6. Engage in **self-study** to formulate, design, implement, analyze and demonstrate an application of digital electronic circuits through an **open ended experiment.**	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Soft skills:** Graduates shall possess proficiency in oral and written communication skills.	9
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Test
2. Quiz
3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4.

Initial write up	10 marks	50 marks
Conduct of experiments, results and conclusion	20 marks	
Viva- voce	20 marks	

5. **Viva-voce shall be conducted for individual student and not in a group.**

Network Analysis Lab

Course Code	16ECL38	**Credits**	2
Course type	L3	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To acquaint the students with all the equipments necessary to conduct the experiments during the entire lab course.
2. To provide thestudents with hands-on experience in the design and analysis of electronic circuits comprising of resistors, capacitors, inductors, power supplies.
3. To introduce principles of circuit analysis from practical perspective.
4. Identify the significance and inter-dependency of the circuit elements.
5. To enable the students to design and verify the circuits for the givenvoltage and current specifications.

Design of experiments on

1. Resistive networks: a) series & parallel combination b) Star to Delta conversion and vice versa.
2. Practical Sources: a) series connection b) Parallel connection.
3. Mesh Analysis for DC circuits.
4. Node Analysis for DC circuits.
5. Mesh analysis for AC circuits.
6. Node analysis for AC circuits.
7. Verification of a) Thevinin's theorem b) Norton's theorem.
8. Verification of Maximum Power Transform theorem.
9. Verification of Superposition theorem.
10. Series resonant circuits.
11. Parallel resonant circuits.
12. Two-port network parameters.

Text Books

1. D. Roy Choudhury, "Networks and Systems",New Age International. , 1st Edition, 1998and onwards.
2. P. M. Chandrashekharaiah, "Network Analysis",Rajeshwari Publications, 5th Edition,2007and onwards.
3. M. E. Van Valkenburg, "Network Analysis", Prentice-Hall, 1964and onwards.

Reference Books

1. Franklin Kuo, "Network Analysis and Synthesis", 2nd Edition, Wiley International, 2008and onwards.
2. A. Chakrabarti, "Circuit Theory", 3rd Edition, Dhanpat Rai and Sons, 2004 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Emphasize the significance of sources and circuit elements.	L3
2.	Demonstrateand analyze the current and voltage variations with circuit elements.	L2, L4
3.	Design and analyzeAC and DC circuits using Network Theorems.	L2, L4
4.	Build and Utilize series and parallel resonant circuits.	L3
5.	Measure and Compare Z and Y parameters.	L5

	Program Outcome of this course (POs)	**PO No.**
1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2.	**Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3.	**Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Test
2. Quiz
3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4. Initial write up 10 marks
   Conduct of experiments, results and conclusion 20 marks
   Viva- voce 20 marks
   50 marks
5. **Viva-voce shall be conducted for individual student and not in a group.**

Calculus, Fourier Analysis and Linear Algebra
(Common to all branches)
(ONLY FOR LATERAL ENTRY STUDENTS)

Course Code	16DIPMAT31	**Credits**	5
Course type	BS	**CIE Marks**	50
Hours/week: L-T-P	4 – 1 – 0	**SEE Marks**	50
Total Hours:	50	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Learn the concept of series expansion using Taylor's and Maclaurin's series and get acquainted with the polar curves and partial differentiation.
2. Learn Differential Equations of first order and higher order and apply them.
3. Get acquainted with Fourier Transforms and its properties.
4. Learn Numerical methods to solve Algebraic, Transcendental and Ordinary Differential Equations.
5. Understand and interpret the system of equations and various solutions.

Pre-requisites:

1. Basic Differentiation and Integration.
2. Trigonometry.
3. Matrix and Determinant operations.
4. Vector algebra.

Unit – I **10 Hours**

Differential Calculus: Taylor's and Maclaurin's Theorems for function of one variable (Statement only)-Problems.Angle between Polar curvePartial Differentiation:Definition and problems, Total Differentiation-Problems. Partial Differentiation of Composite functions-Problems.

Unit – II **10 Hours**

Differential Equations: Linear differential equation, Bernoulli's equation, Exact differential equation(without reducible forms)-Problems and Applications (Orthogonal Trajectories, Electrical circuits and derivation of escape velocity). Linear Differential Equation with constant coefficients-Solution of second and higher order Differential Equations, Inverse differential operator method and problems.

Unit – III **10 Hours**

Fourier Analysis: Fourier Series: Fourier Series, Half Range Fourier sine and cosine Series, Practical examples, Harmonic analysis.

Fourier Transforms: Infinite Fourier Transform and Properties. Fourier Sine and Cosine Transforms Properties and Problems.

Unit – IV **10 Hours**

Numerical Techniques: Numerical solution of Algebraic and Transcendental equations: Method of false position, Newton- Raphson method (with derivation), Fixed point iteration method (without derivation).

Numerical solution of Ordinary differential equations: Taylor's Series method, Euler and Modified Euler's method, Fourth order Runge–Kutta method.

Unit –V **10 Hours**

Linear Algebra:

Rank of a matrix by elementary transformation, Solution of system of linear equations-Gauss Jordan

method and Gauss-Seidal method. Eigen value and Eigen vectors – Rayleigh's Power method.

Text Books

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012 and onwards.
2. P.N.Wartikar and J.N.Wartikar, "Applied Mathematics" (Volume I and II), Pune VidyarthiGrihaPrakashan, 7th Edition, 1994 and onwards.
3. B. V. Ramana,"Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Ltd., 43rd Edition, 2006 and onwards.

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
2. Peter V. O' Neil, "Advanced Engineering Mathematics", Thomson Brooks/Cole, 7th Edition, 2011 and onwards.
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, 2010 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Develop the Taylors and Maclaurins series using derivative concept.	L3
2. Demonstrate the concept and use of Partial Differentiation in various problems.	L3
3. Classify Differential Equations of First and Higher order and apply them to solve relevant problems.	L1, L3
4. Develop frequency bound series from time bound functions using Fourier series.	L3
5. Use Numerical methods and Solve Algebraic, Transcendental and Ordinary differential equations.	L3
6. Interpret the various solutions of system of equations and Solve them.	L2

Program Outcome of this course (POs)	**PO No.**
1. An ability to apply knowledge of Mathematics, science and Engineering.	1
2. An ability to identify, formulate and solve engineering problems.	5
3. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	11

Course delivery methods	**Assessment methods**
1. Black Board Teaching	1. Internal Assessment
2. Power Point Presentation	2. Assignment
3. Scilab/Matlab/ R-Software	3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / Mathematical/ Computational/ Statistical tools	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE: Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

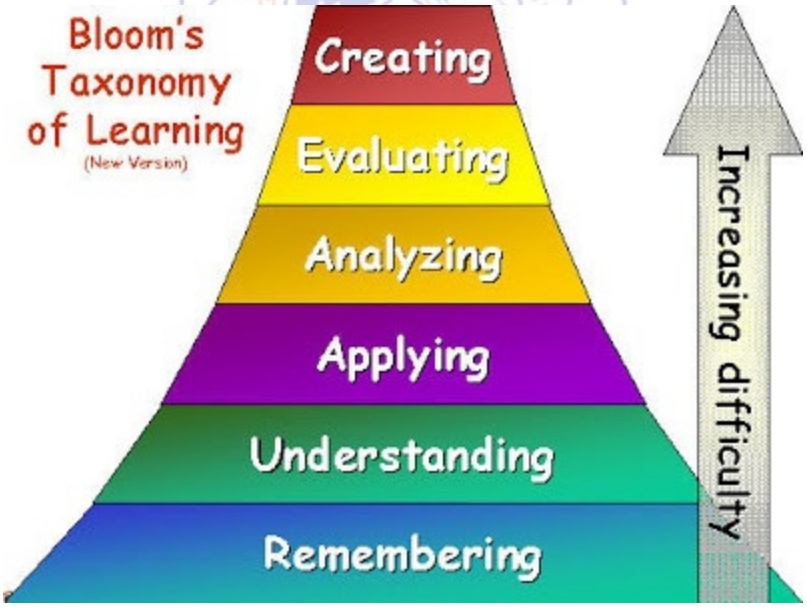
Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Bloom's Taxonomy of Learning Objectives

Bloom's Taxonomy in its various forms represents the process of learning. It was developed in 1956 by Benjamin Bloom and modified during the 1990's by a new group of cognitive psychologists, led by Lorin Anderson (a former student of Bloom's) to make it relevant to the 21st century. The **revised taxonomy** given below emphasizes what a learner "Can Do".

Lower order thinking skills (LOTS)		
L1	Remembering	Retrieve relevant knowledge from memory.
L2	Understanding	Construct meaning from instructional material, including oral, written, and graphic communication.
L3	Applying	Carry out or use a procedure in a given situation – using learned knowledge.
Higher order thinking skills (HOTS)		
L4	Analyzing	Break down knowledge into its components and determine the relationships of the components to one another and then how they relate to an overall structure or task.
L5	Evaluating	Make judgments based on criteria and standards, using previously learned knowledge.
L6	Creating	Combining or reorganizing elements to form a coherent or functional whole or into a new pattern, structure or idea.



Partial Differential Equations, Sampling Techniques and Transforms

(Electronics/Electrical)

(ONLY FOR REGULAR STUDENTS)

Course Code	16MATEE41	**Credits**	4
Course type	BS	**CIE Marks**	50 marks
Hours/week: L-T-P	3-1-0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives

Students should

1. Learn the concept of Interpolation and use appropriately.
2. Understand the concept of Partial Differential Equations.
3. Apply Partial Differential Equations to solve practical problems.
4. Get acquainted with Sampling Distribution and Testing of Hypothesis.
5. Study the concept of Z transforms and its applications.

Pre-requisites :

1. Partial Differentiation.
2. Basic Probability, Probability Distribution.
3. Basic Integration.

Unit – I **8 Hours**

Finite Differences and Interpolation: Forward and Backward differences, Newton's Forward and Backward Interpolation Formulae, Divided Difference, Newton's Divided Difference Formula (without proof). Lagrange's Interpolation Formula. Illustrative examples. Numerical Integration: Newton- Cotes Quadrature formula, Trapezoidal rule, Simpsons 1/3rd rule, Simpsons 3/8th rule, Weddle's rule. Practical Examples.

Unit – II **8 Hours**

Partial Differential Equations: Partial Differential Equations-Formation of PDE by elimination of arbitrary Constants and Functions, Solution of non homogeneous PDE by direct integration, solution of homogeneous PDE involving derivative with respect to one independent variable only.

Unit – III **8 Hours**

Applications of Partial Differential Equations: Derivation of One dimensional Heat and Wave equations. Solutions of one dimensional Heat and Wave equations, Two dimensional Laplace equation by the method of separation of variables. Numerical solution of one dimensional Heat and Wave equations, Two dimensional Laplace equation by finite differences.

Unit – IV **8 Hours**

Sampling distribution and Testing of Hypothesis: Sampling, Sampling distribution, Sampling distribution of means, Level of significance and confidence limits, Tests of significance for small and large samples. 't' and 'chi square' distributions. Practical examples.

Unit – V **8 Hours**

Z -Transform: Definition, Standard Z transforms, Linearity,Damping rule, Shifting properties, Initial and Final value Theorems-Examples. Inverse Z transforms and Solution of Difference Equations by Z transforms.

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012and onwards.
2. P. N. Wartikar& J. N. Wartikar,"Applied Mathematics (Volume I and II)", Pune VidyarthiGrihaPrakashan, 7th Edition 1994and onwards.
3. B. V. Ramana - Higher Engineering Mathematics,Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.

Reference Books:

1. Peter V. O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7thEdition, 2011and onwards.
2. Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Use Finite differences in Interpolation.	L3
2. Form and Solve Partial differential Equations.	L2,L3
3. Develop Heat, Wave equations.	L3
4. Partial Differential Equations to solve practical problems.	L3
5. Test the Hypothesis and Solve problems related to them.	L2, L3
6. Apply Z-Transforms to solve Engineering problems.	L3

Program Outcome of this course (POs)	PO No.
1. An ability to apply knowledge of Mathematics, science and Engineering.	1
2. An ability to identify, formulate and solve engineering problems.	5
3. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	11

Course delivery methods

1. Black board teaching
2. Power point Presentation
3. Matlab/Scilab/R Software

Assessment methods

1. Internal Assessment Tests
2. Assignments
3. Quizzes

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / Mathematical/ Computational/ Statistical tools	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE: Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Computer Organization & Architecture

Course Code	16EC42	**Credits**	4
Course type	PC1	**CIE Marks**	50
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To have a thorough understanding of the representation of numbers employed in arithmetic operations and on the binary coding of symbols used in data processing.
2. To understand the use of register transfer language to express microoperations in symbolic form and develop the hardware design of the most common microoperations.
3. To understand the organization and the design of a basic digital computer.
4. Compare and contrast the various types of CPU architectures.
5. To understand the current state of art in memory system design. To study the different ways of communicating with I/O devices and standard I/O interfaces.

Pre-requisites :

3. Basic Electronics (15ELN15/25).
4. Digital Electronics (16EC33).

Unit – I 8 Hours

Data Representation: Data Types, Number System, Alphanumeric Codes, Complements, Subtraction of Unsigned Numbers, Fixed-point Representation, Arithmetic Addition, Arithmetic Subtraction, Overflow, Floating-point Representation, Error Detection Codes.

Unit – II 8 Hours

Register Transfer and Micro operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Microoperations, Logic Shift Microoperations, Arithmetic Logic Shift Unit.

Unit – III 8 Hours

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input Output and Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic.

Unit – IV 8 Hours

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Comparison of RISC and CISC.

Unit - V 8 Hours

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory.

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Introduction to Priority Interrupt and Input-Output Processor (IOP), Direct Memory Access (DMA), Serial Communication.

Text Books

1. Morris Mano, "Computer System Architecture", PHI, 2002, 3rd Edition and onwards.
2. Carl Hamacher, "Computer organization", McGraw-Hill Inc., 5th Edition, 1996 and onwards.

Reference Books

1. William Stallings, "Computer organization and Architecture", Pearson Education, 6th Edition,

2003and onwards.
2. John P. Hayes,"Computer Architecture and Organization", Tata Mc.GrawHill, 3rdEdition, 1998 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain the generic principles that underlie the design of digital computer, including data representation, digital logic and process simulation.	L2
2. Describe the structure and functioning of a digital computer, including its overall system architecture, operating system, and digital components.	L2
3. Understand the organization of the Control unit and Arithmetic and Logical unit	L3
4. Comprehend the units of computer and aggregate them to design a complete ALU.	L3, L4
5. Understand the organization and working of Memory unit and the I/O unit	L3, L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
3. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz
4. Group Discussion	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Control Systems

Course Code	16EC43	**Credits**	3
Course type	PC2	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Explain basic concepts of control systems, their types & requirements; Explain the modeling of systems and the inter convertibility between electrical and mechanical systems through force voltage and force current analogy.
2. Explain the evaluation of transfer function by representing systems in form of block diagram, and then converting blocks into signal flow graph; evaluate the time response for simple electrical circuits.
3. Determine the error for 1st and 2nd order systems by evaluating their time response to standard test signals; explain the concepts of Poles and zeros and apply the same to evaluate stability of control system using Routh-Hurwitz criterion.
4. Determine the stability of control system by developing the Root Locus plot and suggest modifications in transfer function to improvise upon stability if system is found to be unstable.
5. Determine the stability of control system by developing the Bode plot and comment on stability by analyzing the Gain Margin and Phase Margin; to determine the solution of state equation from by developing the state model for system.

Pre-requisites :

1. Elements of Electrical Engineering (15ELE13/23).
2. Engineering Mathematics (15MAT11, 15MAT21).
3. Elements of Mechanical Engineering (15EME14/24).

Unit – I — 8 Hours

Modeling of Systems: Introduction to control systems, Types viz. open and closed loop, Differential equation of physical system, Mechanical systems viz. translational and rotational systems, Electrical systems.

Self learning topics: Analogous systems (Force-to-Voltage).

Lab Experiment: Introduction to MATLAB.

Unit – II — 8 Hours

Block Diagram, Signal Flow Graph and Standard Signal - Transfer function, Block diagram algebra, Signal flow graph, Mason's Gain formula for SFG.

Self learning topics: Standard test signals.

Lab Experiment: Generation of standard test signals using MATLAB.

Unit – III — 8 Hours

Time Response and Steady State Error - response of 1st and 2nd order systems to step, ramp input; Time response specifications, Steady state error and error constants, Transient and Steady state response of RL, RC and RLC circuits to Step input, Pole Zero Concept, Routh – Hurwitz stability criterion, relative stability.

Self learning topics: Special cases of RH criterion.

Lab Experiments using MATLAB:

1. Time response of RL, RC and RLC systems.
2. Compute time response characteristics of a system.
3. Effect of damping ratio on second order control system.

Unit – IV — 8 Hours

Root Locus Technique – Introduction, Concepts of root locus, Construction and Analysis of Root Locus.

Lab Experiments using MATLAB:

Root Locus of a system defined by an open loop transfer function.

Unit - V **8 Hours**

Stability in Frequency domain - Bode Plot, relative stability using Bode Plot, lead lag compensating networks, State variable analysis: state model for electrical circuits, solution of state equation.

Lab Experiments using MATLAB:

Bode plot of a system defined by an open loop transfer function.

Text Books

1. Nagarath& Gopal, "Control Systems Engineering", New Age International Publications, 4th Edition, 2005 and onwards.
2. Schaum's Outline Series, "Feedback and Control Systems", McGraw Hill Inc.
3. Benjamin Kuo, "Automatic Control Systems ", John Wiley India Pvt. Ltd., 8th Edition, 2008 and onwards.
4. Control Systems, "Principles and Design", M Gopal, McGraw Hill Edu; 4th Edition and onwards.

Reference Books

1. Hayt&Kimmerly, "Engineering Circuit Analysis", TMH, 7th Edition, 2010 and onwards.
2. K. Ogata, "Modern Control Engineering", Pearson Education Asia/PHI, 4th Edition, 2002 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand the basic concepts of control systems, their types & requirements; ability to demonstrate the modeling of systems and the Inter convertibility between electrical and mechanical systems through force voltage and force current analogy.	L1, L2, L3
2. Demonstrate the evaluation of transfer function by representing systems in form of blocks Diagram, and then converting blocks into signal flow graph; ability to explain the various type of standard test signals.	L3
3. Evaluate error for 1st and 2nd order systems by obtaining their time response.	L2
4. Apply root locus technique to analyze stability of an open or closed loop system.	L5
5. Analyze stability in frequency domain and understand basics of state variable analysis.	L5

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Simulations	3. Quiz
4. Videos	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Engineering Electromagnetics

Course Code	16EC44	**Credits**	4
Course type	PC3	**CIE Marks**	50
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To develop a comprehensive and rigorous treatment of the fundamentals of static electric fields.
2. To discuss the fundamentals of static magnetic fields and develop Maxwell's equations. Also to compare and address the analogous nature of Maxwell's equations for static electric and magnetic fields.
3. To build and understand Maxwell's equations both in point and integral form for electrodynamics.
4. To formulate the concepts leading to basic wave equation and properties of wave travelling in free space, dielectrics and conductor.
5. To infer basic concepts of radio wave propagation.

Pre-requisites :

1. Engineering Physics (15PHY12/22).
2. Engineering Mathematics (15MAT31).

Unit –I 8 Hours

Introduction to Static Electric Fields - I: Review ofVector analysis, Co-ordinate systems and transformations, Coulomb's law, Electric Field Intensity (EFI), EFI due to various charge configurations (line charge, surface charge and volume charge), Electric Flux Density (EFD), Gauss' Law & its applications, Gauss's Law in Point form, Divergence Theorem.

Unit –II 8 Hours

Introduction to Static Electric Fields - II: Energy spent in moving charge, Definition of Potential Difference and Potential, Potential field due to Point Charge and System of Charge, Potential gradient, Energy Density, Boundary conditions of static electric field at the interface of materials, Laplace and Poisson's equations.

Introduction to Static Magnetic Fields: Biot-Savart's Law, Ampere's circuital law, Stokes Theorem, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials Magnetic forces, Force on a moving charge, Magnetic Boundary Condition, Energy stored in magnetic field.

Unit –III 8 Hours

Time Varying Fields and Maxwell's Equations: Faraday's Law, Continuity equation for time varying field, Displacement Current, Maxwell's correction to Ampere's Circuit Law, Summary of Maxwell's Equations in Point, Integral and Harmonic form, Retarded Potentials Wave equations, UPW (TEM wave) propagation in free space, dielectrics and good conductors.

Unit –IV 8 Hours

Poynting vector: Poynting's Theorem, Instantaneous, Average and Complex Poynting vector, Power loss in a plane conductor, Wave Power, Polarization.

Plane waves: Reflection of UPW at normal incidence, at multiple interfaces and at oblique incidence angles, Total reflection**.**

Unit –V **8 Hours**

Propagation Characteristics of Radio Waves: The Atmosphere, Ionospheric behavior variations, Sky wave propagation, Virtual height & Critical frequency, Maximum Usable Frequency (MUF), Skip distance, Effect of earth's magnetic field, Space wave propagation: Radius of curvature, Modes of propagation, Radio and Optical Horizon, Ground wave propagation,Tropospheric scatter propagation.

Text Books

1. William H.Hayt Jr. and John A. Buck, "Engineering Electromagnetics", Mc.Graw-Hill Education, 2nd Edition, 2014 and onwards.
2. V. V. Sarwate, "Electromagnetic Fields and Waves", Wiley Eastern Limited, 1st Edition, 1993 and onwards.
3. Joseph A. Edminister, "Theory and Problems on Electromagnetics", Schaum's outline series,Mc.graw-Hill, 2nd Edition, 1993 and onwards**.**

Reference Books

1. Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 6thEdition, 2014 and onwards.
2. David K. Cheng, "Field and Wave Electromagnetics", Pearson Education Asia, 2nd Edition,1989and onwards.
3. A. R. Harish and M. Sachidananda, "Antennas and Wave Propagation", Oxford University Press, 2007 and onwards.

