

RAJALAKSHMI ENGINEERING COLLEGE
(An Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS - 2023

CHOICE BASED CREDIT SYSTEM

VISION

To produce globally competent Electronics and Communication Engineers with a commitment to serve the society.

MISSION

M1 To impart training with the best of teaching expertise supported by excellent laboratory infrastructure and exposure to recent trends in the industry.

M2 To ensure that the students are molded into competent Electronics and Communication Engineers with the knowledge of computer applications and worthy citizens of the country.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

PEO I

To provide students with sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, analyze and solve engineering problems and to prepare them for post graduate studies and for successful careers in industries.

PEO II

To develop the ability among students to define engineering problems in the fields of electronics and communication engineering, and to employ necessary techniques, hardware, and communication tools for modern engineering applications.

PEO III

To instil the values, skills, leadership and team spirit for comprehensive and wholesome personality, to promote entrepreneurial interest among students and to create a fervor for use of engineering in addressing societal concerns.

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

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

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

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

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

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

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

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

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

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

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

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: An ability to formulate solutions for practical societal requirements using communication engineering.

PSO2: To design and formulate solutions for industrial requirements using electronics and communication engineering.

PSO3: To understand and develop solutions required in multidisciplinary engineering fields.

RAJALAKSHMI ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY)

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM

CURRICULUM

SEMESTER I								
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1	HS23111	Technical Communication I	HS	2	2	0	0	2
2	GE23117	தமிழர் மரபு /Heritage of Tamils	HS	1	1	0	0	1
3	MA23111	Linear Algebra and Calculus	BS	4	3	1	0	4
LAB ORIENTED THEORY COURSES								
4	EC23131	Electron Devices	PC	5	3	0	2	4
5	CY23131	Chemistry for Electronics Engineering	BS	5	3	0	2	4
6	GE23131	Programming using C	ES	7	1	0	6	4
LABORATORY COURSE								
7	GE23122	Engineering Practices -Electrical and Electronics	ES	2	0	0	2	1
MANDATORY COURSE								
8	MC23111	Indian Constitution and Freedom Movement	MC	3	3	0	0	0
TOTAL				29	16	1	12	20

SEMESTER II								
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1	MA23212	Differential Equations and Complex Variables	BS	4	3	1	0	4
2	GE23217	தமிழரும் தொழில்நுட்பமும் / Tamils Technology	HS	1	1	0	0	1
LAB ORIENTED THEORY COURSES								
3	EE23132	Basic Electrical Engineering	ES	5	3	0	2	4
4	PH23232	Physics for Electronics Engineering	BS	5	3	0	2	4
5	CS23231	Data Structures	ES	7	3	0	4	5
6	GE23111	Engineering Graphics	ES	6	2	0	4	4
LABORATORY COURSES								
7	GE23121	Engineering Practices- Civil and Mechanical	ES	2	0	0	2	1
8	HS23221/ HS23222	Technical Communication II / English for Professional Competence	HS	2	0	0	2	1
MANDATORY COURSE								
9	MC23112	Environmental Science and Engineering	MC	3	3	0	0	0
TOTAL				35	18	1	16	24

SEMESTER III								
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1	MA23312	Fourier Series and Number Theory	BS	4	3	1	0	4
2	EC23311	Analog Circuits –I	PC	3	3	0	0	3
3	EC23312	Electromagnetic Fields	PC	3	3	0	0	3
4	EC23313	Digital Principles and System Design	PC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
5	EC23332	Principles of Microprocessor and Microcontrollers	PC	5	3	0	2	4
6	CS23336	Introduction to Python Programming	ES	5	1	0	4	3
LABORATORY COURSE								
7	EC23321	Analog and Digital Circuits Laboratory	PC	4	0	0	4	2
TOTAL				27	16	1	10	22

SEMESTER IV								
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1	EC23411	Signals and Systems	PC	3	3	0	0	3
2	EC23412	Transmission Lines and Waveguides	PC	3	3	0	0	3
3	EC23413	Communication Theory	PC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
4	EC23431	Analog Circuits-II	PC	5	3	0	2	4
5	MA23436	Probability and Random Processes	BS	5	3	0	2	4
LABORATORY COURSES								
6	GE23327	Soft Skills-I	EEC	2	0	0	2	1
7	CS23422	Python Programming for Machine Learning	ES	4	0	0	4	2
TOTAL				25	15	0	10	20

SEMESTER V								
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1	EC23511	Control System Engineering	PC	3	2	1	0	3
2	EC23512	Modern Digital Communication	PC	3	3	0	0	3
3		Open Elective-I	OE	3	3	0	0	3
4		Professional Elective-I	PE	3	3	0	0	3
5		Professional Elective-II	PE	3	3	0	0	3
LAB ORIENTED THEORY COURSE								
6	EC23531	Digital Signal Processing	PC	5	2	1	2	4
LABORATORY COURSES								
7	EC23521	Communication Systems Laboratory	PC	4	0	0	4	2
8	EC23522	Industrial Internship	EEC	2	0	0	2	1
9	GE23427	Soft Skills-II	EEC	2	0	0	2	1
TOTAL				28	16	2	10	23

SEMESTER VI								
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1	EC23611	Antenna Theory and Wave Propagation	PC	3	3	0	0	3
2		Open Elective-II	OE	6	0	0	6	3
LAB ORIENTED THEORY COURSES								
3	EC23631	VLSI and Chip Design	PC	5	3	0	2	4
4	EC23632	Communication Networks	PC	5	3	0	2	4
5	EC23633	Wireless Communication	PC	4	2	0	2	3
LABORATORY COURSES								
6	GE23627	Problem Solving Techniques	EEC	2	0	0	2	1
7	EC23621	Design Thinking for Innovation in ECE	EEC	4	0	0	4	2
TOTAL				29	11	0	18	20