Other Resources

1. http://ocw.mit.edu/resources/res-6-002-electromagnetic-field-theory-a-problem-solving-approach-spring-2008/
2. http://www.nptelvideos.in/2012/11/electro-magnetic-fields.html
3. http://emt-iiith.vlabs.ac.in/experiments.php
4. Robert Feynman Lectures
5. http://www.maxwells-equations.com/

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Define, understand and explain concepts on electrostatics and also apply to solve numerical problems on various configurations of distribution of electric charges.	L1, L2, L3
2. Explain and apply various laws involved in electrostatics and magnetostatics.	L2, L3
3. Summarize and solve Maxwell equations for time-varying electric and magnetic fields.	L3, L5
4. Explain and analyze EM wave propagation and understand the power flow mechanism in an unbounded media.	L3, L5
5. Explain and compare various radio wave propagation modes.	L2

Program Outcome of this course (POs)	**PO No.**
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess	12

the motivation for continuing education and professional growth.

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment
2. PPT's	2. Quiz
3. Videos	3. Assignment
4. Animations	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Communication Theory and Techniques

Course Code	16EC45	**Credits**	3
Course type	PC4	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To revisit the basic signal processing concepts in frequency domain.
2. To understand the theoretical concept of various amplitude modulation techniques.
3. To discuss the design and working of angle modulation systems.
4. To comprehend noise in communicationsystems.
5. To discuss the effect of noise in analog communication systems.

Pre-requisites :

1. Signals and Systems (16EC34).
2. Analog Electronics (16EC32).

Unit – I **8 Hours**

Amplitude Modulation Systems: Review of Spectral Characteristics of Periodic and Non-periodic signals, Generation and Demodulation of AM.

Unit – II **8 Hours**

Other AM Techniques: DSBSC, SSB and VSB Signals(block diagram approach), Frequency Translation, FDM,Elements of Color TV, Scanning and synchronization, Composite video signal, Block diagram of transmitter and receiver.

Self learning topics: Comparison of Amplitude Modulation Systems.

Unit – III **8 Hours**

Angle Modulation Systems: Phase and Frequency Modulation. Single tone Narrow Band and Wideband FM, Transmission Bandwidth, Generation and Demodulation of FM Signal. Frequency range and channel bandwidth.

Unit – IV **8 Hours**

Noise Theory: Review of Probability, Random Variables and Random Process, Gaussian Process,Noise – Shot noise, Thermal noise and White noise, Narrow band noise, Noise temperature, Noise Figure.

Unit - V **8 Hours**

Performance of CW modulation systems: Super heterodyne Radio receiver and its characteristic, SNR,Noise in DSBSC systems using coherent detection, Noise in AM system using envelope detection and its FM system, FM threshold effect, Pre-emphasis and De-emphasis in FM.

Self learning topics: Comparison of performances of effect of noise in CW modulation systems.

Text Books

1. Simon Haykin, "An Introduction to Analog and digital Communications", John Wiley, 2nd Edition, 2004 and onwards.
2. B. P.Lathi, "Modern Digital and Analog Communication Systems", Oxford, 3rdEdition, 1998 and onwards.
3. R.R.Gulati,"Monochrome and ColourTelevision", New Age International, 3rd Edition, 2006 and onwards.

Reference Books

1. Dennis Roddy and John Coolen, "Electronic Communication", Prentice Hall ofIndia, 4th Edition,

1995 and onwards.
2. Herbert Taub and Donald L Schilling, "Principles of Communication Systems", Tata McGraw Hill,3rd Edition, 2008 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain and compare various amplitude and angle modulation techniques.	L2, L4
2. Explain and compare various angle modulation techniques.	L2, L4
3. Analyze the working of AM and FM transmitters and receivers.	L4
4. Discuss the effect of noise in communication systems.	L3
5. Analyze the performance of analog communication systems.	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Linear Integrated Circuits Lab

Course Code	16ECL46	**Credits**	2
Course type	L1	**CIE Marks**	25
Hours/week: L-T-P	2 – 0 – 2	**SEE Marks**	25
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To introduce the concept of designing and testing basic op-amp circuits like Inverting, Non-inverting, Summing, Difference Amplifiers.
2. To introduce the concept of designing and testing op-amp circuits like Integrator, Differentiator, Precision Half-Wave and Full-Wave Amplifiers.
3. To introduce the concept of designing and testing op-amp circuits like Low-Pass, High-Pass, Band-Pass and Band-Reject Filters.
4. To introduce the concept of designing and testing op-amp circuits like RC Phase-Shift Oscillator, Square Wave Generator and Triangular Wave Generator.
5. To introduce the concept of designing and testing op-amp circuits like Zero-Crossing Detector, Schmitt trigger (Symmetric and Asymmetric) and R-2R Ladder DAC.

Pre-requisites:

1. Basic Electronics (15ELN15/25).
2. Analog Electronics (16EC32).

Note: All experiments are hardware-based.

1. Introduction to Operational Amplifiers: Interpreting a Typical Set of Data Sheets.

Experiments:

a) Inverting Amplifier, Non-inverting Amplifier, Summing Amplifier and Differential Amplifier.

2. General Linear Applications: Integrator, Differentiator, Instrumentation Amplifier, Precision Rectifiers (Half-Wave and Full-wave).

Experiments:

a) Integrator and Differentiator.

b) Precision HWR and Precision FWR.

3. Active Filters: Introduction, Active Filters, First-Order Low-Pass Butterworth Filter, Second-Order Low-Pass Butterworth Filter, First-Order High-Pass Butterworth Filter, Second-Order High-Pass Butterworth Filter, Band-Pass Filters, Band-Reject Filters.

Experiments:

a) First-Order Low-Pass Filter, Second-Order Low-Pass Filter.

b) First-Order High-Pass Filter, Second-Order High-Pass Filter.

c) Band-Pass Filters, Band-Reject Filters.

4. Oscillators: Introduction, Oscillators, RC Phase-Shift Oscillator, Wien Bridge Oscillator, Square Wave Generator, Triangular Wave Generator, Saw-tooth Wave Generator.

Experiments:

a) RC Phase-Shift Oscillator.
b) Square Wave Generator.
c) Triangular Wave Generator.

5. Comparators and Converters: Introduction, Basic Comparator, Zero-Crossing Detector, Schmitt Trigger, Digital-to-Analog Converters.

Experiments:

a) Zero-Crossing Detector.
b) Schmitt trigger (Symmetric and Asymmetric).
c) R-2R Ladder DAC.

Text Books

1. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Prentice Hall Inc., 4th Edition, 2002 and onwards.

Reference Books

1. Robert F. Coughlin and Frederick F. Driscoll, "Operational Amplifiers and Linear IntegratedCircuits", PHI, 4th Edition, 2000 and onwards.
2. D. Roy Choudhury and Shail B. Jain, "Linear Integrated Circuits", New AgeInternational, 3rd Edition, 2008 and onwards.
3. David A. Bell, "Operational Amplifiers and Linear IC's", Prentice Hall Inc., 2ndEdition, 2004 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Design and test basic op-amp circuits like Inverting, Non-inverting, Summing, Difference Amplifiers.	L3, L4
2. Design and test basic op-amp circuits like Integrator, Differentiator, Precision Half-Wave and Full-Wave Amplifiers.	L3, L4
3. Design and test basic op-amp circuits like Low-Pass, High-Pass, Band-Pass and Band-Reject Filters.	L3, L4
4. Design and test basic op-amp circuits like RC Phase-Shift Oscillator, Square Wave Generator and Triangular Wave Generator.	L3, L4
5. Design and test basic op-amp circuits like Zero-Crossing Detector, Schmitt trigger (Symmetric and Asymmetric) and R-2R Ladder DAC.	L3, L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Engineering Cognizance**: Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4

Course delivery methods **Assessment methods**

1. Blackboard	1. Internal Assessment Tests
2. Presentations	2. Quiz
3. Demonstration	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4. Initial write up 10 marks
   Conduct of experiments, results and conclusion 20 marks
   Viva- voce 20 marks
   50 marks
5. **Viva-voce shall be conducted for individual student and not in a group.**

Communication Lab

Course Code	16ECL47	**Credits**	2
Course type	L2	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand basic concept of modulation and demodulation.
2. To study the concept of frequency translation.
3. To study the effects of noise in communication systems.

List of Experiments

Part – A (Hardware)

1. Realization of AM modulator and demodulator.
2. Realization of Ring modulator to generate DSB SC signal.
3. Realization of Phased Locked Loop.
4. Realization of Frequency Modulation and Demodulation.
5. Realization of Frequency Mixer using BJT.
6. Realization of Pre emphasis and de-emphasis.

Part – B (Software)

7. (a)Plot the spectrum of sine signal, cosine signal and rectangular pulse using MATLAB and SIMULINK.
   (b) Separation of frequencies from a multi-tone signal using MATLAB.
8. (a) Simulate AM modulator and demodulator using MATLAB.
   (b) Simulate AM modulator and demodulator using SIMULINK.
9. Simulate synchronous DSBSC modulator and detector and using SIMULINK.
10. (a) Simulate FM modulator using MATLAB.
    (b) Simulate FM modulator and demodulator using SIMULINK.
11. Determine the various frequency components in AM and FM signals using MATLAB.
12. Generate Random numbers and Analyze WGN using MATLAB.
13. Find the maximum SNR in an AM system affected by AWGN noise.
14. Obtain the noise free signal from DSBSC modulated signal affected by AWGN noise using appropriate filters.
15. SIMULINK modeling of FDM.

Part - B Experiments to be conducted using MATLAB/ SIMULINK.

Text Books

1. Simon Haykin, "An Introduction to Analog and Digital Communications", John Wiley, 2nd Edition, 2004 and onwards.
2. B. P.Lathi, "Modern Digital and Analog Communication Systems", Oxford, 3rdEdition, 1998 and onwards.
3. R. R. Gulati, "Monochrome and ColourTelevision", New Age International Limited, 3rd Edition, 2006 and onwards.

Reference Books

1. Dennis Roddy and John Coolen, "Electronic Communication", Prentice Hall ofIndia, 4th Edition, 1995 and onwards.
2. Herbert Taub and Donald L Schilling, "Principles of Communication Systems", Tata McGraw Hill,3rd Edition, 2008 and onwards.

Assessment methods

1. Internal Test
2. Quiz
3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4. Initial write up 10 marks
   Conduct of experiments, results and conclusion 20 marks — 50 marks
   Viva- voce 20 marks
5. **Viva-voce shall be conducted for individual student and not in a group.**

Digital Design using HDL Lab

Course Code	16ECL48	**Credits**	2
Course type	L3	**CIE Marks**	25
Hours/week: L-T-P	2 – 0 – 2	**SEE Marks**	25
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Appreciate the importance of HDL in digital designs.
2. Understand program flow of Verilog HDL at data flow; gate level, structural, behavioral and RTL levels.
3. Model, program, and develop test bench the combinational, Programmable Logic Devices (PLDs) and synchronous sequential circuits.
4. To provide insight into the architecture of FPGAs and programming on FPGAs
5. To introduce to the fundamental concept of System Verilog and basic programming with examples

Pre-requisites :

1. Digital Electronics (16EC33).

1. Introduction: Structure of HDL Modules, Operators, Data Types ,Types of Descriptions (Data-Flow, Behavioral and Structural, Switch level) , Procedures, Tasks and Functions
Combinational Circuits Building Blocks: Multiplexers, Decoders, Encoders, Code Converters, Arithmetic Comparison Circuits, Verilog for combinational circuits.

Write the Verilog code, simulate and verify with the test bench and Synthesis, post verification on FPGA Board: using data flow, behavioral, structural, tasks and Functions

1. Design an n-bit Adder
2. Design an NX1 MUX
3. Design a n:m Decoders, m:n Encoder
4. Design of Arithmetic Comparator

2. Flip-Flops, Registers, Counters: Flip-Flop, JK Flip-Flop, Registers, Counters, Reset synchronization, other types of counters: BCD Counter, Ring and Johnson Counter, Blocking and Non-Blocking, Non-Blocking Assignments for Combinational Circuits, Flip-Flops with Clear Capability.

Write the Verilog code, simulate and verify with the test bench and Synthesis, post verification on FPGA Board:

1. SR, JK,T and D flip-flops
2. N-bit shift register
3. N-bit counter (with synchronous and asynchronous clear and Preset)
4. Applications of Counters: BCD Counter, Ring and Johnson Counter

3. Introduction to Finite State Machine: Basic Design Steps, , Mealy and Moore State Model (Example as sequence Generator), Mealy and Moore model for Serial Adder Example, FSM as an Arbiter Circuit

Write the Verilog code with FSM, simulate and verify with the test bench and Synthesis:

1. Sequence Generator (Mealy and Moore Model)
2. Serial Adder (Mealy and Moore Model)
3. Arbiter Circuit

4. Digital System Design: Bus Structure, Simple Processor, Concept of Data path and control circuit, a Bit-counting circuit, Shift and add multiplier, Constraints to the design.

Write the Verilog code with FSM, simulate and verify with the test bench and Synthesis:

1. Bus structure using tristate buffer and Multiplexer
2. Shift and Add Multiplier
3. Data path and control circuit of a bit- counting circuit

Open Ended Problems:

- Design and Verilog implementation of a 8-bit simple processor /RISC Processor
- Design and Verilog implementation of an Electronic Die
- Design and Verilog implementation of an Complex Multiplier
- Design and Verilog implementation of UART/ I2C protocol
- Design and Verilog implementation of an Memory

Text Books

1. Stephen Brown, ZvonkoVranesicD."Fundamentals of digital logic with Verilog design", McGraw Hill, 3rd Edition, 2009 and onwards.
2. Nazeih M. Botros, “HDL Programming VHDL and Verilog”, Dream Tech Press, 2008 and onwards.
3. Stuart Sutherland "System Verilog For Design ", 2nd Edition, Springer, 2006 and onwards.
4. Charles H. Roth Jr., "Digital System Design using VHDL", PWS Publishing Company,1998 and onwards.
5. Samir Palnitkar, “VERILOG HDL, A Guide to digital design and synthesis”, 2nd Edition, Pearson education, 2003 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom’s Level
1. Discuss the basic knowledge of HDL, its Syntax and programming.	L2
2. Demonstrate the ability to apply knowledge of HDL in modeling Combinational and sequential circuits and write Verilog code and its test bench to test the functionality of the design.	L3,L4
3. Use EDA tool to for structural and behavioral modeling, simulation and functional verification of combinational and sequential logic using HDL in any problem identification, formulation and solution.(Open ended examples)	L3, L4
4. Discuss the design flow of ASICs, FPGA based system and target a design to an FPGA Board.	L2
5. Recognize theimportance of programming in SystemVerilog,its synthesis features, and ability to choose the Language for digital system design.	L2, L3

	Program Outcome of this course (POs)	PO No.
1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2.	**Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3.	**Modern tool Usage**: Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4.	**Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
5.	**Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Black board	1. Assignments
2. Presentation	2. Quiz
3. Videos and MOOC	3. Case studies with real time examples.
4. Practical with EDA tools.	4. Projects/ Literature survey.

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4.

Initial write up	10 marks	
Conduct of experiments, results and conclusion	20 marks	50 marks
Viva- voce	20 marks	

5. **Viva-voce shall be conducted for individual student and not in a group.**

Electronics and Computer Workshop Lab

Course Code	16ECL49	**Credits**	2
Course type	ES	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand various electronics components and its applications.
2. To understand electronics circuit design.
3. To understand various computer hardware and their operation.
4. To understand disassembling and assembling of computer system.
5. To study various networking components.

List of Experiments

Part A: Electronics Experiments

1. Study of basic passive and active electronics components.
   - ✓ Introduction to various electrical passive components such as R, C, L, transformers, relays, switches, bread board, universal printed circuit board and electronic devices such as rectifying diode, Zener diode, light emitting diode, transistor, seven segment displays, LCD panel, Integrated circuit chip (with different packages and functionalities, both digital and analog) and Surface mount devices/chips. Acquaintance with ratings, specifications, packages of components and devices listed above, using data-sheets.
2. Introduction to various DC regulated power supplies, Cathode Ray Oscilloscope (CRO), Function Generators, and different Electronic Measuring Meters.
   - ✓ Exposure to usual electronic equipment/instruments such as Multi-meter, Oscilloscope, Function generator, IC tester and Power supply, Information about their front panels, Demonstrations on their working, Hands-on for measurement of component values and DC voltage using multi-meter, AC mains voltage/ 1 KHz Square wave/any small signal from function generator on Oscilloscope, Testing of sample digital ICs using IC tester.
3. Construction and testing of basic electronics circuits.
   - ✓ Circuit building practice on standard bread board using simple ICs, components and single strand wires, performing cold test and functionality verification wherever possible.
   - ✓ Building and testing regulated DC power supply, (Fullwaverectifier), voltage divider circuits using resistors, relay driver using transistors and building burglar alarm circuit.
4. Simple PCB design and testing.
   - ✓ The single sided printed circuit board (PCB) shall be designed manually.
   - ✓ The designed circuit layout should be transferred to copper clad laminate board and etched using Hydrochloric Acid.
   - ✓ After soldering the components and devices onto the PCB, the design should be tested and demonstrated for intended functionality.
   - ✓ Sample Examples of Circuits for BUILD and TEST projects:
     1. IC 555 based timer and square wave generator
     2. OP-amp IC 741 based analog computer (adder/subtractor/integrator/Differentiator)
     3. FM remote lock for vehicle
     4. Digital Clock
     5. Temperature sensor and display

Part B: Computer Workshop

1. Introduction to basic computer hardware
   - ✓ Name and identify various PC hardware components: USB Mouse, PS/2 Mouse, Keyboard, LCD/LED Monitor, VGA, HDMI, CAT5, CAT6, server, routers, fiber cable, Hard disk, RAM, CMOS battery, SMPS, cache, ROM, BIOS
2. To assemble and disassemble computer hardware
3. To install different operating systems with dual boot
   - ✓ Install any two operating systems on a PC making it dual boot, including latest version of Ubuntu Linux, Windows 7/8
4. Introduction to computer networks and it's components
   - ✓ Network Hub (4/8 ports), CAT6 cables network tool kit (Network crimper, Cable Tester, Wire stripper)
   - ✓ Connect 2-4 computers together using a network hub to create a LAN

Note: Students must complete all experiments to become eligible for SEE

Text Books

1. Allen Mottershed, "Electronic devices and circuits", Prentice Hall Inc.
2. Robert L Boylestead "Electronic devices and Circuit theory", PEARSON.
3. Ron Glister "PC Hardware: A Beginner's Guide", Osborne/ McGraw –Hill.
4. BehrouzA.Forouzan "Data Communication and Networking", McGraw –Hill.

Reference Books

1. Satish Jain, "Electronics Components And PC Hardware", BPB Publication.
2. Ramakant A. Gayakwad, "Op-amp and Linear Integrated circuits", Prentice Hall Inc.
3. Nurul Sarkar, "Tools for Teaching Computer Networking And Hardware Concepts", Infosci Publication.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Distinguish various electronics components.	L4
2. Analyze and design electronics application circuits.	L4, L6
3. Identify various parts computer hardware.	L3
4. Testing of a computer model.	L4
5. Analyze computer networking.	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Test
2. Quiz
3. Activity
4. Viva-Voce
5. Mini Project/ Course Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4. Initial write up 10 marks
   Conduct of experiments, results and conclusion 20 marks
   Viva- voce 20 marks
   50 marks
5. **Viva-voce shall be conducted for individual student and not in a group.**

Vector Calculus, Laplace Transforms and Probability
(Mech, Civ, E&C, E&E)
(ONLY FOR DIPLOMA LATERAL ENTRY STUDENTS)

Course Code	16DIPMATM41	**Credits**	5
Course type	BS	**CIE Marks**	50
Hours/week: L-T-P	4 – 1 – 0	**SEE Marks**	50
Total Hours:	50	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Study the concept of Double and Triple integrals, Vector Differentiation.
2. Get acquainted with vector integration and its applications.
3. Be proficient in Laplace Transforms and Inverse Laplace Transforms and solve problems related tothem.
4. Learn the concept of Interpolation and use appropriately.
5. Study the concept of Random variables and its applications.

Pre-requisites:

1. Basic Probability, Probability Distribution.
2. Basic Statistics.
3. Basic Differentiation and Integration.

Unit – I **10 Hours**

Vector and Integral Calculus: Double and triple integrals.Scalar and Vector point function, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields.

Unit – II **10 Hours**

Vector Integration: Line Integral, Surface Integral, Volume Integral, Green's Theorem, Stoke's Theorem, GuassDivergence Theorem (statement only) and problems.

Unit – III **10 Hours**

Laplace Transforms: Definition, Laplace Transforms of elementary functions, Laplace Transforms of$e^{at}f(t)$,$t^n f(t)$, $\int_0^t f(t)dt$, $\frac{f(t)}{t}$ (without proof), Inverse Laplace Transforms: Inverse Laplace Transforms-Problems, Applications to solve Linear Differential Equation.

Unit – IV **10 Hours**

Finite Differences and Interpolation: Forward and Backward differences, Newton's Forward and Backward Interpolation Formulae, Divided Difference, Newton's Divided Difference Formula (without proof), Lagrange's Interpolation Formula, Illustrative examples, Numerical Integration: Trapezoidal rule, Simpsons 1/3rd rule, Simpsons 3/8th rule, Weddle's rule, Practical Examples.

Unit –V **10 Hours**

Probability: Random Variables (RV), Discrete and Continuous Random variables, (DRV,CRV) Probability Distribution Functions (PDF) and Cumulative Distribution Functions(CDF), Expectations, Mean, Variance. Binomial, Poisson, Exponential and Normal Distributions (Only examples).

Text Books

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012 and onwards.
2. P. N. Wartikar and J. N. Wartikar, "Applied Mathematics" (Volume I and II), Pune VidyarthiGrihaPrakashan, 7th Edition, 1994 and onwards.
3. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Ltd., 43rd Edition, 2006 and onwards..