SEMESTER VII								
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1		Professional Elective-III	PE	3	3	0	0	3
2		Professional Elective- IV	PE	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
3	EC23731	Optical Communication and Networks	PC	4	2	0	2	3
4	EC23732	RF and Microwave Engineering	PC	4	2	0	2	3
5	EC23733	Embedded and Real Time Systems	PC	5	3	0	2	4
LABORATORY COURSE								
6	EC23721	Artificial Intelligence and Machine Learning for Electronic Engineering	EEC	4	0	0	4	2
TOTAL				23	13	0	10	18

SEMESTER VIII								
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1		Professional Elective-V	PE	3	3	0	0	3
2		Professional Elective-VI	PE	3	3	0	0	3
LABORATORY COURSE								
3	EC23821	Project work	EEC	20	0	0	20	10
TOTAL				26	6	0	20	16
TOTAL NUMBER OF CREDITS:				163				

B.E ELECTRONICS AND COMMUNICATION ENGINEERING
CREDITS DISTRIBUTION

S. NO	COURSE CATEGORY	CREDITS PER SEMESTER								PROPOSED CURRICULUM
		1	2	3	4	5	6	7	8	
1	HS	3	2							5
2	BS	8	8	4	4					24
3	ES	5	14	3	2					24
4	PC	4		15	13	12	14	10		68
5	PE					6		6	6	18
6	OE					3	3			6
7	GE									0
8	EEC				1	2	3	2	10	18
9	MC	*	*							Non credits
	Total	20	24	22	20	23	20	18	16	163

VERTICAL 1 SIGNAL AND IMAGE PROCESSING	VERTICAL 2 RF AND ADVANCED COMMUNICA TIONS	VERTICAL 3 SEMICONDUCT OR AND VLSI DESIGN	VERTICAL 4 HIGH SPEED NETWORKS	VERTICAL 5 MEMS AND IOT	VERTICAL 6 SPACE TECHNOLOGIES
EC23A11 - Medical Electronics	EC23B11 - Information Theory and Coding	EC23C11 - System on Chip and FPGA Testing	EC23D11 - Wireless Networks	EC23E11 - Introduction to MEMS	EC23F11 - Satellite Communication
EC23A12 - Biosensing and its Analysis	EC23B12 - Cognitive Radio	EC23C12 - Physical Design automation	EC23D12 - Wireless Sensor Networks	EC23E12 - MEMS and Microfluidic Technologies	EC23F12 - Radar Technologies
EC23A13 - Statistical Signal Processing	EC23B13 - Advanced Communication Systems	EC23C13 - Digital IC Design	EC23D13 - Network Routing Algorithms	EC23E13 - BioMEMS	EC23F13 - Avionics Systems
EC23A14 - Digital Image Processing	EC23B14 - Electromagnetic Interference and Compatibility	EC23C14 - Functional Verification of SOCs	EC23D14 - Multimedia Compression and Networking	EC23E14 - Biomaterials and Applications	EC23F14 - Positioning and Navigation Systems
EC23A15 - Image and Video Analysis	EC23B15 - Millimeter Wave Communication	EC23C15 - Computer architecture	EC23D15 - Internetworking multimedia	EC23E15 - Nanotechnology and Applications	EC23F15 - Remote Sensing
EC23A16 - Speech and Audio Processing	EC23B16 - Advanced Antenna Technologies	EC23C16 - Semiconductor Packaging	EC23D16 - Cryptography and Network Security	EC23E16 - Sensor Technology	EC23F16 - Space Mechanics
EC23A17 - Fundamentals of Machine Learning	EC23B17 - RF Circuit Design and RADAR Engineering	EC23C17 - VLSI Testing and Testability	EC23D17 - Software Defined Networks	EC23E17 - IoT Communication Technologies	EC23F17 - Rocket Propulsion
EC23A18 - Introduction to Deep Learning	EC23B18 - 5G Physical Layer Technologies	EC23C18 - Computational VLSI and IoT for AI	EC23D18 - High Performance Computing for Cyber Physical Systems	EC23E18 - Industry 4.0 and IIoT	EC23F18 - Drone Technologies

SEMESTER – I

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
HS23111	TECHNICAL COMMUNICATION I	HS	2	0	0	2
Common to all branches of B.E/B. Tech programmes – First Semester						

Objectives:
<ul style="list-style-type: none"> To facilitate students develop their comprehension skills To enable students to improve their receptive skills To equip learners with better vocabulary and enhance their writing skills To aid students speak effectively in all kinds of communicative contexts To improve the learners' basic proficiency in workplace communication

UNIT-I	DEVELOPING COMPREHENSION SKILLS	6
Listening: Introduction to Informational listening – Listening to Podcasts, News Reading: Intentional Reading - Short Narratives and Passages. Speaking: Introducing Oneself, Narrating a Story / Incident. Writing: Sequential Writing – connecting ideas using transitional words (Jumbled Sentences), Process Description Grammar: Verbs – Main & Auxiliary: Simple Tenses – Form, Function and Meaning. Vocabulary: Word formation – Prefix, Suffix, Compound Words.		
UNIT-II	LISTENING AND EXTENDED READING	6
Listening: Deep Listening – Listening to Talk Shows and Debates Reading: In-depth Reading - Scanning Passages Speaking: Describing Current Issues, Happenings, etc..., Writing: Note Making, Note Taking – Paragraph Writing Grammar: Continuous Tenses, Prepositions, Articles Vocabulary: One Word Substitutes, Phrasal Verbs.		
UNIT-III	FORMAL WRITING AND VERBAL ABILITY	6
Listening: Listening to Lectures and Taking Notes Reading: Interpretation of Tables, Charts and Graphs Speaking: SWOT Analysis on Oneself Writing: Formal Letter Writing and Email Writing Grammar: Perfect Tenses, Phrases and Clauses, Discourse Markers Vocabulary : Verbal Analogy / Cloze Exercise		
UNIT-IV	ENHANCING SPEAKING ABILITY	6
Listening: Listening to eminent voices of one's interest (Martin Luther King, APJ Abdul Kalam, etc..) Reading: Timed Reading, Filling KWL Chart. Speaking: Just a Minute, Impromptu Writing: Check-list, Instructions. Grammar: 'Wh' Questions / 'Yes' or 'No' Questions, Imperatives Vocabulary: Synonyms, Antonyms, Different forms of the same words.		
UNIT-V	LANGUAGE FOR WORKPLACE	6
Listening: Extensive Listening (Audio books, rendering of poems, etc.) Reading: Extensive reading (Jigsaw Reading, Short Stories, Novels) Speaking: Short Presentations on Technical Topics Writing: Recommendations, Essay Writing Grammar: Impersonal Passive, Reported Speech, Concord Vocabulary : Informal Vocabulary and Formal Substitutes		
Total Contact Hours: 30		

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> apply their comprehension skills and interpret different contents effortlessly read and comprehend various texts and audio visual contents infer data from graphs and charts and communicate it efficiently in varied contexts participate effectively in diverse speaking situations to present, discuss and coordinate with their peers in workplace using their language skills

Suggested Activities:

- Ice breaker
- Just A Minute
- Ship wreck
- Hot seat
- Vocabulary building
- Chinese whispers
- Case study

Suggested Evaluation Methods:

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Book(s):

1. Effective Technical Communication by M. Ashraf Rizvi (Author) 2nd Edition Paperback 2017
2. Sylvan Barnet and Hugo Bedau, 'Critical Thinking Reading and Writing', Bedford/st. Martin's: Fifth Edition (June 28, 2004)
3. Meenakshi Upadhyay, Arun Sharma – Verbal Ability and Reading Comprehension.
4. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMeng Goh, Cambridge University Press

Reference Books(s) / Web links:

1. Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English With Answers 2nd Edition by Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor)
2. Reading Development and Difficulties By Kate Cain
3. The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK
4. Everybody Writes: Your Go-To Guide to Creating Ridiculously Good Content Hardcover by Ann Handley (Author)

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS23111. 1	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 2	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 3	-	1	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 4	-	-	-	2	-	-	-	-	1	3	-	-	-	-	-
HS23111. 5	-	-	-	1	-	-	-	-	1	3	-	-	-	-	-
Average	-	1	-	1.2	-	-	-	-	1	3	-	-	-	-	-

அலகு I மொழி மற்றும் இலக்கியம்:

3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழிக் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை:

3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:

3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்:

3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:

3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

Total Contact Hours: 15 PERIODS**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies).

9. Keeladi – ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	Course Title	Category	L	T	P	C
MA23111	LINEAR ALGEBRA AND CALCULUS	BS	3	1	0	4
Common to I sem. B.E. - CSE, EEE, ECE, BME and B.Tech. - IT.						

Objectives:

- To introduce the matrix techniques and to explain the nature of the matrix.
- To collect the matrix algebra techniques and the concepts of basis and dimension in vector spaces.
- To construct normalization of vectors and ortho-normal vectors.
- To understand techniques of calculus which are applied in the Engineering problems.
- To apply the techniques of Integration in finding area and volumes.

UNIT-I	MATRICES	12
Matrices - Eigenvalues and eigenvectors - Diagonalization of matrices using orthogonal transformation - Cayley-Hamilton Theorem(without proof) - Quadratic forms - Reduction to canonical form using orthogonal transformation - Numerical computation of Eigen value using Power method.		
UNIT-II	LINEAR TRANSFORMATION	12
Vector spaces – Subspaces – Linear combinations and system of Linear equations – Linear independence and Linear dependence – Bases and Dimensions – Linear Transformation – Matrix representation of Linear Transformation - Null space, Range space and dimension theorem (without proof).		
UNIT-III	INNER PRODUCT SPACES	12
Inner product and norms - Gram Schmidt orthonormalization process - QR Factorization - Singular value decomposition.		
UNIT-IV	FUNCTIONS OF SEVERAL VARIABLES	12
Partial differentiation–Total derivative–Change of variables–Jacobians–Partial differentiation of implicit functions–Taylor’s series for functions of two variables–Maxima and minima of functions of two variables–Lagrange’s method of undetermined multipliers.		
UNIT-V	MULTIPLE INTEGRALS	12
Double integrals–Change of order of integration–Area enclosed by plane curves–Triple integrals–Volume of solids–Numerical computation of double integrals-trapezoidal rule.		
Total Contact Hours: 60		

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

- Demonstrate the matrix techniques in solving the related problems in engineering and technology.
- Apply the concepts of basis and dimension in vector spaces to the solution of related complex engineering problems.
- Construct orthonormal basis by the concepts of normalization in inner products and to analyse complex engineering problems.
- Interpret the problems in Engineering and Technology using the principles of mathematical calculus.
- Evaluate multiple integrals to conduct investigations of complex problems.