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
2. Peter V. O' Neil, "Advanced Engineering Mathematics", Thomson Brooks/Cole, 7th Edition, 2011 and onwards.
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, 2010 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Evaluate Double and Triple Integration.	L3
2. Explain the concept of vector Differentiation and Integration.	L2
3. Define Laplace Transforms, Inverse Laplace Transforms and Solve problems related to them.	L1, L3
4. Use Finite differences in Interpolation.	L3
5. Understand the concept of Random variables, PDF, CDF and its applications.	L2
6. Use of Probability distribution for practical problems.	L3

Program Outcome of this course (POs)	**PO No.**
1. An ability to apply knowledge of Mathematics, science and Engineering.	1
2. An ability to identify, formulate and solve engineering problems.	5
3. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	11

Course delivery methods	**Assessment methods**
1. Black Board Teaching	1. Internal Assessment
2. Power Point Presentation	2. Assignment
3. Scilab/Matlab/ R-Software	3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / Mathematical/ Computational/ Statistical tools	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE: Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Scheme of Semester End Examination (SEE):

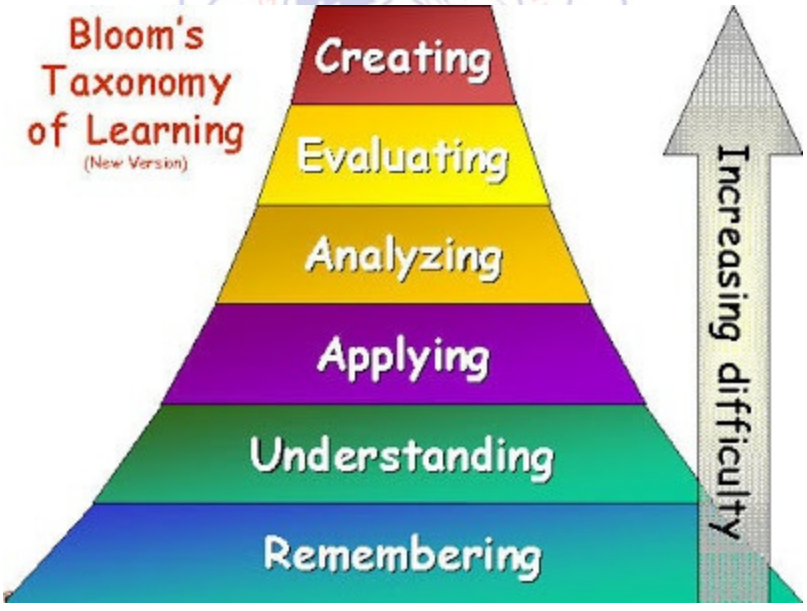
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Bloom's Taxonomy of Learning Objectives

Bloom's Taxonomy in its various forms represents the process of learning. It was developed in 1956 by Benjamin Bloom and modified during the 1990's by a new group of cognitive psychologists, led by Lorin Anderson (a former student of Bloom's) to make it relevant to the 21st century. The **revised taxonomy** given below emphasizes what a learner "Can Do".

Lower order thinking skills (LOTS)		
L1	Remembering	Retrieve relevant knowledge from memory.
L2	Understanding	Construct meaning from instructional material, including oral, written, and graphic communication.
L3	Applying	Carry out or use a procedure in a given situation – using learned knowledge.
Higher order thinking skills (HOTS)		
L4	Analyzing	Break down knowledge into its components and determine the relationships of the components to one another and then how they relate to an overall structure or task.
L5	Evaluating	Make judgments based on criteria and standards, using previously learned knowledge.
L6	Creating	Combining or reorganizing elements to form a coherent or functional whole or into a new pattern, structure or idea.



Digital Communication

Course Code	16EC51	**Credits**	4
Course type	PC1	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To know the principles of sampling theorem.
2. To study the various waveform coding schemes.
3. To learn the various baseband transmission schemes.
4. To understand the various Band pass signaling schemes.
5. To study different spread spectrum modulation techniques.

Pre-requisites:

4. Digital Electronics (16EC33).
5. Signal Systems (16EC34).
6. Communication Theory and Techniques (16EC45).

Unit – I 8 Hours

Sampling Theory: Low pass sampling, Quadrature sampling, Signal Reconstruction,Signal distortion in sampling, Practical Aspects of Sampling and Signal Recovery, Pulse Amplitude Modulation.

Lab Experiments:

1. Verifying Sampling theorem of band-limited signals using MATLAB (Software).
2. TDM of two band limited signals(Hardware).
3. Pulse code modulation using SIMULINK (Software).

Unit – II 8 Hours

Waveform Coding: Pulse Code Modulation, Quantizationnoise and SNR, Robust Quantization, DPCM, Delta Modulation, Adaptive Delta Modulation.

Self learning topics: Digital Multiplexers, Lightwave Transmission.

Lab Experiments:

1. Generate a Delta Modulated wave using MATLAB(Software).

Unit – III 8 Hours

Baseband Transmission: Properties of Line codes, Power Spectral Density of Uni-polar, Polar RZ and NRZ, Bipolar NRZ, Manchester, ISI, Nyquist criterion for distortionless transmission, Correlative coding, Eye pattern, Detection of Binary Signals in Gaussian Noise: Matched Filter.

Unit – IV 8 Hours

Digital Modulation Schemes: Geometric Representation of signals, Generation, Detection, PSD and BER of Coherent BPSK, BFSK and QPSK, QAM, Synchronization.

Lab Experiments:

1.ASK generation and detection (Hardware).
2.FSK generation and detection (Hardware).
3. DPSK generation and detection (Hardware).

Unit –V **8 Hours**

Spread Spectrum Modulation: Pseudo Noise Sequences, Notion of Spread Spectrum, Direct Sequence Spread Spectrum, Coherent Binary PSK, Frequency Hop Spread Spectrum, Applications.

Self learning topics:CDMA and Multipath Suppression.

Lab Experiments:

1. Generate Direct Sequence Spread Spectrum signal.

Text Books

1. Simon Haykin, "Digital Communications", John Wiley, 2005 and onwards.

Reference Books

1. B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009 and onwards.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd Edition, Oxford University Press 2007 and onwards.
3. H. P. Hsu, Schaum's Outline Series, "Analog and Digital Communications", TMH 2006 and onwards.
4. Dr.K.N Hari Bhat, "Digital Communications" 2nd Edition,Sanguine Technical Publishers 2005 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain basics of sampling theorem.	L2
2. Analyze and Design Waveform coding schemes.	L5
3. Distinguish various line coding techniques.	L4
4. Analyze and Design the spectral characteristics of band pass signaling schemes and their noise performance.	L5
5. Analyze various frequency spread spectrum techniques and to understand its applications.	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiment:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions.	11
4. **Self motivated learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Advanced Processors

Course Code	16EC52	**Credits**	3
Course type	PC2	**CIE Marks**	50
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand need and application of ARM Microprocessors in embedded system.
2. To study the architecture of ARM series microprocessor.
3. To understand architecture and features of typical ARM7& ARM CORTEX-M3 Microcontroller.
4. To learn interfacing of real world input and output devices.
5. To learn embedded communication systems.

Unit – I 8 Hours

ARM Architecture: The Acron RISC machine, Architectural inheritance, Architecture of ARM7TDMI, ARM programmers model, ARM development tools, 3 stage pipeline ARM organization, ARM instruction execution. The advanced micro controller bus architecture (AMBA). Introduction, structure of assembly language modules, Predefined register names, frequently used directives, Macros, Miscellaneous assembler features.
Text 1 (2.1,2.2,2.3,2.4,2.5,4.1,4.3) Text 2(4.1 to 4.6)

Unit – II 8 Hours

ARM Instruction Set: Introduction, ARM instruction set-Data processing and branch instructions, Thumb instruction set: The Thumb bit in the CPSR, The Thumb programmer model, Thumb branch instructions, Thumb software interrupt instructions, Thumb data processing instructions, , and Thumb applications. Example programs
Text 1 (5.1 to 5.14,7.1,7.2,7.3,7.4,7.5,7.6,7.7,7.8,7.9)
Self learning topics: Thumb breakpoint instruction, Thumb implementation.

Unit – III 8 Hours

Embedded C Programming: Basic C data types, operators, Decision making statements, C looping Structures, Register allocation, Function calls, Arrays, Structures and programming examples.

Unit – IV 8 Hours

LPC2148 Architecture, Programming and Interfacing: ARM7 Based Microcontroller LPC2148: Features, Architecture (Block Diagram and Its Description), System Control Block (PLL and VPB divider) , on-chip Memory Map, GPIO, Pin Connect Block, timer, UART, ADC, I2C, SPI , RTC interfacing with LED, LCD, memory, Stepper Motor, Buzzer, Keypad.
Text 4
Self-Learning Topics: Buzzer and GLCD.

Unit – V 8 Hours

Architectural support for system development: The advanced micro controller bus architecture (AMBA).The ARM reference peripheral specification, hardware system prototyping tools, the ARMulator, JTAG boundary scan test architecture, The ARM debug architecture, Embedded trace, Text 1 (8.1 to 8.9).

Text Books

1. Steve Furber, "ARM System- on-Chip Architecture" LPE, 2nd Edition and onwards.
2. William Hohl, "ARM Assembly Language fundamentals and Techniques" CRC press, 2009 and onwards.
3. User manual on LPC21XX.

Reference Books

1. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – Designing and Optimizing System Software", ELSEVIER.
2. Morgan Kauffman "ARM system Developer's Guide"- Hardbound, Publication date: 2004 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Describe the ARM microprocessor architectures and its feature	L2
2. Explain the various instructions and write the assembly code.	L2,L3
3. Identify the programming aspects of Embedded C and write embedded C programs using data types, operators, control and looping structures	L2, L3
4. Interface the advanced peripherals to ARM based microcontroller and hence design embedded system with available resources (open ended examples)	L5,L6
5. Describe the ARM Cortex M3 architecture and compare it with ARM7 architecture	L2

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering**: Graduates shall be able to understand and applythe basics of mathematical and scientific concepts in the field of Electronics and communication Engineering.	1
2. **Design of Experiment:** Graduates shall possess the ability to design andconduct experiments, analyze and interpret data.	2
3. **Engineering Cognizance:** Graduate shall be able to stay a breast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Modern Tool Usage**: Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5. **Self motivated learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
4. MOOC and NPTEL courses	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

DSP and Architecture

Course Code	16EC53	**Credits**	4
Course type	PC3	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Representation of discrete-time signals in the frequency domain, using Discrete Fourier Transform (DFT).
2. Understand the implementation of the DFT in terms of the FFT, as well as some of its applications (computation of convolution sums, spectral analysis).
3. Learn the basic forms of FIR and IIR filters, and how to design filters with desired frequency responses.
4. Understand the architecture of a floating point digital signal processor.
5. Design a real-time signal processing algorithm using the latest fixed a floating point digital signal processor.

Pre-requisites :

3. Signals and Systems (16EC34).

Unit – I — 8 Hours

Discrete Fourier Transforms (DFT): A Digital Signal-Processing System, Introduction to DFT, Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms.

Lab Experiments using MATLAB:

1. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
2. Linear convolution of two sequences using DFT and IDFT.

Unit – II — 8 Hours

Properties of DFT: Multiplication of two DFTs, Circular convolution, Additional DFT properties. Use of DFT in linear filtering, Overlap-save and overlap-add method. Direct computation of DFT, Need for efficient computation of the DFT (FFT algorithms), Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and decimation-in-frequency algorithms.

Self learning topics: FFT of N (not a power of 2)

Lab Experiments using MATLAB:

1. Circular convolution of two given sequences using DFT and IDFT.
2. Computation of linear filtering by using overlap-add method.
3. Computation of linear filtering by using overlap-save method.

Unit – III — 8 Hours

FIR Filter Design: LinearphaseFIRfilter, Filterdesign using - Rectangular, Hamming, Bartlet and Kaiser windows, Frequency sampling techniques, Finite word length effects in digital Filters.

Self learning topics: Direct form systems, cascade, lattice.

Lab Experiments using MATLAB:

1. Design and implementation of FIR filter to meet given specifications

Unit – IV **8 Hours**

IIR filter design: Characteristics of commonly used analog filters Butterworth and Chebyshevefilters,analog to analog frequency transformations, Filterdesign,Bilineartransformation,Approximation of derivatives filter design using frequency translation.

Structures for IIR systems: Direct form I and form II systems cascade, Lattice and parallel structures.

Lab Experiments using MATLAB:

1. Design and implementation of IIR filter to meet given specifications.

Unit –V **8 Hours**

Digital signal processors: Introduction, Features of TMS320C6X processor, Internal Architecture, Central processing unit and data paths, Functional units, Addressing modes, Memory architecture.

Self learning topics: Pipeline Operation.

Lab Experiments using DSP processor:

1. Linear convolution of two given sequences.
2. Circular convolution of two given sequences.
3. Computation of N- Point DFT of a given sequence.

Text Books

1. John G. Proakis and Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Pearson education / Prentice Hall, 2007, 4th Edition and onwards.
2. Emmanuel C. Ifeachor, & Barrie.W.Jervis, "Digital Signal Processing", Pearson Education / Prentice Hall, 2002, 2nd Edition and onwards.
3. Avatar Singh and S. Srinivasan, "Digital Signal Processing", Thomson Learning, 2004 and onwards.

Reference Books

1. Oppenheim and Schaffer, "Discrete Time Signal Processing", PHI, 2003 and onwards.
2. S. K. Mitra, "Digital Signal Processing" , Tata Mc-Graw Hill, 3rdEdition, 2010 and onwards.
3. B. Venkatramani, M. Bhaskar, "Digital Signal Processors Architecture, Programming and Applications", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002 and onwards.
4. Texas Instruments Manuel for TMS320C5XProcessor.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Appreciate the importance and scope of digital signal processing in various fields of science and engineering.	L2
2.	Characterize discrete time signals and their spectrum.	L3
3.	Compute DFT of a signal efficiently and know its importance in signal processing	L3
4.	Ability to design linear digital filters both FIR and IIR using different techniques and their associated structures	L6
5.	Learn the basic architecture of digital signal processors	L2

	Program Outcome of this course (POs)	PO No.
1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2.	**Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
3.	**Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
4.	**Self-motivated Learning:** Graduates shall continue to upgrade the skills and	12

possess the motivation for continuing education and professional growth.

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Simulations	3. Quiz
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

CMOS VLSI Design

Course Code	16EC54	**Credits**	3
Course type	PC4	**CIE Marks**	50
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To study the fundamentals of MOSFET and its types.
2. To be able to apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect.
3. To study circuit analysis models in analysis of CMOS for single stage amplifiers
4. To study circuit analysis models for differential amplifier.
5. To examine and recognize the frequency response of amplifiers.

Pre-requisites :

3. Digital Electronics (16EC33).
4. Analog Electronics (16EC32).

Unit –I 8 Hours

MOS Transistor Theory: Introduction, Ideal I-V characteristics, Long-Channel I-V Characteristics, C-V Characteristics, Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Detailed MOS Diffusion Capacitance Model, Non-ideal I-V Effects, Mobility Degradation and Velocity Saturation, Channel Length Modulation Threshold Voltage Effects, Leakage,DC Transfer Characteristics, Beta Ratio Effects, Noise Margin, tristate inverter.
Text-1: 2.1, 2.2, 2.3, 2.4, 2.5.1, 2.5.2, 2.5.3,2.5.6

Unit –II 8 Hours

CMOS Fabrication and layout: CMOS technology, Layout Design Rules: Design rule background, Design rule check, gated layout, stick diagram and layouts (Basic and universal gate).
Characterization & performance Estimation: Delay estimation: RC delay models, logical effort, parasitic delay, Power dissipation: static and dynamic dissipation, transistor scaling.
Text-1:1.5.3, 1.5.4, 1.5.5, 3.1, 3.2, 3.3.1, 3.3.2, 4.1,4.2.3, 4.2.4, 4.4.1, 4.4.2,4.9.1
Self learning topics: Stick diagram and layouts (Logical expressions).

Unit –III 8 Hours

Combinational Circuit Design: Introduction, Circuit families: Ratioed circuits: Pseudo-nMOS, Cascode Voltage Switch Logic, Dynamic circuits, Domino Logic, Pass-transistor circuits, Bi-CMOS circuits.
Text-1: 6.1, 6.2.2, 6.2.3, 6.2.4, 6.2.5, 6.3.3.
Sequential MOS Logic Circuits: Introduction, Behavior of bi-stable elements, SR latch circuits, clocked latch and flip flop circuits, CMOS D-latch and edge Triggered Flip-Flop.
Text-2:8.1, 8.2, 8.3, 8.4, 8.5.
Self learning topics: Designing of logical gates with different CMOS logic structures.

Unit –IV 8 Hours

Single Stage Amplifiers: Basic Concepts, Common-Source stage, source follower, common gate stage, cascode stage: folded cascade, choice of device models.
Text-4: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6

Unit –V **8 Hours**

CAD Systems and Algorithms: Introduction, CAD systems, Switch level Simulation, Layout Synthesis, Layout Analysis, Timing and optimization, Logic Synthesis, Test Generation Sequential Machine optimizations. Scheduling and Binding, Hardware/software Co-design.

Text-5: 10.1, 10.2,10.3,10.4,10.5, 10.6,10.11

Text Books

1. Neil H. E. Weste, and David Money Harris." CMOS VLSI Design-A Circuits and Systems Perspective" Pearson Education, Inc.
2. Sung Mo Kang & Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
3. Neil H. E. Weste, and Kamran Eshraghian." Principles of CMOS VLSI Design", Pearson Education, Inc.
4. BehzadRazavi, "Design of Analog CMOS Integration Circuits", TATA McGRaw -HILL Edition.
5. Wayne wolf, "Modern VLSI Design: System-on-chip Design", Prentice Hall, 2002 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Discuss the basic knowledge of CMOS and its characteristics.	L2
2. Demonstrate the ability to apply knowledge of design rules for to construct stick diagrams and layouts.	L3,L5
3. Design Single stage CMOS amplifiers and solve problems on it.	L3,L4
4. Design Differential CMOS amplifiers and solve problems on it.	L3,L4
5. Analyze and explain frequency response of amplifiers.	L2, L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering**: Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments**: Graduates shall possess the ability to design and conduct experiments, analyze and interpret data	2
3. **EngineeringCognizance:**Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
5. **Self motivated Learning**: Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Black board	1. Assignments
2. Presentation	2. Quiz
3. Videos and MOOC	3. Case studies with real time examples.
4. Practical with EDA tools.	4. Projects/ Literature survey.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – I: Power Electronics

Course Code	16EC551	**Credits**	3
Course type	PE – I	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To learn the basics of Power Electronics and Power Devices.
2. To study the Principles, Characteristics and turn-on methods of Silicon Controlled Rectifiers (SCRs).
3. To study various gate triggering circuits and turn-off methods of SCRs.
4. To study the working of Phase-Controlled Rectifiers.
5. To study Inverters, DC Choppers and AC Regulators.

Pre-requisites :

1. Basic Electronics (15ELN15/25).
2. Analog Electronics (16EC32).

Unit – I 8 Hours

Introduction: Applications of Power Electronics, Power Semiconductor Devices, Types of Power Electronics Circuits, Power Transistors: Switching Characteristics, Power MOSFETs: Switching Characteristics. (Text Book 1)

Lab Experiments:

1. Static characteristics of MOSFET.

Unit – II 8 Hours

Thyristor: Principles and Characteristics: Principle of Operation of SCR, Static Anode-Cathode Characteristics of SCR, The Two-transistor Model of SCR, Gate Characteristics of SCR, Turn-on Methods of a Thyristor, Turn-off Mechanism. (Text Book 2)

Lab Experiments:

1.Static characteristics of SCR.

Unit – III 8 Hours

Gate Triggering Circuits: Introduction, Firing of Thyristors, Pulse Transformers, Optical Isolators, Gate Triggering Circuits, Unijunction Transistor.

Turn-off Methods: Natural Commutation, Forced Commutation (Design of these circuits is not expected): Class A - Self Commutation by Resonating the Load, Class B – Self Commutation by an LC Circuit, Class C – Complementary Commutation, Class D – Auxiliary Commutation, Class E – External Pulse Commutation, Class F – AC Line Commutation. (Text Book 2)

Lab Experiments:

1. SCR Turn-on using UJT Firing Circuit.
2. SCR Turn-off using LC Circuit.

Unit – IV 8 Hours

Phase-Controlled Rectifiers: Introduction, Phase Angle Control, 1ϕ Half-Wave Controlled Rectifier, 1ϕ Full-Wave Controlled Rectifier, 1ϕ Half Controlled Bridge Rectifier. (All Converters with R Load only)

Lab Experiments:

1. Controlled HWR and FWR using RC Triggering Circuit.

Unit –V **8 Hours**

Inverters: Introduction, Classification, Basic Series Inverter, Basic Parallel Inverter.

DC Choppers: Introduction, Principle of Chopper Operation, Step-UP Chopper, Step-Up/Down Chopper, Chopper Configuration: Type A, B, C, D and E (Principle only).

AC Regulators: Introduction, 1ϕ AC Regulators with R Load only. (Text Book 2)

Lab Experiments:

1. Voltage Commutated Chopper.
2. Speed Control of Universal Motor.

Text Books

1. M. H. Rashid, "Power Electronics", PHI / Pearson Publisher.
2. M. D. Singh and Kanchandani K. B., "Power Electronics", TMH Publisher.

Reference Books

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics", John Willey & Sons, Inc.
2. Dr. P. S. Bimbhra, "Power Electronics", Khanna Publishers.
3. P. C. Sen, "Power Electronics", Tata McGraw-Hill Publishing Company Ltd.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Define Power Electronics, Classify power electronics circuits.	L1,L2
2. Explain Principle of Operation of SCR, Interpret Static Anode-Cathode characteristics of SCR, Analyze and Explain Two-transistor Model of SCR.	L2, L4
3. Analyze and Explain different Gate Triggering Circuits and Turn-off methods.	L2,L4
4. Analyze and Explain Phase-Controlled Rectifiers.	L2,L4
5. Analyze and Explain Inverters, DC Choppers and AC Regulators.	L2,L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments**: Graduates shall imbibe the professional and ethical responsibilities of their profession.	2

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz
4. Notes	4. Mini Project

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – I: Image and Video Processing

Course Code	16EC552	**Credits**	3
Course type	PE – I	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To cover the basic theory and algorithms that is widely used in digital image processing.
2. To expose students to current technologies and issues that is specific to image/video processing systems.
3. To develop skills in using computers to process images.
4. To understand the various color spaces.
5. To expose student to use image and video processing MATLAB tool box.

Pre-requisites :

1. DSP & Architecture (16EC53).

Unit – I 8 Hours

Digital Image Fundamentals: Elements of visible perception, Image model, Sampling and quantization, Relationships between pixels, Imaging geometry, Applications of Image processing (Text Book 1 and 2)

Self learning topics: Digital image processing block diagram.