Suggested Activities:

- Problem solving sessions
- Activity based learning
- Implementation of small module

Suggested Evaluation Methods:

- Problem solving in tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):															
1.	Grewal B.S., “ Higher Engineering Mathematics ”, Khanna Publishers, New Delhi, 43 rd Edition, 2014.														
2.	T Veerarajan , Linear Algebra and Partial Differential Equations, Mc Graw Hill Education, 2019.														
3.	Friedberg, A.H., Insel, A.J. and Spence, L., Elementary Linear Algebra, a matrix approach, 2 nd edition, Pearson, 2014.														
4.	T Veerarajan, Engineering Mathematics –I , McGraw Hill Education, 2018.														
5.	Introduction to linear algebra, 5 th Edition, Gilbert Strang, 2016. Wellesley Publishers.														

Reference Books(s) / Web links:															
1.	Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.														
2.	Erwin Kreyszig , " Advanced Engineering Mathematics ", John Wiley and Sons, 10 th Edition, New Delhi, 2016.														
3.	Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.														
4.	Advanced Engineering Mathematics, (Seventh Edition), Peter V. O'Neil, Thomson Learning, 2020.														
5.	Williams, G, “Linear Algebra with Applications”, Jones & Bartlett Learning, First Indian Edition, New Delhi, 2017.														

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23111.1	3	2	1	-	-	-	-	-	-	-	1	-	-	1	-
MA23111.2	3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
MA23111.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA23111.4	2	2	-	-	-	-	-	-	-	-	1	1	-	-	-
MA23111.5	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-
Average	2.6	2.2	1	-	-	-	-	-	-	-	1	1	1	1	-

Course Code	Course Title	Category	L	T	P	C
EC23131	ELECTRON DEVICES	PC	3	0	2	4

Objectives:
<ul style="list-style-type: none"> To acquire knowledge about the PN junction diode To study in detail about the operation and characteristic features of the BJT To introduce the operation and characteristic features of JFET and MOSFET To study the biasing techniques of BJT, JFET and MOSFET To understand the operation and characteristic features of special semiconductor devices

UNIT-I	SEMICONDUCTOR DIODE	9
Introduction to Semiconductor Physics, PN junction diode, current equations, energy band diagram, diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion capacitances, Switching characteristics, Applications of PN junction diode- Rectifiers, clippers and clampers.		
UNIT-II	BJT	9
NPN and PNP configurations and their characteristics, Early effect, current equations, input and output characteristics of CE, CB and CC, h-parameter model, Hybrid π model, Eber's Moll model		
UNIT-III	JFET AND MOSFET	9
JFET: N-channel and P-channel, drain and transfer characteristics, MOSFET: D-MOSFET, E-MOSFET, Drain and Transfer characteristics.		
UNIT-IV	BIASING OF FET AND BJT AMPLIFIERS	9
BJT - DC Load line, operating point, various biasing methods of BJT, Bias compensation, Thermal stability, Biasing of JFET and MOSFET		
UNIT-V	SPECIAL SEMICONDUCTOR DEVICES	9
Schottky barrier diode, Zener diode, Varactor diode, Tunnel diode, UJT, SCR, DIAC, TRIAC, Dual-Gate MOSFETS, FinFET, PIN-FET		
Total Contact Hours: 45		

Description of the Experiments:	Total Contact Hours: 30
1. Characteristics of PN junction diode.	
2. Characteristics of Zener diode.	
3. Characteristics of BJT.	
4. Clippers and Clampers.	
5. Characteristics of JFET.	
6. Characteristics of UJT.	
7. SCR Characteristics.	

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> Demonstrate the operation and characteristics of the PN junction diode Develop a high degree of familiarity with the terminal characteristics of the BJT Identify the characteristics of FETs and MOSFETs Analyze various types of biasing for the BJT Identify a suitable semiconductor device for any given application

Suggested Activities:
<ul style="list-style-type: none"> Video lecture PPT Role Play Quizzes VLAB

Suggested Evaluation Methods:

- MCQ
- Assignment

Text Book(s):

1. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory," 11th edition, PrenticeHall, 2012.
2. D. Neamen, D. Biswas "Semiconductor Physics and Devices," 4/e, Mc Graw-Hill Education, 2012.
3. Salivahanan.S, "Electronic Devices", 3/e, Mc Graw-Hill Education, 2019.

Reference Books(s) / Web links:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.
2. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
3. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
4. Y. Tsvetidis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011
5. All-in-One Electronic Simplified, A.K. Maini, Khanna Publishing House.

Lab equipment required:

S. No.	Name of the Equipment	Quantity Required
1	CRO Function generator Power supply Voltmeters Ammeters Multimeters	18 18 35 60 60 10
2	BJT, FET, PN DIODE, Zener diode, UJT, SCR	Each 50
3	Breadboard	30
4	Connecting wires	As required

Suggested Evaluation Methods:

- Model Practical
- Viva
- Observation and Record

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EC23131.1	3	3	2	3	1	1	1	2	1	1	2	2	2	2	2
EC23131.2	3	3	2	3	1	1	1	2	1	1	2	2	2	2	2
EC23131.3	3	3	2	3	2	1	1	2	1	1	2	2	3	3	2
EC23131.4	3	2	3	2	2	2	1	2	2	1	2	2	2	2	2
EC23131.5	3	2	3	2	1	2	1	2	2	1	2	2	2	2	2
Average	3	2.6	2.4	2.6	1.4	1.4	1	2	1.4	1	2	2	2.2	2.2	2

Course Code	Course Title	Category	L	T	P	C
CY23131	CHEMISTRY FOR ELECTRONICS ENGINEERING	BS	3	0	2	4
Common to B.E. - ECE, BME, EEE, MCT and R&A						

Objectives:
<ul style="list-style-type: none"> To understand the principles of electrochemical processes To explore the functioning of sensors and their applications in industries and health care To get familiarized with the functioning of batteries and fuel cells To acquire knowledge on polymeric materials used in electronics To develop proficiency in nanomaterials

UNIT-I	DYNAMIC ELECTROCHEMISTRY	9
Applied Electrochemistry: Electrode Potential - EMF series - Corrosion- Causes, Consequences and Prevention. Surface Preparation- electropolishing -Electroplating of copper, electrophoretic deposition - Electrochemical machining, electrochemical etching - electrochemical etching of Cu from PCB.		
UNIT-II	ELECTROCHEMICAL SENSORS	9
Electrodes - reference electrodes - ion-selective electrode, determination of electrode potential- Galvanic and concentration cells - potentiometric, amperometric and conductometric methods of analysis - potentiometric sensor, optical sensor, thermal sensor, chemical biosignals- sensors for health care – glucose and urea sensors, gas sensors for CO ₂ , O ₂ and NH ₃ sensing- blood oxygen sensor.		
UNIT-III	ELECTROCHEMICAL ENERGY SYSTEMS	9
Batteries- types - characteristics-fabrication and working of lead-acid battery- NICAD battery – Nickel metal hydride batteries -lithium-ion battery - Supercapacitors- introduction - types - electrochemical double layer capacitor - activated carbon - carbon aerogels. Fuel cells - classification – principle, working and applications of hydrogen-oxygen fuel cell - solid oxide fuel cell - direct methanol fuel cell and proton exchange membrane fuel cells-biofuel cells.		
UNIT-IV	POLYMERS IN ELECTRONICS	9
Conducting polymers - conducting mechanisms- polyaniline, Poly pyrrole - photonic polymers - photo resists - Introduction, Liquid crystalline phases, Identification of the mesophases, Lyotropic main chain liquid crystalline polymers, Thermotropic main chain liquid crystal polymers, Applications of liquid Crystals in Displays (LCDs) - Organic LEDs-functioning-advantages and disadvantages over conventional LEDs- commercial uses.		
UNIT-V	NANO MATERIALS	9
Introduction-Types of nanomaterials-Emergence and challenges in nanotechnology- Synthesis routes for nanomaterials: Bottom-up and top-down approaches- Sol-gel, precipitation, Hydrothermal, Solvothermal, Microwave irradiation, Chemical Vapour Deposition (CVD), Electro deposition- Properties of nanomaterials- Mechanical properties, Chemical, Optical, Electrical and Magnetic properties-applications of nanomaterials.		
Total Contact Hours: 45		

Description of the Experiments:	Total Contact Hours: 30
1. Construction and determination of EMF of simple electrochemical cells and concentration cells	
2. Estimation of acids by pH metry	
3. Determination of corrosion rate on mild steel by weight loss method	
4. Estimation of mixture of acids by conductometry	
5. Estimation of extent of corrosion of iron pieces by potentiometry	
6. Estimation of copper / ferrous ions by spectrophotometry	
7. Estimation of DO by using sensors	
8. Estimation of concentration of sulphate/chloride ions in the given sample solution.	
9. Determination of molecular weight of a polymer by viscometry method	
10. Synthesis of nanomaterials by simple precipitation method	

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> • Apply the knowledge of electrochemistry in exploring electrochemical processes. • Associate the knowledge of sensors in health care and in pollution abatement • Recognize the types of batteries and fuel cells • Employ advanced materials in industrial applications and display techniques • Develop nano and biomaterials for medical applications

Suggested Activities:

- Electroplating process by group of students
- Ceramic coating on implant materials
- Electropolishing of metals and alloys

Suggested Evaluation Methods:

- Continuous assessment tests
- Assignments
- Model lab examination
- End semester examination

Text Book(s):

1. P. C. Jain and Monika Jain, "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2015
2. O.G.Palanna, "Engineering Chemistry", McGraw Hill Education (India) Pvt, Ltd, New Delhi, 2017
3. Shikha Agarwal "Engineering Chemistry-Fundamentals and applications", Cambridge University Press, New Delhi, 2015

Reference Books(s) / Web links:

- Gowarikar V. R., Viswanathan N.V. and Jayadev Sreedhar, —Polymer Science, New Age International (P) Ltd., New Delhi, 2011
- Sujata V Bhat, "Biomaterials", Narosa Publishing House, New Delhi, 2002
- PradeepT, "A Text Book of Nanoscience and Nanotechnology", Tata McGraw Hill, New Delhi, 2012
- An Introduction to Nanomaterials and Nanoscience (PB 2020) : Asim K Das, Mahua Das, CBS publishers and distributors Pvt. Ltd.
- NPTEL course Elementary Electrochemistry course url
https://onlinecourses.nptel.ac.in/noc23_cy19/preview
- For downloading text/reference books the weblink is given below can be used
<http://libgen.rs/>

Lab equipment required:

S. No.	Name of the Equipment	Quantity Required
1.	Oxygen sensors	10
2.	Ion selective electrodes for various ions in solution	10
3	Spectrophotometer	4
4	Magnetic stirrer with hot plate	10

Suggested Evaluation Methods:

- Experiment based viva
- Quizzes

Web links for virtual lab (if any)

<https://drive.google.com/drive/folders/1k8g7fGRJ0D8FPbjQYg4l5jS1U9qIXnJ>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CY23131.1	2	2	1	-	-	-	-	-	-	-	-	1	-	1	1
CY23131.2	3	2	1	-	-	1	1	-	-	-	-	1	-	1	1
CY23131.3	2	1	1	-	-	-	-	-	-	-	-	-	-	-	1
CY23131.4	2	1	1	-	-	-	-	-	-	-	-	1	-	-	1
CY23131.5	3	2	2	-	-	-	-	-	-	-	-	1	-	-	1
Average	2.4	1.6	1.2	-	-	1	1	-	-	-	-	1	-	1	1