Lab Experiments:

1. MATLAB program to increase the size of image using nearest neighbor interpolation.
2. MATLAB program to compute arithmetic and logical operation on image.
3. MATLAB program to count the number of objects using connected component.
4. MATLAB program to calculate distance in a binary image using Euclidean, city block and chessboard distance measure**.**

Unit – II 8 Hours

Image Transforms: Introduction to transforms, Two-dimensional orthogonal and unitary transforms, Properties of unitary transforms, Two dimensional Fourier Transforms(DFT) and its applications, Introduction to Discrete Cosine Transform(DCT) and its applications. (Text Book 1 and 2)

Self learning topics: DCT applications in JPEG Encoder.

Lab Experiments:

1.MATLAB program to display phase and magnitude using Fourier Transforms.
2.MATLAB program to interchange phase of 2 images using Fourier Transforms.
3.MATLAB program to compute energy compaction using Discrete Cosine Transform DCT.

Unit – III 8 Hours

Image Enhancements: Point operations, Histogram modeling, Spatial filtering-smoothing, Sharpening, Low pass, High pass, Homomorphic filtering.

Image Segmentation: Detection of discontinuities, Age linking and boundary detection, Thresholding region oriented segmentation. (Text Book 1 and 2)

Lab Experiments:

1. MATLAB program to perform edge detection using various operators and mask.
2.MATLAB program to remove salt and pepper noise using mean, median and maximum and min/max filters.
3.MATLAB program to implement Homomorphic filtering.

Unit – IV 8 Hours

Introduction to video: Analog vs. Digital, Audio and Video Compression, Color Spaces -YUV Color Space, YIQ Color, YCbCr Color Space (Text Book 3 and 4).

Lab Experiments:

1. MATLAB program to separate RGB, HSV, YIQ component.
2. MATLAB program to change contrast enhancement of colour image.
3. MATLAB program to smoothing and sharpening of colour image.

Unit –V **8 Hours**

Digital Video Processing: SDTV-HDTV YCbCr Transforms, Luma and Chroma Keying, DCT-Based Compression, NTSC, PAL, and SECAM Overview (Text Book 3 and 4).

Text Books

1. Gonzalez and Woods, "Digital Image processing", Pearson and Prentice Hall, 2009, 3rd Edition and onwards.
2. A.K. Jain, "Fundamentals of digital image processing," Prentice Hall, 1989 and onwards.

Reference Books

1. Keith Jack, Video Demystified-A Handbook for the Digital Engineer, Newnes, Elsevier, 2007, 5th Editionand onwards.
2. Alan C.Bovik, 'The Essential Guide to Video Processing', Elsevier Science, 2009, 2nd Edition and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Identify and describe image and video signal.	L2
2. Analyze various transforms application for image and video.	L5
3. Develop image and video algorithms for various applications.	L5
4. Explain various video compression techniques.	L2
5. Explain and analyze digital video processing methods.	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
3. **Research and Innovation:**Graduates shall have the ability to pursue research and provide innovative solutions.	11
4. **Self-motivated Learning:**Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz
4. Notes	4. Mini Project

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – I: Soft Computing

Course Code	16EC553	**Credits**	3
Course type	PE – I	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To learn the key aspects of Soft computing.
2. To explore types of neural network.
3. To study fuzzy relationships and schemes.
4. To design de-fuzzification rules.
5. To comprehend the structure of genetic algorithms.

Unit – I **8 Hours**

Introduction to Soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications. Fundamental concept of ANN, Evolution, basic Model of ANN, Terminologies used in ANN, MP model, Hebb model.

Lab Experiments:

1. Design of a neural network to classify the output of X-OR logic gate.

Unit – II **8 Hours**

Perceptron Network: Adaptive linear neuron, Multiple adaptive linear neurons, Back propagation Network (Theory, Architecture, Algorithm for training, learning factors, testing and applications of all the above NN models).

Lab Experiments:

1. Design of a neural network to sort English alphabets and numbers from a given input set.

Unit – III **8 Hours**

Introduction to classical sets and fuzzy sets: Classical relations and fuzzy relations,Membership functions, Fuzzification schemes.

Unit – IV **8 Hours**

Defuzzification: Fuzzy decision making, and applications, FAM rules, Non-linearity handling capability, Knowledge based system design and its applications.

Lab Experiments:

1. Design a FIS for speed control of a motor.
2. Design a Fuzzy algorithm for image thresholding.

Unit –V **8 Hours**

Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, The schema theorem, Genetic programming, applications

Lab Experiments:

1. Design a code based Genetic Algorithm used to find a maximum or minimum value of a given function using the concept of biological chromes and genes.

Text Books

1. Shivanandam, Deepa S. N,"Principles of Soft computing", Wiley India, ISBN 13: 9788126527410, 2011 and onwards.
   (Chapters 1, 2, 3(upto 3.5), 7, 8, 9, 10, 13, 15 (upto 15.6 & 15.9,15,10)
2. J.S.R. Jang, C.T. Sun, E. Mizutani, "Neuro-Fuzzy And Soft Computing", Pearson Higher Education, 2012 and onwards.

Reference Books

1. Vinod Chandra S.S. "Artificial Intelligence and Machine Learning", Prentice Hall India Learning Private Limited, 1st Edition, 2014 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand the basic concepts of neural networks.	L2
2. Differentiate types of neural networks.	L3
3. Comprehend the requirement for a fuzzy system.	L3
4. Apply Neuro –fuzzy systems to classification problems.	L4
5. Design Genetic Algorithm to solve the optimization problem.	L5

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz
4. Notes	4. Mini Project

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE): 40

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass:**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – I: Cryptography and Network Security

Course Code	16EC554	**Credits**	3
Course type	PE – I	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Study the network security model, security attacks, mechanisms and services and to demonstrate use of various symmetric key ciphers and their principles.
2. Understand the concept of Modular Arithmetic and its application in public key cryptography and apply the knowledge to solve security related problems.
3. Understand the design principles of Public key cryptosystems for encryption, key exchange and authentication.
4. Learn the concept of secured electronic transaction with web security considerations.
5. Study the security threats to networks and their countermeasures.

Unit – I **8 Hours**

Security services, mechanisms and attacks, OSI Security model, Symmetric Key cryptography, Substitution techniques: Playfair and Transposition techniques, SDES: encryption, decryption and key generation, DES: design principles, AES: encryption and decryption model, Stegenography.

Lab Experiments:

1. Design an experiment to perform encryption and decryption on the principle of substitution and transposition cipher.
2. Design an experiment to perform image watermarking.

Unit – II **8 Hours**

Galois Fields, Extended Euclid's Theorem, Discrete Log Problem, Chinese remainder theorem, Elliptic Curve Arithmetic, Principles of public key cryptosystems.

Lab Experiments:

1. Applications of extended Euclid's algorithm to find inverse of a number.
2. Executing ECC algorithm.

Unit – III **8 Hours**

RSA, Diffie-Hellman Key exchange, Hash Functions.

Lab Experiments:

1. Applications of RSA algorithm to implement public key cryptosystems.
2. Implementing simple Hash Function.

Unit – IV **8 Hours**

Web security requirement, Secure sockets layer, Transport layer security, Secure electronic transaction.

Lab Experiments:

1. Demonstration of secure socket layers applications.
2. Study of secure electronic transactions.

Unit –V **8 Hours**

Viruses, Firewalls, Types, Configuration and Limitations.

Lab Experiments:

1. Demonstration of working of firewall.
2. Study of Viruses life cycle.

Text Books

1. William Stallings,"Cryptography and Network security: principles and practice",2nd Edition,Prentice Hall of India,New Delhi,2002 and onwards.
2. Behrouz A. Fourcuzan," Cryptography and Network security" Tata McGraw-Hill, 2008 and onwards.

Reference Books

1. AtulKahate," Cryptography and Network security", 2nd Edition, Tata McGraw-Hill, 2008 and onwards.
2. H. Yang et al., Security in Mobile Ad Hoc Networks: Challenges and Solution, IEEE Wireless Communications, 2004 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Identify and describe different techniques in modern cryptography	L1, L2, L3
2. Employ the modular arithmetic fundamentals to cryptography	L4
3. Describe, recognize and use the principles of Public key cryptosystems	L3, L4
4. Recognize the use of cryptography in Data Networks	L4
5. Analyze the security issues related to internet and networks	L5

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
3. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz
	4. Mini Project

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Advanced Processors Lab

Course Code	16ECL56	**Credits**	2
Course type	L1	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Acquaint the students with all the equipment necessary to conduct the experiments during the entire lab.
2. Provide the students with hands-on experience in the design, analysis, testing, and comprehension of Digital Signal and ARM 7 processor.
3. Introduce principles of signal processing and ARM 7 programming for practical applications.
4. For each program application, identify the significance and inter-dependency of the processors elements.
5. Enable the students to design and verify the expected outcomes as per the given specifications.

List of Experiments Using ARM7 Processor

Part A:

5. Perform the addition of 2 16-bit numbers and store the result. Extend the program to 64-bit numbers.
6. Disassemble a byte data into two nibbles (each of byte).
7. Add a series of 16-bit number by using a table address look-up.
8. Scan a series of 32-bit number to find how many are negative. Extend to zero and positive numbers.
9. Scan a series of 16-bit number to find the largest.
10. Set the parity bit on a series of Characters, store the amended string.
11. Convert ASCII numeric character into decimal.
12. Divide a 32-bit binary number by a 16-bit binary number, store the quotient and remainder.
13. Examine a table for a match. Store a new entry at the end if no match found.

Part B:

5. Embedded C program for GPIOs.
6. UART Programming with and without Interrupt.
7. I2C Programming.
8. DAC Programming for wave form generation.
9. On-chip timer and external buzzer Interface Programming.
10. LCD Interfacing.
11. Seven Segment Interfacing.
12. Stepper Motor Interfacing.
13. Temperature Sensor Interfacing.

Note:

- Part A program are coded using assembly language and simulated on the Keil simulator. Part B programs are coded in Embedded C, simulated and verified using the ARM 7 development kits.
- Part A and Part B questions are to be asked during the SEE.

Text Books

1. Steve Furber, "ARM System- on-Chip Architecture" LPE, 2nd Edition and onwards.
2. William Hohl, "ARM Assembly Language fundamentals and Techniques" CRC press, 2009 and onwards.
3. User manual on LPC21XX.

Reference Books

1. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – Designing and Optimizing System Software", ELSEVIER.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Identify the instructions and write the assembly code for the given problem statement.	L2,L3
2. Illustrate the operation of looping instructions for the given problem statements.	L3
3. Write an embedded C program to interface on-chip peripherals and test the logic on ARM 7 Board.	L6
4. Write an embedded C program for an LCD display unit.	L6
5. Write an embedded C program for a temperature Measurement system and speed control of stepper motor.	L6

Program Outcome of this course (POs)

	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions	11
4. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Test
2. Quiz
3. Activity
4. Viva-Voce
5. Mini Project/ Course Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4.

Initial write up	10 marks	50 marks
Conduct of experiments, results and conclusion	20 marks	
Viva- voce	20 marks	

5. **Viva-voce shall be conducted for individual student and not in a group.**

VLSI Lab

Course Code	16ECL57	**Credits**	2
Course type	L2	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Be able write Verilog code for the given circuit.
2. Be able to verify the code by writing the test bench for the code.
3. Draw the schematic, generate the symbol and verify the circuit on the tools.
4. Draw the layout of the schematic.
5. Verify & Optimize for Time, Power and Area.

List of experiments

Part A- ASIC Digital Design Flow

1. Inverter
2. NAND and OR gate

   b) NAND and OR gate Test Bench
3. Flip Flops along with the Test Bench

   a) D

   b)T

   c)JK

   d)MS-JK
4. Full adder circuit
5. 4 – bit counter (up/Down)

Part B- Full Custom Design

6. Inverter
7. NAND gateand NOR gate
8. Common Source Amplifiers
9. Common Drain Amplifiers
10. Differential Amplifier

Text Books

1. Neil H. E. Weste, and David Money Harris." CMOS VLSI Design-A Circuits and Systems Perspective" Pearson Education, Inc.
2. Sung Mo Kang & Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
3. Basic VLSI Design - Douglas A. Pucknell& Kamran Eshraghian,PHI 3rdEdition and onwards.
4. Neil H. E. Weste, and Kamran Eshraghian." Principles of CMOS VLSI Design" Pearson Education, Inc.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Apply the fundamental skill to write a Verilog code and verify it by writing the test bench	L3,L5
2. Observe the waveform and synthesize the code with technological library	L2
3. Draw the schematic and verify the DC Analysis and Transient Analysis	L3
4. Draw the Layout and verify the DRC, ERC,LVS, Extract RC and back annotate.	L5,L6
5. Verify & Optimize for Time, Power and Area.	L2

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Modern tool Usage**: Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Test
2. Quiz
3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4.

Initial write up	10 marks	50 marks
Conduct of experiments, results and conclusion	20 marks	
Viva- voce	20 marks	

5. **Viva-voce shall be conducted for individual student and not in a group.**

Advanced C and C++ Lab

Course Code	16ECL58	**Credits**	2
Course type	L3	**CIE Marks**	25
Hours/week: L-T-P	2 – 0 – 2	**SEE Marks**	25
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To realize the importance of modularization and develop an in-depth understanding of advanced C concepts like pointers, structures, unions and files.
2. To introduce the three pillars of Object Oriented Programmingnamely Encapsulation, Polymorphism and Inheritance and emphasize their benefits in software development.
3. To develop programming and debugging skills.

Pre-requisites: Basics of C Programming.

Unit – I — 4 + 4* Hours

Introduction: Header files and compilation process.
Functions: Designing structured programs, function in C, User defined functions, Inter function communication, standard functions, scope and Programming examples. Passing individual elements of array, passing the whole array, passing two dimensional arrays, Recursion.

Unit – II — 4 + 4* Hours

Pointers: Introduction, Pointers for inter function communication, Pointers to pointers, Compatibility, Lvalue and Rvalue. Arrays and Pointers, Pointers arithmetic and arrays, passing an array to a function, Memory allocation functions, Array of pointers, Programming applications.

Unit – III — 4 + 4* Hours

Structures and Unions: The type definition (typedef), Enumerated types, Structures, Unions, pointers to structures. Programming examples.
Files: File handling functions in C.

Unit – IV — 4 + 4* Hours

Introduction: Procedure-oriented Programming, Object-oriented programming paradigm, Basic concepts of OOP, Benefits of OOP, Object Oriented languages, Applications of OOP. Sample C++ program, Class Specification, Classes & Objects, Scope resolutionoperator, Accessing members, Defining member functions, Data hiding. Constructors, Destructors, Parameterized constructors, Data Hiding and Encapsulation.

Unit – V — 4 + 4*Hours

Functions in C++: Functions- Overloading, Passing objects as arguments,Returning objects, Arrays of objects. Introduction to Inheritance and Polymorphism, Public and Private Inheritance.

*** 8 lab sessions each of 2 hours will be covered as part of laboratory.**

List of Experiments

1) Implement a shopping cart system for an E-store in C using array of structures with the following functionalities.

i) Add item
ii) Delete an item
iii) Display items
iv) Billing information

2) Implement a simple calculator application in C. Include the modules for following

i) Read the two numbers and the operation (+, - * /)
ii) Modules for addition, subtraction, multiplication and Division
iii) Display the results

Use pointers to functions for add, subtract, multiply and divide operations.

3) Implement a simple banking application in C by making use of array of structures. Include the modules to

i) Create a new account
ii) Deposit amount
iii) Withdraw amount
iv) Balance Enquiry

4) Implement a simple inventory using data files in C. Include the modules

i) Add/Delete a new part
ii) Manufacture/Sales transaction
iii) Display a particular part
iv) Display stock of all parts

Use separate files for each of the above operations and execute them with make utility.

5) Write and execute a C++ program to read ***n*** students' details - Name, USN, and Marks in 3 subjects. Calculate and display the total, percentage and grade obtained for each student. Refer the following table for grading

>= 80 Grade is A
>=70 and <80 grade B
>=60 and <70 Grade C

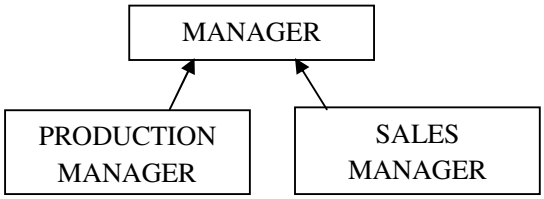
Create a STUDENT class; initialize the student details using constructors.

6) Write and execute C++ program with function overloading to calculate the area of a circle, rectangle and a triangle .

7) Write and execute a C++ program to implement the COMPLEX number class and perform the following operations:

i) Read a COMPLEX number
ii) Display a COMPLEX number.
iii) Add 2 COMPLEX numbers (use objects as function arguments).
iv) Add an integer number to one of the COMPLEX number.

8) Write and execute a C++ program to implement the following class hierarchy



Perform the following operations with the help of runtime polymorphism:

i) Read the basic salary and calculate the net salary for both PRODUCTION MANAGER and SALES MANAGER using the following details:

PRODUCTION MANAGER – HRA =10%, DA=75%, Allowance=60%

SALES MANAGER – HRA =10%, DA=75%, Allowance=20%, Travelling Allowance=80%

ii) Display the gross salary of both managers.

iii) Display the number of objects created for each class in the hierarchy using static data member.

Books

1. Computer Science-A structured Programming approach Using C.Behrouz A.Forouzan& Richard F.Gilberg,CENGAGE learning, 3rd Edition.
   [Chapters:4.1 to 4.7, 8.3,8.7,6.9,9.1-9.5,10.5-10.6,12.1-12.5,7.1-7.5]
2. Object-Oriented Programming with C++ by E. Balaguruswamy. Tata McGraw Hill, 6th Edition.[Chapter: 1.3 - 1.8]
3. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill, 2003.
   [Chapters 11,12 and 13].

Reference Books

1. Robert Lafore : Object-Oriented Programming in C++, Copyright 2002 by Sams Publications, 4thEdition and onwards.
2. Stanley B.Lippmann, Josee Lajore: C++ Primer, 4th Edition, Pearson Education, 2005 and onwards.
3. YashavantKanetkar: Let us C, 2nd Edition, BPB Publications, 2010 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Analyze given problem and develop the necessary programs using functions, pointers and structures.	L3,L5
2. Identify and demonstrate the need for Object Oriented Programming for software development.	L2
3. Design and develop software programs using OOP concepts like Encapsulation, Polymorphism and Inheritance.	L3
4. Design and develop programs for various problems with the ability to debug and fix errors/bugs.	L5,L6

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Modern tool Usage**: Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods(planned)	Assessment methods(planned)
1. Chalk and board	1. Project
2. PPT	2. Experiments
3. Video lectures	

Scheme of Continuous Internal Evaluation (CIE):

Components	Project	Experiments	Class participation	TotalMarks
Maximum Marks: 25	10	10	5	25

Minimum marks required to pass in CIE: 50% of Maximum Marks

A team of 3 students needs to formulate a problem definition in consultation with the guide for the Project component and work towards completion after approval. Project report has to be submitted by each team.

Experiments from the approved list need to be executed by the students for the Experiments component. Journal has to be submitted by each student.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hours duration and will be scaled down to 25 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40% of Maximum Marks**
3. Student has to execute one experiment based on lots. Also, the obtained experiment would be modified to test the programming and debugging skills.
4. Change of experiment is permitted only once and within the first half an hour of the commencement of the exam. A student cannot revert to the original experiment after change. 20% of the marks would be deducted for change of experiment.

Components	Experiment Write-up	Experiment Execution	Project Viva	Total Marks
Maximum Marks: 50	10	20	20	50

Design Thinking and Innovation

Course Code	16EC59	**Credits**	2
Course type	PC	**CIE Marks**	50 marks
Hours/week: L-T-P	0 – 0 – 2	**SEE Marks**	----
Total Hours:	40	**SEE Duration**	-----

Course Description:

In this course, students will learn how to apply Design Thinking to create new product and service innovations. This course intends to excite students about the power of Design Thinking with its roots in empathetic design, and—through hands-on experiences—equip them with the skills needed to use it. Students will experience the intersection of diversity, ethics/social responsibility, critical thinking and communication as they identify problems to address, craft their design challenge, engage in field research, synthesize their findings, brainstorm solutions, present their concepts, while expanding their personal/professional networks.

Course learning objectives

1. To understand the various processes and systems to address human needs by creating tangible products.
2. To pursue learners with emphasis on learning-by-doing and following a comprehensive process of design, engineering and producing products and systems.
3. To train the eye and hand in creative thinking, sharpen observational skills through site visits and case studies.

UNIT - I **4 Hours**

1. Introduction to Product Design: Introduction to the course, role of Product Design in the domain of industry, product innovation, Designer's philosophy and role in product design, What is good design?

2. Product Design Methodology : User Centered Design methods, Systems Approach, Product Design and Development Methodology, Design Thinking, Creativity and Innovation.

- Research and analysis: Question framing and conducting research, design strategy.
- Concept building: Create a Concept, Conceptualize Designs, Sketching, prototyping.
- Testing: Usability Testing, Refine and Enhance Design

Discussions shall be done with reference to some Design Case Studies.

Unit II (Branch specific):

Product Design Project (Problem Solving / Re-Design):

- Introduction to engineering design
- Problem identification and requirement specification
- Engineering design process
- System design: conceptulization, synthesize, analyze
- Documentation and writing technical reports
- Preliminary Report Submission
- Final Report Submission and presentation

The course will be organized as workshop sessions with some mini-lectures and considerable individual work. All students will be encouraged to develop their own projects of innovations using these methods.