Course Code	Course Title	Category	L	T	P	C
GE23131	PROGRAMMING USING C	ES	1	0	6	4

Objectives:

• To develop C programs using basic programming constructs
• To develop C programs using arrays and strings
• To do searching and sorting algorithms in C
• To develop applications in C using user defined functions and recursive functions
• To develop applications in C using pointers and structures

List of Experiments:

1.	Overview of C, Constants, Variables and Data Types
2.	Operators and Expressions, Managing Input and Output Operations
3.	Decision Making and Branching
4.	Decision Making and Looping
5.	Nested Loops - while and for, Jumps in Loops
6.	One-Dimensional Arrays
7.	Searching Algorithms - Linear and Binary
8.	Sorting Algorithms - Bubble and Selection
9.	Two-Dimensional and Multi-dimensional Arrays
10.	Character Arrays and Strings Handling Functions
11.	User-Defined Functions - Recursive Functions
12.	Passing Arrays and Strings to Functions
13.	Scope, Visibility and Lifetime of Variables
14.	Structures and Unions
15.	Pointers
16.	The Preprocessor
Total Contact Hours: 105	

Lab Requirement: GCC Compiler for Windows/Linux

Text Book(s):

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Second Edition, PHI
2. Byron Gottfried, "Programming in C", Second Edition, Schaum Outline Series

Reference Books(s) / Web links:

• Herbert Schildt, "C: The Complete Reference", Fourth Edition, McGraw Hill.
• Yashavant Kanetkar, "Let Us C", BPB Publications
• E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
• NPTEL course , "Problem Solving Through Programming In C", By Prof. Anupam Basu, IIT Kharagpur

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

• Formulate simple algorithms for arithmetic and logical problems.
• Implement conditional branching, iteration and recursion.
• Decompose a problem into functions and synthesize a complete program using divide and conquer approach.
• Use arrays, pointers and structures to formulate algorithms and programs.
• Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Suggested Activities:

• Practice small and tricky codes
• Practice problems in portals like Digital café
• Debugging the codes
• Completing the function definitions etc

PO/PSO CO	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
GE23131.1	1	2	2	2	1	-	-	-	1	2	1	1	2	3	-
GE23131.2	1	1	1	1	1	-	-	-	-	-	1	1	2	2	-
GE23131.3	1	1	2	1	1	-	-	-	-	-	1	1	2	2	-
GE23131.4	2	2	3	2	1	-	-	-	1	-	2	1	2	2	2
GE23131.5	2	2	3	2	1	-	-	-	-	-	2	1	2	2	2
Average	1.4	1.6	2.2	1.6	1.0	-	-	-	1.0	2.0	1.4	1.0	2.0	2.2	2.0

Course Code	Course Title	Category	L	T	P	C
GE23122	ENGINEERING PRACTICES - ELECTRICAL AND ELECTRONICS	ES	0	0	2	1

Objectives:

- To provide hands-on experience on various basic engineering practices in Electrical Engineering.
- To provide hands-on experience on various basic engineering practices in Electronics Engineering.

List of Experiments:
A. ELECTRICAL ENGINEERING PRACTICE

1	Residential house wiring using switches, fuses, indicators, lamp and energy meter.
2	Fluorescent lamp wiring.
3	Stair case wiring.
4	Measurement of electrical quantities – voltage, current, power & power factor in RL circuit.
5	Measurement of earth resistance using Megger.
6	Study of Ceiling Fan and Iron Box

B. ELECTRONICS ENGINEERING PRACTICE

1	Study of electronic components and equipment – Resistor, colour coding, measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO/DSO.
2	Measurement of electrical quantities using Multimeter Testing of electronic components.
3	Study of logic gates : AND, OR, EXOR and NOT.
4	Generation of Clock Signals.
5	Soldering practice – Components Devices and Circuits – Using general purpose PCB.
6	Measurement of ripple factor of Half-wave and Full-wave Rectifiers.

Total Contact Hours: 30

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

- fabricate the basic electrical circuits
- implement the house wiring circuits
- fabricate the electronic circuits
- verify the truth table of logic gates
- design the Half-wave and Full-wave Rectifiers using diodes and passive components

Suggested Evaluation Methods:

- Experiment based viva

Reference Book(s):

- Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, 2007.
- Jeyachandran K., Natarajan S. & Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
- Jeyapooan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas Publishing House Pvt.Ltd, 2006.
- Rajendra Prasad A. &Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.

Lab Equipment Required:

S.No.	Name of the Equipment	Quantity Required
1	Residential house wiring using switches, fuse, indicator, lamp and energy	3 Nos
2	Fluorescent lamp wiring.	3 Nos
3	Stair case wiring	3 Nos
4	Measurement of electrical quantities – voltage, current, power & power factor	2 Nos
5	Study purpose items: Iron box, Ceiling fan.	2 each
6	Megger (250V/500V)	2 Nos.
7	Soldering guns	10 Nos.
8	Assorted electronic components for making circuits	50 Nos.
9	Small PCBs	10 Nos.
10	Multimeters	10 Nos.
11	Digital trainer kit	5 Nos.
12	CRO	8 Nos.
13	Transformer	8 Nos.
14	Function Generator	8 Nos.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23122.1	3	3	3	2	-	-	2	-	3	2	-	3	-	1	1
GE23122.2	3	3	2	2	-	-	2	-	3	2	-	3	-	1	1
GE23122.3	3	3	3	2	-	-	2	-	3	2	-	3	-	1	1
GE23122.4	3	3	3	2	-	-	-	-	3	2	-	3	-	1	1
GE23122.5	3	3	3	2	-	-	-	-	3	2	-	3	-	1	1
Average	3	3	2.67	2	-	-	2	-	3	2	-	3	-	1	1

Course Code	Course Title	Category	L	T	P	C
MC23111	INDIAN CONSTITUTION AND FREEDOM MOVEMENT	MC	3	0	0	0
Common to all branches of B.E/B. Tech Programmes – First / Second / Third Semester						

Objectives:
<ul style="list-style-type: none"> To apprehend the sacrifices made by the freedom fighters. To inculcate the values enshrined in the Indian constitution. To instil a sense of responsibility as the citizens of India. To familiarise about the functions of the various levels of Government. To be informed about Constitutional and Non- Constitutional bodies.