Text Books:

1. James Garratt, Design and Technology.
2. WuciusWong, Principles of Design.
3. EskildTjalve, A Short Course in Industrial Design.
4. Francis D. K. Ching, Architecture - Form, Space and Order.
5. Virtual & Physical Prototyping, Taylor & Francis.
6. Engineering Design: A Systematic Approach, Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., 3rd Edition, 2007, XXI, 617 p., ISBN 978-1- 84628-319- 2

E-Resources:

1. http://www.ulrich-eppinger.net/
2. http://www.npd-solutions.com
3. http://www.qfdi.org
4. http://www.cheshirehenbury.com/rapid/

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Develop sketches, virtual and physical appearance models to communicate proposed designs	L2, L3
2. Ability to apply the principles of design studied in abstract to a minor project	L3
3. Refine product design considering design principles and manufacturing requirements and constraints.	L4
4. Design products using user centered design process	L6
5. Make mock-up model and working prototype along with design documentation.	L6

Program Outcome (POs)	PO No.
1. Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2
2. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3
3. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10

Course delivery methods	Assessment methods
1. Lectures	1. Report
2. PPT, Videos	2. Model making
3. Practice session	3. Presentation

Scheme of Continuous Internal Evaluation (CIE):

Components	Report	Creative Project and presentation	Mid review and Participation	Total Marks
Maximum Marks: 50	20	20	10	50
Eligibility for passing: 20 marks				

Report:
A reportshall contain thevarious aspects of the course undergone and needs to discuss the issues discussed in the course as awhole. The project report will also includethe concepts and principles used for the creative project and relate them clearly to the content of the course. Also, it should contain the relevant bibliography (at least 3-5 scholarly sources).

Creative Project:
Students will apply their insights on concepts and ideas explored in the course for designing the product or solving the industry/societal problem. The product (prototype/model) should be displayed and presented.

Mid review and Participation:
Each student will be evaluated according to their contribution to the project, level of preparedness and oral presentation.

Partial Differential Equations, Z –Transforms and Stochastic Processes
(Mech, Civ, E&C, E&E)
(ONLY FOR DIPLOMA LATERAL ENTRY STUDENTS)

Course Code	16DIPMATM51	**Credits**	5
Course type	BS	**CIE Marks**	50
Hours/week: L-T-P	4 – 1 – 0	**SEE Marks**	50
Total Hours:	50	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Get acquainted with Joint Probability Distribution.
2. Study the concept of Stochastic processes.
3. Understand the concept of Partial Differential Equations.
4. Apply Partial Differential Equations to solve practical problems.
5. Study the concept of Z transforms and its applications.

Pre-requisites:

1. Partial Differentiation.
2. Basic Probability, Probability Distribution.
3. Basic Integration.

Unit – I **10 Hours**

Joint PDF: Discrete Joint PDF, conditional Joint PDF, Expectations (Mean, Variance and Covariance).

Unit – II **10 Hours**

Stochastic Processes: Definition and classification of stochastic processes. Discrete state and discrete parameter stochastic process, Unique fixed probability vector, Regular Stochastic Matrix, Transition probability, Markov chain.

Unit – III **10 Hours**

Partial Differential Equations: Partial Differential Equations-Formation of PDE by elimination of arbitrary Constants and Functions, Solution of non homogeneous PDE by direct integration, solution of homogeneous PDE involving derivative with respect to one independent variable only.

Unit – IV **10 Hours**

Applications of Partial Differential Equations: Derivation of One dimensional Heat and Wave equations. Solutions of one dimensional Heat and Wave equations, Two dimensional Laplace equation by the method of separation of variables. Numerical solution of one dimensional Heat and Wave equations, Two dimensional Laplace equation by finite differences.

Unit –V **10 Hours**

Z -Transform: Definition, Standard Z transforms, Linearity, Damping rule, Shifting properties, Initial and Final value Theorems-Examples. Inverse Z transforms and Solution of Difference Equations by Z transforms.

Text Books

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012 and onwards.
2. P. N. Wartikar and J.N.Wartikar, "Applied Mathematics" (Volume I and II), Pune VidyarthiGrihaPrakashan, 7th Edition, 1994 and onwards.
3. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Ltd., 43rd Edition, 2006 and onwards.

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
2. Peter V. O' Neil, "Advanced Engineering Mathematics", Thomson Brooks/Cole, 7th Edition, 2011 and onwards.
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, 2010 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Apply Joint Probability Distribution to solve relevant problems.	L3
2. ApplyStochastic processes to solve relevant problems.	L3
3. Form and Solve Partial differential Equations.	L2, L3
4. Develop Heat, Wave equations.	L3
5. Apply Partial Differential Equations to solve practical problems.	L3
6. Apply Z-Transforms to solve Engineering problems.	L3

Program Outcome of this course (POs)	PO No.
1. An ability to apply knowledge of Mathematics, science and Engineering.	1
2. An ability to identify, formulate and solve engineering problems.	5
3. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	11

Course delivery methods	Assessment methods
1. Black Board Teaching	1. Internal Assessment
2. Power Point Presentation	2. Assignment
3. Scilab/Matlab/ R-Software	3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / Mathematical/ Computational/ Statistical tools	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE: Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

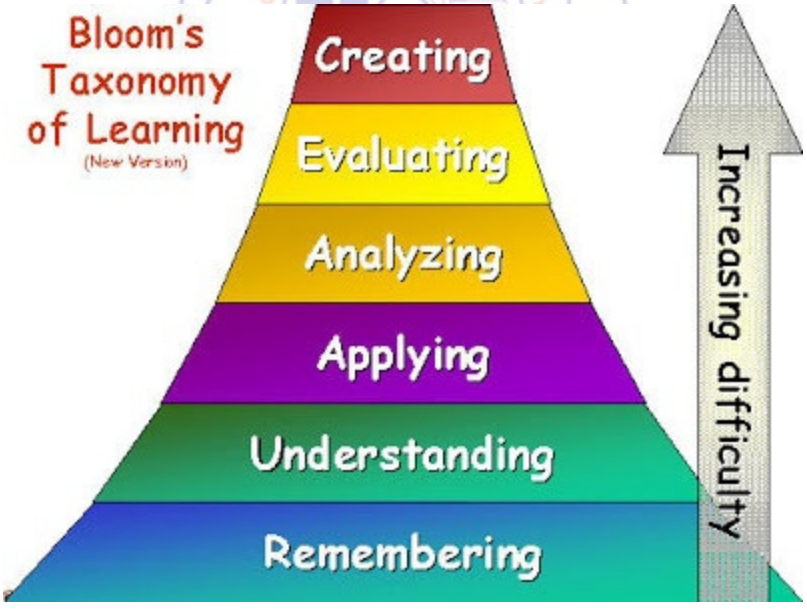
Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Bloom's Taxonomy of Learning Objectives

Bloom's Taxonomy in its various forms represents the process of learning. It was developed in 1956 by Benjamin Bloom and modified during the 1990's by a new group of cognitive psychologists, led by Lorin Anderson (a former student of Bloom's) to make it relevant to the 21st century. The **revised taxonomy** given below emphasizes what a learner "Can Do".

Lower order thinking skills (LOTS)		
L1	Remembering	Retrieve relevant knowledge from memory.
L2	Understanding	Construct meaning from instructional material, including oral, written, and graphic communication.
L3	Applying	Carry out or use a procedure in a given situation – using learned knowledge.
Higher order thinking skills (HOTS)		
L4	Analyzing	Break down knowledge into its components and determine the relationships of the components to one another and then how they relate to an overall structure or task.
L5	Evaluating	Make judgments based on criteria and standards, using previously learned knowledge.
L6	Creating	Combining or reorganizing elements to form a coherent or functional whole or into a new pattern, structure or idea.



Microwave and Antenna Engineering

Course Code	16EC62	**Credits**	3
Course type	PC1	**CIE Marks**	50
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand basic concepts of microwave transmission lines.
2. To explore network theory and components as applied microwave transmission.
3. To study various microwave active devices and their application.
4. To understand basic parameters those define an antenna.
5. To study numerous types of antennas as applied to various domains.

Pre-requisites :

5. Fields and Waves (16EC44).
6. Engineering Mathematics.

Unit – I **8 Hours**

Microwave Transmission Lines: Introduction, Transmission lines equations and solutions, Reflection and transmission coefficients, Standing waves and SWR, Line impedance and line admittance, Smith chart, Impedance matching using single stubs.
Self learning topics: Calculation of Standing Wave parameters using Smith Chart.

Unit – II **8 Hours**

Microwave Network TheoryAnd Components: Introduction, Rectangular waveguides, Symmetrical Z and Yparameters for reciprocal Networks, S matrix representation of multi portnetworks, Waveguide Tees (E, H and Magic), Directional couplers, Circulators, Isolators, Phase shifters,Attenuators.
Self learning topics:S-parameters of mismatch load.

Unit – III **8 Hours**

Microwave Diodes: Transfer electron devices: Introduction, GUNN effect diodes – GaAs diode,RWH theory, Modes of operation, Avalanche transit time devices: READdiode, IMPATT diode, BARITT diode, Parametric amplifiers, PIN diodes.
Self learning topics: Schottky barrier diodes.

Unit – IV **8 Hours**

Antenna Basics: Introduction, basic Antenna parameters, patterns,beam area, Beam efficiency, diversity and gain, antennaapertures, effective height, bandwidth, radiation efficiency, antennatemperature and antenna field zones, point sources, Power theorem, Radiation intensity, Array of two isotropic point sources, Array factor expression of 'n' isotropic point sources, End- fire array and Broadside array.
Self learning topics: Antenna Polarization.

Unit – V **8 Hours**

Antenna Types: Introduction to short electric dipole, fields of a short dipole, radiation resistance of short dipole, Small loop, loop antenna general case, far field patterns of circular loop, radiation resistance, directivity, Patch antennas, Helical Antenna, Corner reflectors, parabolic reflectors, log periodic antenna, embedded antennas, ultra wide band antennas, Intelligent antennas, antenna for remote sensing.
Self learning topics: Antenna for Mobile phones

Text Books

1. Annapurna Das andSisir K Das, "Microwave Engineering",TMHPublication, 2nd Edition, 2010and

onwards.
2. John D. Krauss,"Antennas and Wave Propagation", 4th Edition,McGraw-Hill International, 2010 and onwards.

Reference Books

1. Liao, "Microwave Devices and circuits", Pearson Education.
2. David M Pozar,"Microwave Engineering", John Wiley India Pvt.Ltd., 3rd Edition, 2008 and onwards.
3. C A Balanis,"Antenna Theory Analysis and Design", 3rd Edition,John Wiley India Pvt. Ltd, 2008 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain working of microwave transmission line and derive related equations	L2
2. Model and determine the performance characteristics of a microwave circuit	L6
3. Explain how transmission and waveguide structures and how they are used as elements in impedance matching and filter circuits.	L1
4. Design antenna arrays of various types and evaluate radiation patterns.	L6
5. Derive radiation mechanism and patterns of dipole, loop and patch antennas.	L3

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering**: Graduates shall be able to understand and applythe basics of mathematical and scientific concepts in the field of Electronics and communication Engineering.	1
2. **Engineering Cognizance:** Graduate shall be able to stay a breast with recent developments in the field of Electronics and Communication Engineering.	4
3. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
4. **Entrepreneurship:** Graduates shall imbibe project management and finance skills to pursue entrepreneurial endeavours.	10
5. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions.	11
6. **Self motivated learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Information Theory and Coding

Course Code	16EC63	**Credits**	4
Course type	PC2	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To develop a comprehensive and rigorous treatment of the fundamentals of information theory.
2. To build & understand source coding algorithms.
3. To deal with the concepts channels and channel capacity of various channels.
4. To infer basic concepts of error control coding.
5. To establish the foundation for the design and analysis of error control codes.

Pre-requisites :

4. Engineering Mathematics.
5. Digital Communication (16EC51).
6. Digital Electronics (16EC33).

Unit – I 8 Hours

Basics of Information Theory: Introduction, Measure of information, Average information content (entropy) of symbols in long independent sequences, Information rate, Logarithmic inequality, properties of entropy, Extension of zero-memory source, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source.

Lab Experiments using MATLAB:

1. Compute the entropy and entropy rate of a given discrete source.

Unit – II 8 Hours

Source Coding: Basic definitions, Encoding of the source output, Properties of codes, Prefix codes, Code efficiency and redundancy, Shannon's first theorem (Noiseless coding theorem), Shannon-Fano algorithm (binary & r-ary coding), Huffman coding (binary & r-ary coding).

Lab Experiments using MATLAB:

1. Implement source coding algorithms.

Unit – III 8 Hours

Communication Channels: Discrete communication channels, Representation of a channel, Entropy functions of a channel, Relation between entropies, Mutual information and its properties, Rate of transmission over a discrete channel, Shannon's theorem on channel capacity, Special channels, Estimation of channel capacity of special channels.

Lab Experiments using MATLAB:

1. Compute the channel capacity of given discrete channel.

Unit – IV **8 Hours**

Error Control Coding: Introduction, Methods of controlling errors, Types of errors and their sources, Types of codes to combat errors, Linear Block Codes(LBCs): Matrix description, Encoding circuit of (n,k) LBCs, syndrome and error correction, syndrome calculation circuit, Hamming weight, Hamming distance and minimum distance of LBC, Error detection and correction capabilities of LBCs, Hamming bound.

Lab Experiments using MATLAB:

1.Generate Linear Block Codes for given specifications.

Unit –V **8 Hours**

Binary Cyclic Codes: Algebraic structure of cyclic codes, Encoding using an (n-k)-bit shift register, Syndrome calculation, Error detection and correction.

Convolution Codes: Time domain and Transform domain approach of encoding.

Self learning topics: Pipeline Operation.

Lab Experiments using MATLAB:

1. Generate cyclic codes and convolutional codes for given specifications.

Text Books

1. K. Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd.
2. Shu Lin, Daniel J. Costello, "Error Control Coding", PHI, 2nd Edition, and onwards.

Reference Books

1. ITC and Cryptography, Ranjan Bose, TMH, 2nd Edition and onwards.
2. Bernard Sklar, "Digital Communication Fundamentals and Applications", Pearson Education, 2nd Edition and onwards.
3. Satyanarayana P.S., "Concepts of Information Theory & coding", Dynaram Publications, 2005 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Define, understand and explain concepts on quantification of information content in a message, entropy, and entropy rate.	L2
2. Apply the concepts of information theory and solve problems of independent and dependent information sources.	L3
3. Apply source coding algorithms to evaluate the efficiency of the source.	L3
4. Estimate the channel capacity of different classes of channels.	L4
5. Design, analyze and compare error control codes.	L5

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
5. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
6. **Self-motivated Learning:** Graduates shall continue to upgrade the skills and	12

possess the motivation for continuing education and professional growth.

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Simulations	3. Quiz
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Operating Systems

Course Code	16EC64	**Credits**	4
Course type	PC4	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To learn the evolution, key functions and structure of Operating systems.
2. To understand the mechanism of process control and concepts related to concurrency.
3. To understand deadlock prevention and avoidance mechanisms and various memory management strategies.
4. To learn the principal techniques for file organization and access.
5. To understand secondary storage structure and key aspects of system security.

Pre-requisites :

5. Computer Organization and Architecture (16EC42).

Unit –I 8 Hours

Introduction: Goals of OS, Classes of Operating systems: Batch processing OS, Multiprogramming OS, Time – sharing OS, Real – time OS, Distributed OS, Modern OS (Text 3)

Structure of Operating Systems: Policies and Mechanisms, Portability and Extensibility of Operating Systems, Operating Systems with Monolithic Structure, Layered Design of OS, Virtual Machine OS, Kernel-Based OS, Microkernel-Based OS. (Text 3)

Lab Experiment: Installing an Operating System using Virtual Machine.

Unit –II 8 Hours

Process Management: Process, Process States, Process Description, Process Control, Execution of the Operating System, Security Issues, Processes and Threads (Text 2)

Process Scheduling: Basic concepts, Scheduling criteria, scheduling algorithms. (Text 1)

Concurrency: Principles of Concurrency, Mutual Exclusion: Hardware Support, Semaphores, Monitors, Message Passing, Readers/Writes Problem (Text 2)

Lab Experiment: Simulate the following CPU Scheduling Algorithms: a) FCFS b) SJF c) Round Robin d) Priority.

Unit –III 8 Hours

Deadlock and Starvation: Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategy, Dining Philosophers Problem. (Text 2)

Memory Management: Swapping, Contiguous Memory Allocation, Paging, Segmentation, Demand Paging, Page Replacement, Allocation of Frames, Thrashing (Text 1).

Lab Experiment: a) Implement Contiguous file allocation technique b) Simulate Paging Technique of memory management c) Simulate page replacement algorithms: a) FIFO b) LRU.

Unit –IV 8 Hours

File System Interface and Implementation: File Concept, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection, File – System Structure, File– System Implementation, Directory Implementation, Allocation Methods, Free–Space Management. (Text 1)

Lab Experiment: Simulate file Allocation strategies: a) Sequential b) Indexed c) Linked.

Unit –V **8 Hours**

Secondary Storage: Disk Structure, Disk Scheduling, Disk Management (Text 1)

Computer Security: The Security Problem, User Authentication, Program Threats, System Threats. (Text 1)

Self-learning topics: Case study of Linux Operating system: Linux System, Linux history, Design Principles, Kernel modules, Process management, scheduling, Memory management, File systems, Input and output, Inter-process communications. (Text 1)

Lab Experiment: Write C programs for the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir.

Text Books

1. Silberschatz, Galvin, Gagne, "Operating System Concepts" John Wiley, 6th Edition,2004 and onwards.
2. William Stallings, "Operating Systems – Internals and Design Principles" Pearson, 6th Edition, 2012 and onwards.
3. Dhananjay M. Dhamdhere, "Operating Systems – A Concept – Based Approach", Tata McGraw – Hill, 3rd Edition, 2012 and onwards.

Reference Books

1. Elmasri, Carrick, Levine, "Operating Systems – A spiral Approach", Tata McGraw – Hill, 2012 and onwards.
2. H. M. Deitel, P. J.Deitel and David R. Choffnes, "Operating Systems". PHI, 3rd Edition and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain the key functions and structure of Operating systems	L2
2. Compare the various scheduling algorithms for process control	L3
3. Describe concepts of deadlock and starvation and illustrate paging and segmentation techniques necessary for memory management	L2, L3
4. Explain the structure of file system and examine the file implementation and access techniques	L2, L4
5. Recognize the security issues in operating systems and illustrate the working of Linux operating system	L2, L3

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering	1
2. **EngineeringCognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering	4
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures	5
4. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions	11
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth	12

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment
2. PPT's	2. Quiz
3. Videos	3. Assignment
4. Animations	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Quiz**	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE :**20					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

Minimum marks required in SEE to pass: 40

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Transducers and Sensors

Course Code	16EC65	**Credits**	4
Course type	PC4	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To provide the fundamental knowledge of transducers and sensors.
2. To understand the functional elements of instrumentation/measurement systems.
3. To understand the various physical parameters sensing and its transduction principles.
4. To gain knowledge about the feedback transducers.
5. To expose the students to industrial instrumentation.

Unit –I 8 Hours

Dynamics of Instrument Systems: Generalized Performance of Systems, Zero-order Systems, First-order Systems, Second-order Systems, Higher Order Systems, Electrical Networks, Mechanical Systems, ElectromechanicalSystems, Thermal Systems, Fluidic Systems, Filtering and Dynamic Compensation, RC Networks as Filters Dynamic Compensation.

Unit –II 8 Hours

Mechanical Transducers: Temperature Measurement, Pressure Measurement, Force Measurement, Torque Measurement, Density Measurement, Liquid-Level Measurement, Viscosity Measurement, Flow Measurement, Displacement-to-Pressure Transducer, Seismic Displacement Transducer, Basics of a Gyroscope.

Unit –III 8 Hours

Electrical Transducers: Resistive Transducers, Inductive Transducers CapacitiveTransducers,Active Electrical Transducers, Thermoelectric Transducers,Piezoelectric Transducers, Magnetostrictive Transducers, Hall-Effect Transducers, Tachometers, Photoelectric Transducers, Ionization Transducers, Digital Transducers, Electrochemical Transducers.

Unit –IV 8 Hours

Feedback Transducers: Feedback Fundamentals, Inverse Transducers,Temperature Balance System,Self-Balancing Potentiometers,Self-Balancing Bridges, Heat-Flow Balance Systems, Beam Balance Systems, Servo-Operated Manometer, Feedback Pneumatic Load Cell, Servo-Operated Electromagnetic Flow meter, Feedback Accelerometer System,Integrating Servo, Automatic Measurement of Dew Point, Non-Contact Position Measurement, Bimorph Position-Control System, Other Applications of Feedback.

Unit –V **8 Hours**

Sensor Technology:

Semiconductor Sensors, Smart Sensors, IR Radiation Sensors, Ultrasonic Sensors, Fibre Optic Sensors, Chemical Sensors, Bio Sensors, Thermometry and Thermography, Nano-Instrumentation, Condition Monitoring, Biomedical Instrumentation, Tomography, Analysis Instrumentation, Electronic Nose, Environmental Pollution Monitoring, Robotic Instrumentation,

Process Control Instrumentation:

Pharmaceutical Industries, Paper and Textile Industries, Food-Processing Industry, Aerospace Industry, Nuclear Power Industry, Bioprocess Industry, Field Instrumentation-Fieldbus.

List of Lab Experiments:

1. Characteristics of Strain gauge.
2. Characteristics of thermistor.
3. Characteristics of RTD.
4. Characteristics of LDR.
5. Characteristics of LVDT.
6. Characteristics of Piezo-electric transducer.
7. Characteristics of Hall-effect transducer.

Text Books

1. D.V.S.Murty, "Transducers and Instrumentation", 2nd Edition, PHI, 2009 and onwards.
2. A. K. Ghosh, "Introduction to Measurements and Instrumentation", 2ndEdition, PHI, 2007 and onwards.

Reference Books

1. B.C.Nakra and K.K.Choudhry, "Instrumentation Measurement and Analysis", 3rdEdition, McGraw Hill Education (India) Pvt.Ltd., 2009 and onwards.
2. Ernest O.Doeblin and Dhanesh N.Manik, "Measurement Systems Application and Design", 5th Edition, McGraw Hill, 2007 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain the basic idea of measurements and the errors associated with measurement.	L2
2. Differentiate between the types of transducers available.	L5
3. Analyze the function of various measuring instruments and using them.	L4
4. Apply feedback transducers in various systems.	L3
5. Understand modern sensor technology and industry related instrumentation.	L2

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering	1
2. **EngineeringCognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering	4
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures	5
4. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions	11
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth	12

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment
2. PPT's	2. Quiz
3. Videos	3. Assignment
4. Animations	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – II: Automotive Electronics

Course Code	16EC661	**Credits**	3
Course type	PE – II	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand the concepts of Automotive Electronics and its evolution and trends, Automotive systems and subsystems overview.
2. To understand sensors and sensor monitoring mechanisms aligned to Automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
3. To understand role of Automotive Grade Microcontrollers in ECU design and choice of appropriate Hardware and Software.
4. To understand, design and model various automotive control systems using Model based development technique.
5. To understand Safety standards, advances in autonomous vehicles, and vehicle on board and off board diagnostics.

Unit – I 8 Hours

Introduction to Automotive Systems and Design Cycle:

Automotive System: Role of technology in Automotive Electronics and interdisciplinary design tools and processes. Introduction to modern automotive systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles, Overview of Hybrid Vehicles.

Design Cycle: V-Model development cycle, Components of ECU and Examples.

Unit – II 8 Hours

Automotive Sensors and Actuators:

Systems approach to control and instrumentation: Concept of a system, Analog and Digital systems, Basic measurements systems- Automotive Sensors, Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Sensor modeling , Smart Nodes, Examples of sensors in automotive.

Actuators – Examples of actuators in automotive- solenoid and motor based.

Unit – III 8 Hours

Microcontrollers/Microprocessors in Automotive domain, Communication protocols:

Microcontrollers/Microprocessors in Automotive domain: Review of microprocessor, microcontroller and digital signal processor development, Criteria to choose the right microcontroller/processor for automotive applications, Automotive grade processors.

Communication Protocols: Overview of Automotive communication protocols: CAN, LIN, Flex Ray, MOST, Ethernet, D2B and DSI.

Unit – IV 8 Hours

Automotive Control Systems and Model Based Development:

Automotive Control System: Control system approach in Automotive (State variables approach only):Analog and Digital control methods, modelling of linear systems, System responses. Modelling of Automotive Systems simple examples (PID tuning by Zeigler-Nichols Method).

Model based Development: Model-Based Design for a small system, Explore the system response using different control methods, Study of modelling and simulation of any one of the Automotive systems.

Self learning Topics: Laplace and Z- Transforms, MATLAB/ Simulink and SIMSCAPE tool boxes.

Unit –V 8 Hours

Safety Systems in Automobiles and Diagnostic Systems:

Active Safety Systems: ABS, TCS, ESP, Brake assist etc

Passive Safety Systems: Airbag systems, Advanced Driver Assistance Systems (ADAS), Examples of assistance applications.

Functional Safety: Need for safety systems, safety concept, safety process for product life cycle, Safety by design, Validation.

Diagnostics: On board and off board diagnostics in Automobiles, Diagnostic tools, Diagnostic protocols.

Text Books

1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Newness Publication, An imprint of Elsevier Science, 2003 and onwards.
2. Ronald K Jurgen, "Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 1999 and onwards.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 5th Edition and onwards.

Reference Books

1. Tom Denton, "Advanced Automotive Diagnosis, 2nd Edition, Elsevier, 2006 and onwards.
2. Allan Bonnick, "Automotive Computer Controlled Systems: Diagnostic Tools andTechniques", Elsevier Science, 2001 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Describe different concepts of Automotive Electronics and its evolution and trends, Automotive systems & subsystems overview.	L2
2. Explain sensors, actuators and sensor monitoring mechanisms aligned to Automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.	L1
3. Explain role of Automotive Grade Microcontrollers in ECU design and choice of appropriate Hardware and Software.	L2
4. Design and model various automotive control systems using Model based development technique.	L5
5. Describe Safety standards, advances towards autonomous vehicles, and vehicle on board and off board diagnostics.	L2

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Social Engineering:** Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions.	3
4. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
5. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
6. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Workshop	3. Quiz
4. Activity	4. Mini Project

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – II: Requirements Engineering

Course Code	16EC662	**Credits**	3
Course type	PE – II	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To explain the importance of linking requirements to the Business Case.
2. To describe the roles and responsibilities of key stakeholders in the requirements engineering processes.
3. To explain the use of a range of requirements elicitation techniques and the relevance of the techniques to business situations.
4. To describe the use of tools to support Requirements Engineering.
5. To identify problems with requirements and explain how requirements documentation may be improved.

Unit – I **8 Hours**

Introduction to Requirements Engineering: Framework for Requirements Engineering, Requirements Engineering activities – Elicitation, Analysis, Validation,
Documentation, Management, Rationale for Requirements Engineering and the problems with requirements, The importance of requirements planning and estimating, The business rationale and inputs, The business case, Terms of Reference / Project Initiation Document (PID).

Unit – II **8 Hours**

Hierarchy of requirements: Building the hierarchy, Categories of requirements within the hierarchy
Stakeholders in the requirements process: Project Stakeholders, Business Stakeholders, External stakeholders.

Unit – III **8 Hours**

Requirements Elicitation: Knowledge types – tacit and non-tacit, Elicitation techniques, Understanding the applicability of techniques.
Use of models in Requirements Engineering: The purpose of modelling requirements, Modelling the business context for the system, Developing a model to represent the system processing requirements, Interpreting a data model.

Unit – IV **8 Hours**

Requirements Documentation: Documentation styles and levels of definition, Requirements Catalogue.
Requirements Analysis: Prioritizing and packaging requirements for delivery, Organizing requirements, Ensuring well-formed requirements, Prototyping requirements, Verifying requirement.

Unit –V **8 Hours**

Requirements Validation: Agreeing the requirements document, Types of reviews, Stakeholders and their areas of concern.
Requirements Management: Dealing with changing requirements, The importance of traceability, Traceability and ownership, Requirements Engineering support tools.

Text Books

1. Debra Paul, Donald Yeates and James Cadle, Business Analysis, 2nd Edition, BCS Publisher, 2010 and onwards.
2. Suzanne Robertson and James Robertson, "Mastering the Requirements Process", Addison Wesley, 1999 and onwards.
3. Alistair Cockburn, "Writing Effective Use Cases", Addison-Wesley, 2000 and onwards.

Reference Books

1. Gerald Kotonya and Ian Sommerville, "Requirements Engineering: Processes and Techniques", John Wiley & Sons.
2. James Cadle, Debbie Paul and Paul Turner, "Business Analysis Techniques: 72 Essential Tools for Success", BCS.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Analyze, prioritize and organize elicited requirements	L5
2. Explain the use of a range of requirements elicitation techniques and the relevance of the techniques to business situations	L2
3. Explain the process and stakeholders involved in Requirements Validation	L2
4. Explain documentation methods required to analyze requirements.	L2, L4
5. Describe the principles of Requirements Management and explain the importance of managing requirements	L5

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Social Engineering:** Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions	3
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering	4
4. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Activity	3. Quiz
	4. Seminar

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage

shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – II: Consumer Electronics

Course Code	16EC663	**Credits**	3
Course type	PE – II	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To sketch and describe operating principles of different types of microphones.
2. To learn various components of composite video signal and differentiate betweenhue, brightness, saturation, luminance and chrominance.
3. To acquaint with various devices related to telecommunication system.
4. To describe working of Washing machine, Digital Camera system, Microwave ovens with sketches of block diagram.
5. To understand the working principles of various consumer electronic devices.

Pre-requisites :

1. Basic Electronics Engineering (15ELN15/25).
2. Elements of Electrical Engineering (15ELE13/23).

Unit – I 8 Hours

Audio System: Microphones, Tape recorder, Audio compact disc system, High fidelity Audio system, Stereo soundsystem, Loudspeaker, Public address system, Magnetic sound recording.

Unit – II 8 Hours

Television: Introduction, Radio and TV Transmission & Reception, Block diagram of TV transmitter, Televisionstudies and Equipment, Antenna for TV transmitter, Block diagram of TV receiver, TV camera tube,Persistence of vision, Scanning, Synchronization, CCTR-B System, Composite video signal, Bandwidth of TV signal, Audio signal modulation, TVchannel, Television Rx antenna, Feeder cable,Balun T/F, Monochrome picture tube, Black & white TV Rx, Colour TV signal, Colour TV Rx, PAL, NTSC, SECAM signal, compatibility, CCTV, Cable TV, HDTV.

Unit – III 8 Hours

Telecommunication Systems: Basics of Telephone system, Caller ID Telephone, Intercoms, Cordless Telephones, Cellular mobile systems.

Unit – IV 8 Hours

Home Electronics: Digital Camera system, Microwave ovens, Washing Machines, Air Conditioners and Refrigerators.

Unit –V 8 Hours

Miscellaneous Devices: Digital watch, Calculators, An electronic guessing game, Cordless Telephone, Mobile telephone, Cellular telephone, Battery telephone, Battery Eliminator, Battery charger, DC supply, DC supply operational amplifier, IC regulator, UPS, Inverter, Decorative Lighting, Microwave oven, LCD tunes with alarm.

Text Books

1. S.P. Bali, Consumer Electronics,Pearson Education, 2005 and onwards.
2. R. R. Gulati, “Monochrome and Color Television”, New Age International Publisher, 2009 and onwards.
3. B.R. Gupta and V. Singhal, “Consumer Electronics”, S.K. Kataria& Sons, 2013 and onwards.

Reference Books

1. A.Dhake, "Color Television", McGraw Hill Education, 2004, 2nd Edition and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. List technical specification of electronics Audio system (microphone and speaker).	L1
2. Trouble shoots consumer electronics products like TV, washing machine and AC.	L5
3. Identify and explain working of various colour TV transmission blocks.	L4
4. Understand various functions of Cam coder and shoot a video and take snapshots and save them in appropriate format.	L2
5. Understand the basic functions of various consumer electronic goods.	L2

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments**: Graduates shall imbibe the professional and ethical responsibilities of their profession.	2

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz
4. Notes	4. Mini Project

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – II: Heterogeneous Computing

Course Code	16EC664	**Credits**	3
Course type	PE – II	**CIE Marks**	50 marks
Hours/week: L-T-P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	35	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. To better undersand the world heterogeneous computers in general and of the solutions provided by OpenCL in particular.
2. To present introductory concepts of parallel computing.
3. To leverage the OpenCL framework to build interesting and useful applications and explore the full benefits of heterogeneous computing.

Pre-Requisites:

1. Advanced C & C++ (16ECL58).

Unit - I — 8 Hours

Introduction to Parallel Programming: Introduction, Thinking Parallel, Concurrency And Parallel ProgrammingModels, Threads And Shared Memory, Message-Passing Communication, Different Grains Of Parallelism, Data Sharing And Synchronization.

Introduction to OpenCL: The OpenCL Standard, Platform and Devices,The Execution Environment, Memory Model, Writing Kernels,Source CodeExample for Vector Addition

Unit - II — 8 Hours

OpenCL Device Architectures:Introduction, Hardware Trade-offs: Performance increase by frequency and its limitations, Superscalar Execution, ,VLIW, SIMD and Vector Processing, Hardware Multithreading , Multi-Core Architectures, Integration: Systems-On-Chip and The Apu , Cache Hierarchies and Memory Systems , The Architectural Design Space: CPU Designs, GPU Architectures, APU and APU-Like Designs.

Unit - III — 8 Hours

Basic OpenCL Examples: Introduction, Simple Matrix Multiplication Example, Image Rotation Example, Image Convolution Example, Compiling OpenCL Host Applications.

Unit – IV — 8 Hours

OpenCL's Concurrency and Execution Model: Kernels, Work-Items, Workgroupsand the Execution Domain, OpenCL Synchronization: Kernels, Fences and Barriers, Queuing and Global Synchronization, The Host-Side Memory Model, The Device-Side Memory Model.

Self learning topics: Memory Performance Considerations in OpenCL

Unit – V — 8 Hours

OpenCL Case Study:Video Processing: Introduction, Getting Video Frames: Decoding on the CPU, Decoding Video on the GPU, Processing avideo in OpenCL, Processing Multiple Videos with multiple special effects: Event Chaining, Display to screen of final output: OpenCL/OpenGL Interoperability.

Self learningtopics: Debugging OpenCL Applications, Overview Of Gdebugger,

Text Books

1. Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, "Heterogeneous Computing with OpenCL", MGH, 2011 and onwards.
2. Jason Sanders, Edward Kandrot, "CUDA By Example – An Introduction to General-Purpose GPU Programming", Addison Wesley, 2011 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand the meaning and the importance of heterogeneous systems	L2
2. Develop software to support general-purpose heterogeneous systems	L5
3. Leverage the power and flexibility of the OpenCL programming standard	L3

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures	5
4. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth	12

Course delivery methods	Assessment methods
1. Chalk / Blackboard	1. Assignments
2. Presentations	2. Internal Assessment Tests
3. Demonstrations	3. Quiz
4. Videos	4. Seminar

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Microwave and Antenna Lab

Course Code	16ECL67	**Credits**	2
Course type	L1	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To have detailed study on microwave equipments and microstrip components.
2. To understand the conceptsand principles of microwave engineering.
3. To gain knowledge on operation of different microwave devices.
4. To explore characteristics of an antenna.

List of experiments

Part – A (Hardware)

0. (a) Study of microwave instruments,
   (b) Study of waveguide and microstrip components,
   (b) Study of reflex klystron characteristics
1. Characteristics of Gunn Oscillator and Gun diode as modulated source
2. (a) Isolation and coupling coefficient of E, H and Magic Tee
   (b) Measure Coupling coefficient, Insertion loss and Directivity of a Directional Coupler
3. (a) Characteristics of a Power Divider (PD) in microstrip Power Division and Isolation Characteristic
   (b) To measure the standing wave ratio and reflection coefficient in a microwave transmission line
4. Measurement of resonance characteristics of a microstrip ring resonator and determination of dielectric constant of the substrate
5. To measure the frequency of a microwave source and demonstrate relationship among guide dimensions, free space wavelength and guide wavelength
6. Measurement of directivity and gain of standard dipole microstrip patch antenna and Yagi antenna (printed)

Part – B (Software)

1. MATLAB program to plot two-dimensional (2-D) polar and semipolar patterns
2. MATLAB program to calculate the:
   (a) Radiated power (b) Maximum directivity (dimensionless and in dB) of any antenna.
3. MATLAB program to computes the:
   (a) Maximum directivity (dimensionless and in dB)
   (b) Radiation resistance (Rr)
   (c) Normalized current distribution
   (d) Directivity pattern (in dB) in polar form
   (e) Normalized far-field amplitude pattern (E-theta, in dB) in polar form for a symmetrical dipole of finite length.
4. MATLAB program to computes the:
   (a) Maximum directivity (dimensionless and in dB)
   (b) Radiation resistance (Rr)
   (c) Normalized current distribution
   (d) Directivity pattern (in dB) in polar form
   (e) Normalized far-field amplitude pattern for a circular loop (with constantcurrent).
5. MATLAB program that computes the radiation characteristics of:
   (a) Linear Arrays(Uniform & Broadside Non-uniform)
   (b) Planar Array (Broadside Uniform)
6. Simulation of a 2.4 GHz Patch Antenna using IE3D

Text Books

1. Annapurna Das andSisir K Das, "Microwave Engineering",TMHPublication, 2nd Edition, 2010 and onwards.
2. John D. Krauss,"Antennas and Wave Propagation", 4thEdition,McGraw-Hill International, 2010 and onwards.

Reference Books

1. Liao, "Microwave Devices and circuits", Pearson Education.
2. David M Pozar,"Microwave Engineering", John Wiley India Pvt.Ltd., 3rdEdition, 2008 and onwards.
3. C A Balanis,"Antenna Theory Analysis and Design", 3rdEdition,John Wiley India Pvt. Ltd, 2008 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand basic principles involved in microwave engineering.	L2
2. Analyze the performance of waveguides and resonators.	L5
3. Apply computational tools to study the performance of various antennas.	L3
4. Evaluate antenna performance parameters using simulation tool.	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Soft skills:** Graduates shall possess proficiency in oral and written communication skills.	9
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Test
2. Quiz
3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**

2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4.

Initial write up	10 marks	50 marks
Conduct of experiments, results and conclusion	20 marks	
Viva- voce	20 marks	

5. **Viva-voce shall be conducted for individual student and not in a group.**

Data Structures Lab

Course Code	16ECL68	**Credits**	2
Course type	L2	**CIE Marks**	25
Hours/week: L-T-P	2 – 0 – 2	**SEE Marks**	25
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand the abstract data types stack, queue, and list.
2. To understand prefix, infix, and postfix expression formats.
3. To be able to recognize problem properties where stacks, queues, lists and trees are appropriate data structures.
4. To understand the implementation of trees and searching-sorting algorithms.
5. To be able to implement the ADTs stack, queue, and lists using 'C'.
6. To understand the performance of the implementations of basic linear data structures.

Pre-requisites : Programming in C.

Unit – I — 8 Hours

The Stack: Definition and Examples **-** Primitive operations, the stack as an abstract data type, representing Stack in C – Implementing the push and pop operation. Infix, Postfix and Prefix – Basic Definition and Examples, Evaluating a Postfix Expression

Lab Experiments:

1. To write a menu driven program to perform following operations on the stack**-** (i)Push (ii) Pop
2. Program to Evaluate a Postfix Expression, converting an expression from infix to postfix.

Unit – II — 8 Hours

Recursion: Recursive definition and processes.

Lab Experiments:

1. Writing program to calculate Factorial, Fibonacii numbers.
2. Writing recursive programs to translate from Prefix to postfix using Recursion.

Unit –III — 8 Hours

Queue and Lists:

The Queues and its sequential Representation. Implementation of Queue, insert operation, Priority Queues

Linked Lists – Inserting and Removing Nodes from a list, Linked implementation of stacks, getnode and freenode operations.

Lab Experiments:

1. To perform queue operations on the menu**-**

(i) Insert (ii) Delete (iv) Display.

2. To write program to create linked list and perform the following function

a) Insertion b) Deletion c) Searching d) Display

Unit – IV — 8 Hours

Trees: Binary Trees – Operations on binary trees, Applications of binary trees

Binary tree Representations – Node Representation of binary trees, Internal and external nodes, binary tree traversal in C, Threaded binary trees, Heterogeneous Binary trees.

Lab Experiments:

1. Design, Develop and Implement a menu driven Program in C for the following operations on BinarySearch Tree (BST) of Integers:
   a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2.
   b. Traverse the BST in Inorder, Preorder and Post Order.
   c. Search the BST for a given element (KEY) and report the appropriate message.

d. Delete an element (ELEM) from BST.
e. Exit.

Unit –V **8 Hours**

Sorting & Searching: Sorting – Bubble sort, quick sort, Merge sort, Radix sort
Searching - Linear search, Binary search.

Lab Experiments:

1. To arrange the numbers in ascending order using Bubble sort.
2. To arrange the numbers in ascending order using Quick sort.
3. To search a element in an array using linear search.
4. To search a element in an array using Binary search.

Text Books

1. Yedidyah, Augenstein, Tannenbaum, "Data Structures Using C and C++",2nd Edition, Pearson Education, 2003 and onwards.
2. Horowitz, Sahni and Anderson-Freed,"Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2007 and onwards.

Reference Books

1. DebasisSamanta,"Classic Data Structures", 2nd Edition, PHI, 2009 and onwards.
2. Richard F. Gilberg and Behrouz A. Forouzan,"Data Structures: A Pseudocode Approach with C".

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Define basic static and dynamic data structures and relevant standard algorithms for them: stack, queue, dynamically linked lists, trees, graphs, heap, priority queue, hash tables, sorting algorithms, min-max algorithm.	L1, L2
2. Select basic data structures and algorithms for autonomous realization of simple programs or program parts.	L3
3. Analyze and demonstrate bugs in program, recognize needed basic operations with data structures.	L4
4. Formulate new solutions for programming problems or improve existing code using learned algorithms and data structures.	L3
5. Demonstrate advantages and disadvantages of specific algorithms and data structures.	L2

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Blackboard and chalk	1. Internal Assessment Test
2. PPT	2. Assignment
3. Video	3. Quiz
4. Demonstration	4. Seminar

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4. Initial write up 10 marks

   Conduct of experiments, results and conclusion 20 marks

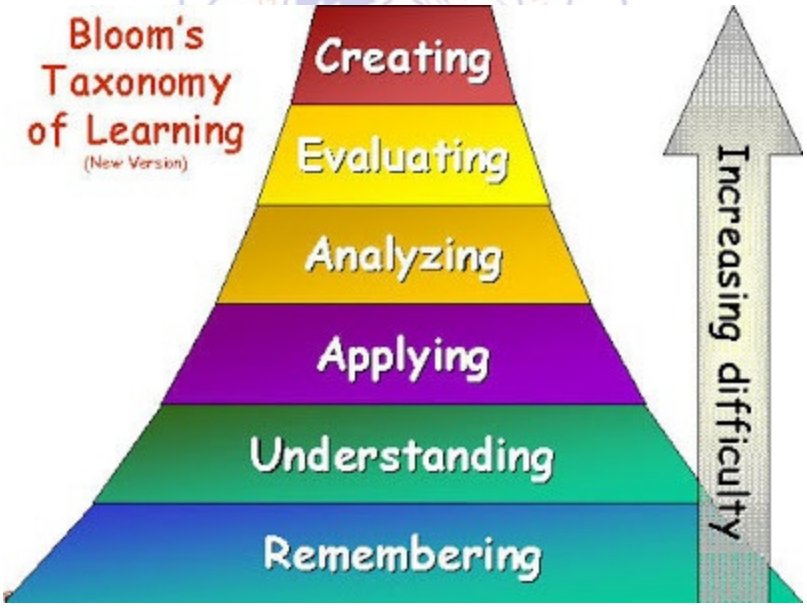
   Viva- voce 20 marks

   50 marks
5. **Viva-voce shall be conducted for individual student and not in a group.**

Bloom's Taxonomy of Learning Objectives

Bloom's Taxonomy in its various forms represents the process of learning. It was developed in 1956 by Benjamin Bloom and modified during the 1990's by a new group of cognitive psychologists, led by Lorin Anderson (a former student of Bloom's) to make it relevant to the 21st century. The **revised taxonomy** given below emphasizes what a learner "Can Do".

Lower order thinking skills (LOTS)		
L1	Remembering	Retrieve relevant knowledge from memory.
L2	Understanding	Construct meaning from instructional material, including oral, written, and graphic communication.
L3	Applying	Carry out or use a procedure in a given situation – using learned knowledge.
Higher order thinking skills (HOTS)		
L4	Analyzing	Break down knowledge into its components and determine the relationships of the components to one another and then how they relate to an overall structure or task.
L5	Evaluating	Make judgments based on criteria and standards, using previously learned knowledge.
L6	Creating	Combining or reorganizing elements to form a coherent or functional whole or into a new pattern, structure or idea.