UNIT-I	INDIAN FREEDOM MOVEMENT	9
British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India-Indian Freedom Struggle under Mahatma Gandhi-Non- Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition.		
UNIT-II	CONSTITUTION OF INDIA	9
Historical Background – Indian Constitution: Constitution’ meaning of the term, Sources and constitutional history, Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.		
UNIT-III	STRUCTURE AND FUNCTIONS OF CENTRAL GOVERNMENT	9
Union Government – Structure of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.		
UNIT-IV	STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY	9
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, Elected officials and their roles, Village level: Role of Elected and Appointed officials.		
UNIT-V	CONSTITUTIONAL FUNCTIONS AND BODIES	9
Indian Federal System – Centre – State Relations – President’s Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies.		
Total Contact Hours: 45		

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> appreciate the sacrifices made by freedom fighters during freedom movement. be responsible citizens and abide by the rules of the Indian constitution. be aware of the functions of the Indian government. be knowledgeable about the functions of the state Government and the Local bodies. apply the knowledge on constitutional functions and role of constitutional bodies and non-constitutional bodies.

Suggested Activities:
<ul style="list-style-type: none"> Famous speeches from around the world relating to independence Case study Quiz on Portfolio and Cabinet Discussions on International Associations like the UN, BRICS, QUAD Presentation on issues around the world

Suggested Evaluation Methods:
<ul style="list-style-type: none"> Assignment topics Quizzes Class Presentation/Discussion Continuous assessments (CAT)

Text Book(s):															
1. M. Laxmikanth , “Indian Polity:, McGraw-Hill, New Delhi.															
2. Durga Das Basu, “Introduction to the Constitution of India “, Lexis Nexis, New Delhi. 21 st ed 2013.															
3. P K Agarwal and K N Chaturvedi ,PrabhatPrakashan, New Delhi, 1 st ed , 2017.															

Reference Books(s) / Web links:															
1. Sharma, Brij Kishore, “Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.															
2. U.R.Gahai, “Indian Political System “, New Academic Publishing House, Jalaendhar															
3. Bipan Chandra, India’s Struggle for Independence, Penguin Books, 2016.															
4. Maciver and Page, “Society: An Introduction Analysis “, Mac Milan India Ltd., New Delhi.2 nd ed, 2014.															
5. Bipan Chandra, History of Modern India, Orient Black Swan, 2009.															

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MC23111. 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MC23111.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MC23111.3	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
MC23111.4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
MC23111.5	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-
Average	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-

SEMESTER – II

Course Code	Course Title	Category	L	T	P	C
MA23212	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	BS	3	1	0	4
Common to II Sem. B.E. –AERO, AUTO, BME, CIVIL, EEE, ECE, MECH, MCT, R&A and B. Tech. - BT, FT & CHEM						

Objectives:

- To provide students with an introduction to the theory of ordinary differential equations through applications, methods of solution, and numerical approximations.
- To introduce students to how to solve linear Partial Differential with different methods.
- To enable the students to study the Laplace Transforms, properties of Laplace Transform, inverse Laplace Transform and some applications to solve the differential equations and integral equations.
- To explain the concept of a vector integration in a plane and in space.
- To describe basic properties of complex variables and to have the ability to compute complex integrals.

UNIT-I	ORDINARY DIFFERENTIAL EQUATIONS	12
Second and higher order Linear differential equations with constant coefficients - Method of variation of parameters – Legendre's linear equations – Numerical solution of ODE - Single Step methods: Taylor's series method, Euler's method.		
UNIT-II	PARTIAL DIFFERENTIAL EQUATIONS	12
Formation of partial differential equations - Classification of PDE – Solutions of standard types of first order partial differential equations - Lagrange's linear equation –Linear homogeneous partial differential equations of second and higher order with constant coefficients.		
UNIT-III	LAPLACE TRANSFORM	12
Laplace transform –Basic properties – Transforms of derivatives and integrals of functions - Transforms of unit step function and impulse functions, periodic functions. Inverse Laplace transform – Problems using Convolution theorem – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques		
UNIT-IV	VECTOR CALCULUS	12
Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.		
UNIT-V	COMPLEX VARIABLES	12
Analytic functions — Construction of analytic function - Bilinear transformation –Singularities – Cauchy's integral theorem (without proof) - Residues – Residue theorem (without proof) - Simple problems - Contour integral over $ z =1$.		
Total Contact Hours: 60		

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

- Apply the methods as a potent tool in the solution of a variety of problems in the natural sciences and technology.
- Develop specific methodologies, techniques and resources in Partial differential equations to conduct research and produce innovative results in the area of specialisation.
- Use Laplace transform and inverse transform techniques to solve the complex problems in engineering and technology.
- Apply the concepts in multivariable analysis, including space curves; directional derivative; gradient; multiple integrals; line and surface integrals; vector fields; divergence, curl ; the theorems of Green and Stokes, and the divergence theorem in different fields of engineering.
- Demonstrate the concept of Analytic functions, conformal mapping and complex integration in solving Engineering problems.