Computer Communication Networks

Course Code	16EC71	**Credits**	3
Course type	PC1	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To study the OSI model, Layers in OSI &Internet Architecture.
2. To comprehend the different flow and multiple access techniques and protocols.
3. To study and compare different IEEE standards for wired and wireless LAN's.
4. To get familiar with networking devices and IPv4 and IPv6 addressing schemes.
5. To gain knowledge about routing, forwarding of data and DNS.

Unit – I 8 Hours

Introduction: Data Communications, Networks, Internet, Protocols and Standards, OSI Model, Layers in OSI model, TCP/IP Suite, Addressing.

Unit – II 8 Hours

Data Link Control: Framing, Flow and error controlProtocols, Noiseless channels and noisy channels, HDLC, Multiple Access:Random access, Controlled access, Channelization.

Unit – III 8 Hours

Wired LAN, Ethernet,IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11.

Unit – IV 8 Hours

Connecting devices, Back bone Networks, Virtual LANs,**Network Layer**: Logical addressing, Ipv4 addresses, Ipv6 addresses.

Unit –V 8 Hours

Unicast Routing Protocols, Multicast Routing protocols. Transport layer Process to process Delivery, UDP, TCP, Domain name system, Resolution.

Text Books

1. Behrouz A Forouzan, "Data Communication and Networking", Tata McGraw-Hillblishing Company Limited, Indian Edition, 2006 and onwards.

Reference Books

1. Larry L. Peterson and Bruce S. Devie, Computer Networks, Morgan Kaufmann Publications, 5th Edition and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Compare and contrast the OSI and TCP/IP architecture suite.	L5
2. Apply knowledge of Flow control in general to data networks.	L3
3. Understand the significance of standards in the networking industry and analyze wired and wireless LAN architectures.	L2
4. Design networks using the knowledge of IPV4 and IPV6 addressing.	L6
5. Compare the different Routing and Forwarding protocols and structure of the DNS.	L5

	Program Outcome of this course (POs)	PO No.
1.	**Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2.	**Design of Experiment:** Graduates shall possess the ability to design and conduct experiments, analyze and interpret data.	2
3.	**Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Wireless and Mobile Communication

Course Code	16EC72	**Credits**	4
Course type	PC2	**CIE Marks**	50
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To enable the student to understand the various generations of wireless communications and different components of cellular communication.
2. To enable the student to understand the different techniques of cellular communication.
3. To enable the student to understand channel concept and call establishment in GSM and CDMA techniques.
4. To enable the student to understand different wireless protocols and standards.
5. To enable the student to understand different wireless protocols and standards for IoT.

Pre-requisites :

7. Basics of electronic Communication.

Unit – I **8 Hours**

Introduction to wireless telecommunication systems and Networks: History and Evolution Different generations of wireless cellular networks 1G, 2G,3G , 4G and 5G networks.
Common Cellular System and Cellular network components, Hardware and software, Views of cellular networks, 3G cellular systems components, Cellular component identification, Call establishment.

Unit – II **8 Hours**

Wireless network architecture and operation: Cellular concept Cell fundamentals, Capacity expansion techniques, Cellular backbone networks, Mobility management.
GSM and TDMA techniques, GSM system overview, GSM Network and system Architecture, GSM channel concepts, TDMA Frames.

Unit – III **8 Hours**

GSM system operation: Traffic cases, Cal handoff, Roaming, TDMA systems, CDMA technology, CDMA overview, CDMA channel concept CDMA operations.

Unit – IV **8 Hours**

Introduction to wireless LAN 802.11X technologies: Evolution of Wireless LAN Introduction to 802.15X technologies in PAN Application and architecture Bluetooth Introduction to Broadband wireless MAN, 802.16X technologies.

Unit – V **8 Hours**

Networking Protocols and Standards for Internet of Things:IEEE 802.11ah,Z-ave,HomePlug,RPL, Security Protocols: 6LoWPAN, MQTT SMQTT,CoAP and AMQP.

Text Books

1. Mullet, "Wireless Telecom: Systems and networks", Thomson Learning, 2006 and onwards.
2. Oliver Hersent,David Boswatrhick and Omar Elloumi,"The Internet of Things Applications and Protocols", Willey India Pvt. Ltd.
3. V.Madisetti and A. Bahga,"IoT:A hands on approach", Learning, 2004 and onwards.

Reference Books

1. Lee W.C.Y,"Mobile Cellular Telecommunication", MGH, 2nd Edition, 2009 and onwards.
2. D P Agrawal,"Wireless communication, 2nd Edition, Thomson learning 2007 and onwards.
3. David Tse and Pramod Viswanath,"Fundamentals of Wireless Communication", Cambridge 2005and onwards.
4. S. S. Manvi, M. S. Kakkasageri, "Wireless and Mobile Network concepts and protocols", John Wiley India Pvt. Ltd, 1st Edition, 2010and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Identify and describe different generations of wireless communication.	L1, L2
2. Analyze the different Techniques of cellular communication.	L4
3. Compare different channel concepts in GSM and CDMA.	L2
4. Analyze and Compare Wireless Protocols and Standards.	L4, L5
5. Analyze and Compare IoT Protocols and Standards.	L4, L5

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering**: Graduates shall be able to understand and applythe basics of mathematical and scientific concepts in the field of Electronics and communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
5. **Entrepreneurship:** Graduates shall imbibe project management and finance skills to pursue entrepreneurial endeavours.	10
6. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

GPS and IoT

Course Code	16EC73	**Credits**	4
Course type	PC3	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To introduce to the basics of Global Positioning System.
2. To explore various positioning modes in GPS.
3. To study ambiguity resolution techniques.
4. To introduce the concepts of internet of things.
5. To explore the applications of IoT.

Unit – I — 8 Hours

Introduction to GPS: Historical Review, Overview of GPS, GPS Segments, GPS Satellite Generations, Current GPS Constellation, Control Sites, GPS: the Basic Idea, GPS Positioning Service, Why Use GPS?

GPS Details: GPS Signal Structure, GPS Modernization, Types of GPS Receivers, Time Systems,Pseudorange Measurements, Carrier-Phase Measurements, Doppler Measurements, Cycle Slips, Linear Combinations of GPS Observables.

List of Experiments:

1. With the help of a hand-held GPS, determine Planimetric coordinates and elevations of various points.
2. Create Routes in a GPS receiver:Datums, Entering coordinates, Making a route.

Unit – II — 8 Hours

GPS Errors and Biases: GPS Ephemeris Errors, Selective Availability, Satellite and Receiver Clock Errors, Hardware Delay, Multipath Error, Antenna Phase Center Variations, Receiver Measurements Noise, Ionospheric Delay, Tropospheric Delay, Satellite Geometry Measures, GPS Mission Planning, User Equivalent Range Error.

GPS Positioning Modes: GPS Point Positioning, Precise Point Positioning, GPS Relative Positioning, Static GPS Surveying, Fast (Rapid) Static, Stop & Go GPS Surveying, RTK GPS, Real-Time Differential GPS, Real-Time vs. Post processing, Communication (Radio) Link.

List of Experiments:

1. Navigation using a GPS receiver:Compass function, Route, Tracks, Backtracking.
2. Making maps: Plotting points collected from the GPS receiver, Data transfer.

Unit –III — 8 Hours

Ambiguity Resolution Techniques: Antenna Swap Method. On-the-Fly Ambiguity Resolution, The LAMBDA Method, GPS Data and Correction Services – GPS Data Service, Precise GPS Orbit and Clock Service, DGPS Radio Beacon Systems, Wide-Area DGPS Service, Wide Area Augmentation System (WAAS), European Geostationary Navigation Overlay System (EGNOS), Multi-site Real-Time Kinematic (RTK) System.

List of Experiments:

1. Google Earth (GE) and Online Data: Navigating in GE, Using GE to obtain coordinates, Other data sources (eg. USGS).

Unit –IV — 8 Hours

The Third ICT Wave: Rise of the machines, The IoT Kaleidoscope, Defining Internet of Things, IoT: A Web 3.0 View.

Ubiquitous IoT Applications: A Panoramic View of IoT Applications, Important Vertical IoT Applications.

Unit - V **8 Hours**

Four Pillars of IoT: The Horizontal, Verticals, and Four Pillars, M2M: The Internet of Devices, RFID: The Internet of Objects, WSN: The Internet of Transducers, SCADA: The Internet of Controllers.

The DNA of IoT: DCM: DCM: Device, Connect, and Manage, Device: Things That Talk, Connect: Via Pervasive Networks (Wired Networks, Wireless Networks, Satellite IoT), Manage: To Create New Business Value.

List of Experiments:

1. Start Raspberry Pi and try various Linux commands in command terminal window.
2. Run some python programs on Pi.
3. Implement an intruder system that sends an alert to the given email.
4. Get the status of a bulb at a remote place (on the LAN) through web.

Books

1. Ahmed El-Rabbany, "Introduction to GPS", Artech House.
2. G S Rao, "Global Navigation Satellite Systems: With Essentials of satellite communications", TMH.
3. Honbo Zhou, "The Internet of Things in the Cloud".

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain the concepts of global positioning system.	L2
2. Enumerate various GPS ambiguity resolution techniques.	L3
3. Analyze navigation techniques to obtain geographical coordinates.	L2, L4
4. Understand the basic concepts of internet of things in modern world applications.	L2
5. To implement the concepts of GPS and IoT to solve real life problems	L6

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering	1
2. **EngineeringCognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering	4
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures	5
4. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions	11
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth	12

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment
2. PPT's	2. Quiz
3. Videos	3. Assignment
	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Optical Fiber Communication

Course Code	16EC74	**Credits**	4
Course type	PC4	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors. Design optimization of SM fibers, RI profile and cut-off wave length.
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes and different fiber amplifiers.
4. To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.
5. To learn fiber splicing and connectors, noise effects on system performance, operational principles WDM and solutions.

Unit –I 8 Hours

Introduction to Optical Fibers: Evolution of fiber optic system, Element of an Optical Fiber Transmission link, Ray Optics, Optical Fiber Modes and Configurations, Mode theory of Circular Wave guides, Overview of Modes-Key Modal concepts, Linearly Polarized Modes, Single Mode Fibers-Graded Index fiber structure.

Lab Experiments:

1. Measurement of Numerical Aperture.
2. Measurement of Power Launching into the Fiber.

Unit –II 8 Hours

Signal Degradation Optical Fibers: Attenuation, Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling -Design Optimization of SM fibers-RI profile and cut-off wavelength.

Lab Experiments:

1. Measurement of Spectral Attenuation.
2. Measurement of Fiber Loss.

Unit –III 8 Hours

Fiber Optical Sources and Coupling: Direct and indirect Band gap materials, LED structures, Light source materials, Quantum efficiency and LED power, Modulation of a LED, lasers Diodes, Modes and Threshold condition, Rate equations, External Quantum efficiency, Resonant frequencies, Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers, Power Launching and coupling, Lensing schemes, Fiber -to- Fiber joints, Fiber splicing.

Lab Experiments:

1. Setting up an Analog Fiber link for Optical Fiber System.
2. Characterization of Sources for Optical Fiber Systems.

Unit –IV 8 Hours

Fiber Optical Receivers: PIN and APD diodes, Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Comparison of Photo detectors, Fundamental Receiver Operation,Preamplifiers, Error Sources, Receiver Configuration, Probability of Error, Quantum Limit.

Lab Experiments:

1. Characterization of Detectors for Optical Fiber Systems.
2. Wavelength Multiplexing in an Optical Fiber.

Unit –V **8 Hours**

Digital Transmission System: Point-to-Point links System considerations, Link Power budget, Rise - time budget, Noise Effects on System Performance, Operational Principles of WDM, Solitons-Erbium-doped Amplifiers, Basic on concepts of SONET/SDH Network.

Self study topics: Analog Transmission System, Wavelength Division Multiplexing**.**

Lab Experiments:

1. Optical Link Design.
2. An Optical Fiber Acoustic Sensor.

Text Books

1. Gerd Keiser, "Optical Fiber Communication" McGraw -Hill International, Singapore, 3rd Edition, 2000 and onwards.

Reference Books

1. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 1994 and onwards.
2. J.Gower, "Optical Communication System", Prentice Hall of India, 2001 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Recognize and classify the structures of Optical fiber and types.	L2
2. Discuss the channel impairments like losses and dispersion.	L2
3. Analyze various coupling losses.	L4
4. Classify the Optical sources and detectors and to discuss their principle.	L4, L5
5. Familiar with Design considerations of fiber optic systems.	L1
6. To perform characteristics of optical fiber, sources and detectors, design as well as conduct experiments in software and hardware, analyze the results to provide valid conclusions.	L5, L6

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **EngineeringCognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures	5
5. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions	11
6. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth	12

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment

2. PPT's
3. Videos

2. Quiz
3. Assignment
4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – III: Electronic System Design

Course Code	16EC751	**Credits**	3
Course type	PE – III	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Understand the importance of SystemC in designing a system.
2. Understand the modeling of systems above the Register transfer Level of abstraction.
3. Understand functional modeling and requirement of intellectual property.
4. To understand the need of communication and synchronization in systems through interfaces and channels.
5. Understanding the process of refinement and the need for testing and debugging the system.

Pre-requisites :

1. Computer Organization and Architecture (16EC41).
2. Computer Programming in C (16CCP14/24).

Unit –I **8 Hours**

Fundamentals of SystemC: Modules, Interfaces, Ports and channels, Processes, Events, Sensitivity, Event finder, Module and channel instantiation.

Unit –II **8 Hours**

Models of Computation: Introduction, RTL model of computation, Kahn process networks, Static dataflow, Transaction-Level models.

Classical Hardware modeling with SystemC: Introduction, Register transfer level modeling, Behavioral-level modeling, Hardware oriented data types.

Unit –III **8 Hours**

Functional Modeling: Untimed functional models – dataflow, Timed functional model, Stopping a dataflow simulation.

Parameterized Modules and Channels: Introduction, Forms of parameterization, Parameterized design examples, Protecting intellectual property.

Unit –IV **8 Hours**

Interface and Channel Design: Introduction, Interface design, Primitive versus hierarchical channels, Primitive channel examples, Hierarchical channel examples.

Unit –V **8 Hours**

Communication Refinement: Steps in refinement process, Hardware-hardware communication refinement, Software-software communication refinement.

Test benches, Tracing and Debugging: Introduction, Test benches, Tracing, Debugging.

Self learning topics: Hardware-software communication interface.

Lab Experiments:

All experiments to be conducted using SystemC

1. Combinational logic modeling.
2. Sequential logic modeling.
3. Memories in SystemC.
4. FSM design.
5. Hierarchical channels.

6. Implementation of stack.

Text Books

1. Grötker, T., Liao, S., Martin, G., Swan, S, "System Design with SystemC", Springer, 2002 and onwards.
2. Sandro Rigo, Rodolfo Azevedo and Luiz Santos, "Electronic System Level Design", Springer, 2011 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Recognize the need of SystemC in designing a system.	L2
2. Examine the modeling of electronic system at the register level.	L3
3. Evaluate a system and asses the need for intellectual property.	L4
4. Explain the communication and synchronization in electronic systems.	L1
5. Test the designed system and validate it based on the requirements specified.	L5, L6

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures. .	5

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment
2. PPT's	2. Quiz
3. Videos	3. Assignment
4. Demonstration	4. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – III: Satellite Communication

Course Code	16EC752	**Credits**	3
Course type	PE – III	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand the basic concept in the field of Satellite Communication and to know how to place a satellite in an orbit.
2. To study the propagation impairments and Space link.
3. To get a complete knowledge aboutthe earth and space segments.
4. To understand the variety of multiple access techniques.
5. To gain knowledge about the Satellite system and mobile services provided.

Pre-requisites :

1. Communication Theory and Techniques (16EC45).
2. Fields and Waves (16EC44).
3. Digital Communication (16EC51).

Unit - I 8 Hours

Overview of Satellite Systems: Introduction, Frequency allocation for satellite services, INTELSAT, Polar orbiting satellites, Argos system.

Satellite Orbits: Introduction, Kepler's Laws, Definitions of terms for earth orbiting satellites, Orbital elements, Apogee and Perigee heights, Orbital Perturbations, Inclined Orbits, Geostationary orbits,Solar time and sun synchronous orbits.

Lab Experiments Using MATLAB:

1. Compute orbital period of Satellite.
2. Compute true anomaly for given altitude.
3. Compute radial and tangential velocity components of satellite.
4. Compute velocities at Apogee and Perigee.
5. Compute eccentricity of satellite orbit.
6. Illustration of Kepler's Laws.
7. Sun-synchronous Orbit Design.
8. Compute Local Side Real Time.

Unit - II 8 Hours

Propagation Impairments& Polarization: Introduction, Atmospheric losses, Ionospheric effects, Rain attenuation, Antenna polarization, Polarization of satellite signals, Discrimination, Ionospheric depolarization, Rain depolarization, Ice depolarization.

Space Link: Introduction, Equivalent Isotropic Radiated Power (EIRP), Transmission losses, Link power budget equation, System noise, CNR, Uplink, Down link, Effects of rain, Combined uplink and downlink CNR.

Self learning topics: Cross polarization.

Lab Experiments Using MATLAB:

1. Simulation of satellite link budget analysis.

Unit - III 8 Hours

Space Segment: Introduction, Power supply units, Attitude control, Station keeping, Thermal control, TT&C subsystems, Transponders, Antenna subsystem.

Earth Segment: Introduction, Receive only home TV system, Master antenna TV system, Transmit-Receive earth stations.

Self learning topics: Community Antenna TV system.

Unit – IV **8 Hours**

Interference: Introduction, Interference between satellite circuits, Downlink, Uplink, Combined [C/I] due to interference on both uplink and downlink, Antenna gain function, Pass band interference, Receiver transfer characteristic, Energy dispersal.

Satellite Access: Introduction, Single access, Pre-assigned FDMA, Demand-assigned FDMA, Spade system, TDMA, Pre-assigned TDMA, Demand assigned TDMA, Down link analysis for digital transmission, Comparison of uplink power requirements for TDMA & FDMA, Satellite switched TDMA, On-board signal processing for FDMA/TDM operation.

Unit - V **8 Hours**

DBS Television: Introduction, Orbital spacing, Power rating and number of transponders, HDTV, Frequencies and polarization, Transponder capacity, Bit rates for Digital Television, The Home Receiver Outdoor Unit (ODU), The Home Receiver Indoor Unit (IDU).

Satellite Mobile and Specialized Services:Introduction, Satellite mobile services, VSATs, Radarsat, Global Positioning System, Orbcomm, Iridium.

Lab Experiments Using MATLAB

1. Satellite image enhancement.

Text Books

1. Dennis Roddy,"Satellite Communications", 4th Edition, McGraw-Hill International Edition, 2006and onwards.
2. Timothy Pratt, Charles Bostian and Jeremy Allnutt,"Satellite Communications", 2nd Edition, John Wiley Pvt. Ltd & Sons, 2008and onwards.

Reference Books

1. W. L. Pitchand, H. L. Suyderhoud and R. A. Nelson,"Satellite Communication Systems Engineering", 2ndEdition, Pearson Education, 2007and onwards.
2. J. Martin, "Communication satellite Systems", PHI publication, 2001and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Describe the frequency allocation and types of satellite systems.	L2
2. Understand modulation and coding schemes in satellite communication systems using principles and techniques developed throughout the course.	L2
3. Illustrate the orbital determination and launching methods.	L3
4. Describe multiple access techniques like TDMA, CDMA, FDMA.	L2
5. Demonstrate the impacts of GPS, Navigation.	L3

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Modern tool Usage:**Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
3. **Research and Innovation:**Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	Assessment methods
1. Black board teaching	1. Assignments
2. PPT	2. CIE

3. Video
4. Animation

3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – III: ASIC Design

Course Code	16EC753	**Credits**	3
Course type	PE – III	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Explain ASIC methodologies and programmable logic cells to implement afunction on IC.
2. Analyse back-end physical design flow, including partitioning, floor-planning, placement and routing.
3. Gain sufficient theoretical knowledge for carrying out FPGA and ASIC designs.
4. Design CAD algorithms and explain how these concepts interact in ASIC.

Pre-requisites :
1. CMOS VLSI Design (16EC54).

Unit - I — 8 Hours

Introduction to ASICs, Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries. **CMOS Logic:** Datapath Logic Cells**:** Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells.

Lab Experiments:
1. Realization of Data Path Elements like Adders.

Unit - II — 8 Hours

ASIC Library Design: Logical effort: Predicting Delay, Logical area and logical efficiency, Logical paths, Multi stage cells, Optimum delay and number of stages.

Programmable ASIC Logic Cells: MUX as Boolean function generators, Actel ACT: ACT 1, ACT 2 and ACT 3 Logic Modules, Xilinx LCA: XC3000 CLB, Altera FLEX and MAX.

Lab Experiments:
1. Analysis of Logical effort: Predicting Delay, Logical area and logical efficiency for a given circuit.

Unit – III — 8 Hours

Programmable ASIC I/O Cells: Xilinx and Altera I/O Block. **Low-level design entry:** Schematic entry: Hierarchical design, Netlist screener. **ASIC Construction:** Physical Design, CAD Tools.

Partitioning: Goals and objectives, Constructive Partitioning, Iterative Partitioning Improvement, KL, FM and Look Ahead algorithms.

Lab Experiments:
1. Realization of Partitioning algorithms(K-L algorithm).

Unit – IV — 8 Hours

Floor planning and placement: Goals and objectives, Floorplanning tools, Channel definition, I/O and Power planningand Clock planning, Placement**:** Goals and Objectives, Min-cut Placementalgorithm, Iterative Placement Improvement, Physical DesignFlow.

Lab Experiments:
1. Introduction of SPICE and Abel Hardware Description Languages (HDL).

Unit - V **8 Hours**

Routing: Global Routing: Goals and objectives, Global Routing Methods, Back-annotation. Detailed Routing: Goals and objectives, Measurement of Channel Density, Left-Edge and Area-Routing Algorithms, Special Routing, Circuit extraction and DRC.

Lab Experiments:

1. Design and simulation of routing algorithms.

Text Books

1. Michael John Sebastian Smith, "Application - Specific Integrated Circuits" Addison Wesley Professional; 2005and onwards.
2. Neil H.E. Weste, David Harris, and Ayan Banerjee, "CMOS VLSI Design: A Circuitsand Systems Perspective", 3rd Edition, Addison Wesley/ Pearson education, 2011and onwards.

Reference Books

1. Rakesh Chadha**,** Bhasker J., "An ASIC Low Power Primer", Springer.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Describe the concepts of ASIC design methodology, data path elements, logical effort and FPGA architectures.	L1, L2
2. Analyze the design of FPGAs and ASICs suitable for specific tasks, perform design entry and explain the physical design flow.	L3
3. Design data path elements for ASIC cell libraries and compute optimum path delay.	L6
4. Create floorplan including partition and routing with the use of CAD algorithms.	L6

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5

Course delivery methods	Assessment methods
1. Presentation	1. Internal Assessment
2. Video	2. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – III: Data Base Management System

Course Code	16EC754	**Credits**	3
Course type	PE – III	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Understand basic database concepts, including the structure and operation of the relational data model.
2. Understand and successfully apply logical database design principles, including E-R diagrams and database normalization.
3. Construct simple and moderately advanced database queries using Structured Query Language (SQL).
4. Design and implement a small database project.
5. Understand the concept of a database transaction and related database facilities, including concurrency control and protocols.
6. Understand the role of the database administrator.

Unit - I — 8 Hours

Introduction: Introduction; An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; A brief history of database applications; when not to use a DBMS.

Data models, schemas and instances; Three-schema architecture and data independence.

Lab Experiment: Creation of a database and writing SQL queries to retrieve information from the database.

Unit - II — 8 Hours

Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues.

Lab Experiment: Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.

Unit - III — 8 Hours

Relational Model and Relational Algebra: Relational Model Concepts; Relational Model constraints and Relational Database Schemas; Update Operations, Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Examples of Queries in Relational Algebra;

Lab Experiment: Creating an Employee database to set various constraints. Creating relationship between the databases.

Unit – IV — 8 Hours

SQL: SQL Data Definition and Data Types; Specifying basic constraints in SQL; Schema change statements in SQL; Basic queries in SQL; More complex SQL Queries.

Lab Experiment: Mini project (Application Development using Oracle/ sql/ Mysql)

a) Inventory Control System.
b) Material Requirement Processing.
c) Hospital Management System.

Unit – V **8 Hours**

Database Design: Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms 1NF, 2NF and 3NF; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form.

Lab Experiment: Mini project (Application Development using Oracle/ sql/ Mysql)

a) Railway Reservation System.
b) Personal Information System.
c) Web Based User Identification System.
d) Timetable Management System.
e) Hotel Management System.

Text Books

1. Elmasri and Navathe,"Fundamentals of Database Systems", 5th Edition, Pearson Education, 2007and onwards.
2. Silberschatz, Korth and Sudharshan,"Data base System Concepts", 6th Edition, Mc-GrawHill, 2010and onwards.
3. C. J. Date, A. Kannan and S. Swamynatham,"An Introduction to Database Systems", 8th Edition, Pearson Education, 2006and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Master the basic concepts and appreciate the applications of database systems.	L2
2. Master the basics of SQL and construct queries using SQL.	L3
3. Be familiar with the relational database theory, and be able to write relational algebra expressions for queries	L4
4. Master sound design principles for logical design of databases, including the E-R method and normalization approach	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4. **Self motivated Learning** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Chalk / Blackboard	1. Assignments
2. Presentations	2. Internal Assessment Tests
3. Videos	3. Quiz
4. Demonstration	4. Seminar

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective IV – Low Power VLSI

Course Code	16EC761	**Credits**	3
Course type	PE – IV	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	35	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To study the fundamentals of low power in MOSFET.
2. Understand the power dissipation at device level.
3. To inspect gating techniques used.
4. To study power reduction with special techniques.
5. To examine and recognize performance management in architectures.

Pre-requisites :

3. Digital Electronics (16EC32).
4. CMOS VLSI Design (16EC54).

Unit – I **8 Hours**

Introduction:Introduction, Sources of power dissipation, designing for low power. Physics of power dissipation in MOSFET devices, MIS Structure, Long channel and sub-micron MOSFET, Gate induced Drain leakage, Power dissipation in CMOS, Short circuit dissipation, dynamic dissipation,Load capacitance.

Self learning topics: Low power design limits,Principles of low power design.

Unit – II **8 Hours**

Design and Test of Low-Voltage CMOS Circuits: Introduction, Design style, Leakage current in Deep sub-micron transistors, device design issues, minimizing short channel effect, Low voltage design techniques using reverse V, steep sub threshold swing and multiple threshold voltages, Testing with elevated intrinsic leakage, multiple supply voltages

Unit – III **8 Hours**

Logic: Gate Reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Pre-computation Logic.

Unit – IV **8 Hours**

Special Techniques: Power reduction in Clock Networks, CMOS Floating Node, Low Power Bus, Delay Balancing, Low Power Techniques For SRAM.

Unit – V **8 Hours**

Architecture and System: Power and Performance Management, Switching Activity Reduction, Flow Graph Transformation.

Self learning topics: Parallel Architecture with Voltage Reduction.

Text Books

1. Kaushik Roy and Sharat C Prasad,"Low-Power CMOS VLSI Circuit Design", John WileyPvt. Ltd., 2008and onwards.
2. Gary Yeap and Kluwer, "Practical Low power Digital VLSI Design", Academic Publications,1998and onwards.

Reference Books

1. Jan M. Rabaey andMassoudPedram, "Low-power-design-Methodology", The Springer International Series in Engineering and Computer Science, 1995and onwards.
2. Neil H. E. Weste and K. Eshraghian, "Principles of CMOS VLSI Design", Addison Wesley (Indian reprint), 2nd Edition and onwards.

List of Experiments:

The experiments are conducted using the software. Hence no hardware is required. These can be worked on the license software namely: Cadence, Mentor Graphics, synopsis and Xilinx ISE.

1. Techniques at Circuit Level: Multi Threshold, Varying VDD, Use of Sleep transistors.
2. Signal Coding Technique: Use of 2's complement, Gray code, one-hot coding, Bus inversion coding.
3. Architecture level: Clock gating, Power gating, Isolation techniques.
4. System level: Pipelining and Parallelism.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Discuss the sources of power dissipation in MOSFET.	L2
2. Analyze and verify Low-Voltage CMOS Circuits.	L3,L4
3. Understand different gating techniques to reduce power dissipation.	L3, L4
4. Comprehend special technique forpower reduction networks.	L2
5. Recognize performance management system used in architecture and system.	L2, L3

Program Outcome of this course (POs)	PO No.
1. **FundamentalsofEngineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
3. **EngineeringCognizance:**Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.	4
4. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Black board	1. Assignments
2. Presentation	2. Quiz
3. Videos and MOOC	3. Case studies with real time examples.
4. Practical with EDA tools.	4. Projects/ Literature survey.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – IV: Ad Hoc and Sensor Networks

Course Code	16EC762	**Credits**	3
Course type	PE – IV	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Understand the constraints of the wireless physical layer that affect the design and performance of ad hoc and sensor networks, protocols, and applications.
2. To get skilled in wireless networks technology platforms and standards.
3. To learn real time traffic support in wireless networks with working principles of wireless LAN.
4. To understand the Principles of Ad hoc wireless and sensor networks.
5. To get familiar in standards of wireless LAN and learn hybrid networks.

Unit - I **8 Hours**

Ad Hoc Wireless Networks and MAC: Introduction, Issues in ad Hoc wireless networks, MAC protocols, Issues, classifications of MAC protocols,Contention based protocols, Contention based protocols with reservation mechanism,Multi-channel CSMA andpower control MAC protocol.

Unit - II **8 Hours**

Routing Protocols and TCP over Ad Hoc: Issues in designing a routing protocol, Classifications of routing protocols, Hierarchical and power aware.multicast routing, Classifications, Tree based, Mesh based Ad Hoc transport layer issues, TCP over Ad Hoc, Feedback based - TCP with explicit link, TCP-Bus, Ad Hoc TCP and split TCP, Ad Hoc transport protocol.

Unit – III **8 Hours**

Quality of Service in Ad Hoc Wireless Networks: Real-time traffic support, Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions,QoS routing protocols, Ticket based and predictive location based QoS routing protocols, On-Demand link state multipath QoS routing protocol, QoS frameworks, Energy management Ad Hoc, Battery and power management schemes, Transmission power management schemes.

Unit – IV **8 Hours**

Basics of Wireless sensors and Applications: The Mica Mote, Sensing and Communication ranges, Design Issues, Energy Consumptions, Clustering of sensors, applications.

Unit - V **8 Hours**

Hybrid Wireless Networks: Introduction, Next generation hybrid wireless architectures, Routing in hybrid wireless networks, Power controlschemes and load balancing in hybrid wireless networks, Recent advances in wireless networks,Ultra wide bandradio communication, Wireless fidelity systems, Optical wireless networks.

List of Experiments:

Following experiments to be conducted usingSimulator Ns2/ Ns3

1. Study Zigbee/Cross Bow Wireless Network.
2. Study ad hoc network formation in different operating system. Implement ad hoc network in one operating system.
3. Implement AODV routing protocol.
4. Implement Wireless LAN MAC scheme with RTS/CTS and without RTS/CTS and analyze the performance.
5. Create a small topology of nodes in C++/Java. Assign Energy to each node and Elect a node with highest energy to be Master node.
6. Which signal propagation loss models can be applied to ad hoc network? Implement models in C++/Java.
7. Create a small topology. Perform data transmission among nodes and calculate throughput. Use C++/Java/simulator.
8. Create a small topology. Assign symmetric keys and perform encryption. Use C++/Java/simulator
9. Implement DSR routing protocol.
10. Implement black hole attack. Take 3 nodes in topology.

Text Books

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols', New Delhi: Pearson Education, 2004and onwards..
2. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks" Noida: Morgan Kaufman Publishers, 2004and onwards..
3. C. K. Toh, "Ad Hoc Mobile Wireless Networks",New Delhi: Pearson Education, 2002and onwards.
4. Thomas Krag and SebastinBuettrich, "Wireless Mesh Networking", Mumbai: O'Reilly Publishers,2007and onwards.
5. Carols Corderio, "Adhocand Sensor Networks -Theory And Applications", Dharma Prakash Agarwal, World Scientific Publications / Cambridge University Press, March 2006and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain the performance of various unicast and multicast routing protocols that have been proposed for ad hoc networks.	L2
2. Explain the operation of several media access protocols that have been proposed for ad hoc and sensor networks	L2
3. Explain the energy issues in sensor networks and how they can be addressed using scheduling, media access control, and special hardware.	L2
4. Implement protocols with location based QoS.	L3
5. Appreciate the importance of good Ad-Hoc Networks Functionality.	L3

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Modern tool Usage:**Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
3. **Research and Innovation:**Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	Assessment methods
1. Blackboard and chalk	1. Internal Assessment Test
2. PPT	2. Assignment
3. Video	3. Quiz
4. Demonstration	4. Seminar

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50
➢ Writing two IA test is compulsory. ➢ **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**					

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – IV: Real Time OS

Course Code	16EC763	**Credits**	3
Course type	PE – IV	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To understand the basic concepts of a Real Time Operating System and their applications.
2. To study different RTOS's and their significance.
3. To give the skills necessary to develop software for embedded computer systems using a real-time operating system.
4. To provide knowledge and skills that can be applied immediately.
5. To introduce the principles shared by many real-time operating systems, and their use in the development of embedded multitasking application software

Unit - I **8 Hours**

Basics of RTOS: Introduction, Characteristics of Real-Time Tasks, Real-Time Scheduling, Operating System Designs, RTOS for Safety Critical Systems, Multi-Core Architectures, Operating Systems for Wireless Sensor Networks, Real-Time Requirements of Multimedia Application

Unit - II **8 Hours**

Real Time Kernel: Principles, Design issues, Polled Loop Systems, RTOS Porting to a Target, Comparison and study of RTOS VX works and uCOS – Case studies.

Unit - III **8 Hours**

Real Time Models: Event Based – Process Based and Graph based Models,Petrinet Models, Real Time Languages, RTOS Tasks, RT scheduling, Interrupt processing, Synchronization, Control Blocks, Memory Requirements.

Unit – IV **8 Hours**

Real Time Memory Management: Process stack management, TCB model, Run time ring buffer, Dynamic allocation, Swapping, Overlays, Real-time garbage collection.

Unit - V **8 Hours**

RTOS Application Domains: RTOS for Image Processing, Embedded RTOS for voice over IP, RTOS for fault Tolerant Applications, RTOSfor Control Systems.

List of Lab Experiments:

1. Write a C/C++ program for Real time Scheduling.
2. Installation of Real Time OS.
3. Write a C/C++ program for implementing a Real Time Clock.

Text Books

1. Charles Crowley, "Operating Systems-A Design Oriented approach", McGraw Hill.
2. C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill.

Reference Books

1. Phillip Laplante, "Real – time Systems design and analysis", PHI.
2. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Evaluate the suitability of an operating system for real-time applications.	L5
2. Describe and apply commonly used abstract models and terminology for real-time scheduling and resource management.	L4
3. Understand and apply the proofs of the fundamental theorems of deadline and fixed priority real-time scheduling.	L4
4. To select an appropriate software architecture and combination of scheduling techniques to satisfy a set of timing requirements.	L3
5. Empirically estimate the accuracy and overhead of a real-time scheduler.	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Modern tool Usage:**Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
3. **Research and Innovation:**Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	Assessment methods
1. Black board teaching	1. Assignments
2. PPT	2. CIE
3. Video	3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Elective – IV: Multimedia Communication

Course Code	16EC764	**Credits**	3
Course type	PE – IV	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 2	**SEE Marks**	50
Total Hours:	35	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. Understand the Concepts and Fundamentals of digital information compression.
2. Apply and analyze mathematical transform for Multimedia information.
3. Understand the design procedure of Video CoDec.
4. Analyze JPEG, JPEG 2000 still image standards.
5. Analyze and evaluate MPEG 4 and H.264 AVC CoDecstandards.

Unit - I **8 Hours**

Fundamentals: Practical need for Audio, image and video compression, statistical and psychovisual redundancy, Quantization - uniform, non uniform, Audio compression - Psychoacoustics, Audio CoDec, Lossless Compression MPEG-4, Lossy Compression G.719, AC3.

Unit - II **8 Hours**

Coding standard: Transform coding, DCT and DWT (for data compression), Variable length coding, Huffman codes, Arithmetic codes, Dictionary codes - LZ77 and LZ78.

Unit – III **8 Hours**

Still Image and Video Compression: Still image compression coding standards, JPEG, JPEG 2000, Motion estimation and motion compensation, Block matching, fundamentals of digital video coding.

Unit – IV **8 Hours**

Digital video coding standard and applications: MPEG 1/2 video coding, MPEG-4 video standards (Block diagram study), Introduction and fundamentals H.261, H.263.

Unit - V **8 Hours**

H.264 AVC (Block diagram study), and SVC standards (Block diagram study), Comparative study of MPEG-4 and H.264 AVC.

Self learning topics: Overview of the Scalable Video Coding.

List of Lab Experiments:

Software Experiments:

1. Entropy Coding.
2. Quantization.
3. Motion Estimation and Compensation.
4. Transform Coding and Intra-Coding Chain.
5. Video Codec.

- Experiments to be conducted using MATLAB/ SIMULINK

Hardware Experiments:

1. Demonstration of working of Scanner.
2. Interface of Webcam.
3. PCM using real-time audio from PC.
4. Benchmarking of Compression Techniques.
5. Character Recognition.

Text Books

1. Yun Q. Shi andHuifang Sun, "Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards, CRC Press, 2008and onwards.

Reference Books

1. Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia", Prentice Hall.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Identify and describe multimedia signal processing and communications	L2
2. Analyze and report different transforms for video coding.	L4
3. Describe and compare Video CoDec designs.	L3
4. Describe a number of standards, including H.26x, Moving Picture Expert Group (MPEG), and Joint Photographic Expert Group (JPEG).	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Soft skills:**Graduates shall possess proficiency in oral and written communication skills.	9
4. **Research and Innovation:**Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	Assessment methods
1. Black board	1. IA Test
2. PPT	2. Assignment
3. Videos	3. Quiz
4. Demonstrations	4. Course project/seminar

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	Average of two assignments / activity	Quiz	Class participation	Total Marks
Maximum Marks: 50	25	10	5	10	50

- Writing two IA test is compulsory.
- **Minimum marks required to qualify for SEE :Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. **Minimum marks required in SEE to pass: 40**
3. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

Communication and Networking Lab

Course Code	16ECL77	**Credits**	2
Course type	L1	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course learning objectives

1. To study of different types network cables network devices and IP.
2. To study how to connect the computers in Local area network.
3. To study and understand the different network commands and network configuration commands.
4. To study and Make use of Packet tracer simulation tool.
5. To study how to configure a network and different vector routing protocols using Packet tracer.

Following experiments shall be conducted using C/MATLAB/NS2/ Packet Tracertools

List of experiments

1. PC to PC Communication.
2. Parallel Communication using 8 bit parallel cable.
3. Serial communication using RS 232C.
4. Ethernet LAN protocol.
5. Create scenario and study the performance of CSMA/CD protocol through simulation.
6. Token bus and token ring protocols.
7. Create scenario and study the performance of token bus and token ring protocols through simulation.
8. Wireless LAN protocols.
9. Create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
10. Implementation and study of stop and wait protocol.
11. Implementation and study of Goback-N and selective repeat protocols.
12. Implementation of distance vector routing algorithm.
13. Implementation of Link state routing algorithm.
14. Implementation of Data encryption and decryption.
15. Transfer of files from PC to PC using Windows.

Text Books

1. Behrouz A Forouzan, “Data Communication and Networking”, Tata McGraw-Hill Publishing Company Limited, Indian Edition, 2006and onwards.

Reference Books

1. Larry L. Peterson and Bruce S. Devie, “Computer Networks”, Morgan Kaufmann Publications, 5th Edition, 2008and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom’s Level
1. Understand the working of different types of network cables and network devices and IP.	L2
2. Connect two computers in Local area network.	L3
3. Understand the different network commands and network configuration commands.	L2
4. Analyze Packet tracer simulation tool effectively.	L4
5. Configure a network and different vector routing protocols using Packet tracer.	L5

Program Outcome of this course (POs)	**PO No.**

1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2.	**Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3.	**Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4.	**Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Assessment
2. Quiz
3. Mini Project/ Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4.

Initial write up	10 marks	50 marks
Conduct of experiments, results and conclusion	20 marks	
Viva- voce	20 marks	

5. **Viva-voce shall be conducted for individual student and not in a group.**

Wireless and Mobile Communication Lab

Course Code	16ECL78	**Credits**	2
Course type	L2	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25
Total Hours:	36	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs)

1. To studyTx /Rx signals and their constellation.
2. To study Audio unit of GSM phone.
3. To study performance and detection of SIM andGSM data services.
4. To study Wireless Access Point (WAP).
5. To study MIMO communication.

Following experiments shall be conducted using Mobile Phone Trainer ST2132 kit

1. Study of the Tx IQ/Rx IQ signals.
2. Observe signal constellation.
3. Study working of Audio IC and observe the signals.
4. Study and verify the performance of SIM Detection.
5. Study and Measure the PWM signal of Vibrator.
6. Study and Analyze the Buzzer in GSM Handset.
7. Study GSM communication Data Services and Capability.
8. Study and Configure setting up of WAP.
9. Introduction to MIMO Communication and Multiplexing.
10. Introduction to MIMO OFDM. .

Text Books

1. Mullet, "Wireless Telecom: Systems and networks", Thomson Learning, 2006 and onwards.
2. Oliver Hersent,David Boswatrhick and Omar Elloumi,"The Internet of Things Applications and Protocols", Willey India Pvt. Ltd.
3. V.Madisetti and A. Bahga,"IoT:A hands on approach", Learning, 2004 and onwards.

Reference Books

1. Lee W.C.Y,"Mobile Cellular Telecommunication", MGH, 2nd Edition, 2009 and onwards.
2. D P Agrawal,"Wireless communication, 2nd Edition, Thomson learning 2007 and onwards.
3. David Tse and Pramod Viswanath,"Fundamentals of Wireless Communication", Cambridge 2005and onwards.
4. S. S. Manvi, M. S. Kakkasageri, "Wireless and Mobile Network concepts and protocols", John Wiley India Pvt. Ltd, 1st Edition, 2010and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Outlinebasics of cellular communication , Tx and Rx signals and Constellation	L2
2. Explain the working of Audio IC and Measure audio signals	L1/L5
3. Detect SIM in GSM network and verify performance	L2
4. Analyze Buzzer in GSM handset and List GSM services	L3
5. Configure WAP	L5

Program Outcome of this course (POs)

		PO No.
1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	1
2.	**Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3.	**Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4.	**Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
5.	**Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods

1. Internal Assessment
2. Quiz
3. Mini Project/ Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Total Marks
Maximum Marks: 25	10	15	25
➢ Submission and certification of lab journal is compulsory to qualify for SEE. ➢ **Minimum marks required to qualify for SEE :13 marks out of 25**			

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hoursduration. **It will be reduced to 25 marks for the calculation of SGPA and CGPA.**
2. Only one experiment to be conducted.
3. **Minimum marks required in SEE to pass: 20/50 (10/25)**
4.

Initial write up	10 marks	50 marks
Conduct of experiments, results and conclusion	20 marks	
Viva- voce	20 marks	

5. **Viva-voce shall be conducted for individual student and not in a group.**

Bloom's Taxonomy of Learning Objectives

Bloom's Taxonomy in its various forms represents the process of learning. It was developed in 1956 by Benjamin Bloom and modified during the 1990's by a new group of cognitive psychologists, led by Lorin Anderson (a former student of Bloom's) to make it relevant to the 21st century. The **revised taxonomy** given below emphasizes what a learner "Can Do".

Lower order thinking skills (LOTS)		
L1	Remembering	Retrieve relevant knowledge from memory.
L2	Understanding	Construct meaning from instructional material, including oral, written, and graphic communication.
L3	Applying	Carry out or use a procedure in a given situation – using learned knowledge.
Higher order thinking skills (HOTS)		
L4	Analyzing	Break down knowledge into its components and determine the relationships of the components to one another and then how they relate to an overall structure or task.
L5	Evaluating	Make judgments based on criteria and standards, using previously learned knowledge.
L6	Creating	Combining or reorganizing elements to form a coherent or functional whole or into a new pattern, structure or idea.