Suggested Activities:

- Problem solving sessions
- Activity based learning

Suggested Evaluation Methods:

- Problem solving in tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):

1. Grewal B.S., "Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Veerarajan. T, Engineering Mathematics –II, Mc Graw Hill Education, 2018.
3. Erwin Kreyszig, " Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
4. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
5. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.

Reference Books(s) / Web links:

1. Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. T Veerarajan, Transforms and Partial Differential Equations, Third Edition, 2018.
3. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 4th Edition 2006.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23212.1	3	2	1	-	-	-	-	-	-	-	-	1	-	-	1
MA23212.2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	1
MA23212.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
MA23212.4	2	2	1	-	-	-	-	-	-	-	-	-	-	-	1
MA23212.5	3	2	1	-	-	-	-	-	-	-	-	1	-	-	1
Average	2.8	2	1	-	-	-	-	-	-	-	-	1	-	-	1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்:

3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:

3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரம் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்:

3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:

3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுவித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கல்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் :

3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

Total Contact Hours: 15**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu)(Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies).
9. Keeladi – ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	Course Title	Category	L	T	P	C
EE23132	BASIC ELECTRICAL ENGINEERING	ES	3	0	2	4

Objectives:
<ul style="list-style-type: none"> To provide knowledge on the analysis of DC circuits. To teach methods of analysis of AC circuits. To impart knowledge on principles of operation of electrical machines. To teach the basics of electrical safety measures. To provide hands on experience on electric circuits and machines

UNIT-I	DC CIRCUITS	9
Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's laws, Mesh and Nodal Analysis, Superposition, Thevenin's, Norton's Theorems and Maximum Power Transfer Theorem		
UNIT-II	AC CIRCUITS	9
Representation of sinusoidal waveforms, Power and Power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations. Three phase balanced circuits.		
UNIT-III	DC MOTORS AND TRANSFORMERS	9
Construction, working and characteristics of DC motors. Construction, principle of operation of single-phase Transformer, EMF Equation.		
UNIT-IV	AC ROTATING MACHINES	9
Construction and basic working of three phase Alternators and Induction motors, Construction and Types of single-phase induction motors- Construction and basic working of Stepper motor, Permanent magnet Brushless Motor (PMBLDC) (Qualitative Treatment Only).		
UNIT-V	ELECTRICAL SAFETY MEASURES	9
Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection -Safety in the use of portable tools - Preventive maintenance- Types of earthing and its importance-Safety precautions for electrical appliances- National electrical Safety code - Indian electricity acts and rules		
		Total Contact Hours: 45

List of Experiments:	
1. Kirchhoff's laws	
2. Network theorems (Thevenin's , Norton's and Maximum Power Transfer Theorems)	
3. Determination of Impedance and Current in RL, RC and RLC series circuits	
4. Measurement of voltage and current in three phase balanced star & delta connected loads	
5. Load test on DC shunt motor (Virtual Lab)	
6. Load test on single-phase transformer (Virtual Lab)	
7. Load test on three phase induction motor (Virtual Lab)	
8. Load test on Single phase induction motor	
	Contact Hours: 30
	Total Contact Hours: 75

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> analyse DC circuits and apply circuit theorems. calculate the power and power factor in AC circuits comprehend the principles of electrical machines. realise the electrical safety precautions. experimentally analyze the electric circuits and machines.

Suggested Activities:
<ul style="list-style-type: none"> Problem solving sessions
Suggested Evaluation Methods:
<ul style="list-style-type: none"> Quizzes Class Presentation / Discussion

Text Book(s):	
1.	E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
2.	J.B.Gupta, “Fundamentals of Electrical Engineering and Electronics” S.K.Kataria & Sons Publications, 2010.
3.	K.Venkataratnam, —Special Electrical Machines, Universities Press (India) Private Limited, 2008.
4.	John Cadick, P.E. Mary Capelli-Schellpfeffer, M.D., M.P.A. Dennis K. Neitzel, C.P.E. “Al Winfield Electrical Safety Hand Book, fifth edition, The McGraw-Hill 2012.

Reference Books(s) / Web links:	
1.	Joseph A. Edminister, Mahmood, Nahri, “Electric Circuits” – Schaum Series and Systems”, Schaum’s Outlines, Tata McGrawHill, Indian. 5 th Edition , 2017
2.	D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3.	D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.
4.	L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
5.	https://nptel.ac.in/courses/108108076
6.	E G Janardanan, —Special Electrical Machines, Prentice Hall India Limited, 2013.
7.	Maxwell Adams.J, “Electrical safety- a guide to the causes and prevention of electric hazards”,The Institution of Electric Engineers, 1994.

Lab Equipment Required:

S.No.	Name of the equipment	Quantity Required (for batch of 30 students)
1.	Verification of Kirchhoff's Laws 1. DC Regulated Power supply (0 - 30 V variable) 2. Bread Board 3. Resistors 4. Ammeter (0-50)mA 5. Voltmeter (0-30)V 6. Multimeter 7. Connecting wires	1 1 As per Circuit diagram 3 3 1 As Required
2.	Verification of Network Theorems (Thevenins and Nortons) 1. DC Regulated Power supply (0 - 30 V variable) 2. Bread Board 3. Resistors 4. Ammeter (0-50)mA 5. Voltmeter (0-30)V 6. Multimeter 7. Connecting wires	1 1 As per Circuit diagram 1 1 1 As Required
3.	Determination of current and Impedance in RL, RC and RLC series circuit 1. DC Regulated Power supply (0 - 30 V variable) 2. Resistors, Inductors and capacitors 3. Ammeter (0-50)mA 4. Voltmeter (0-30)V 5. Connecting wires	1 As per Circuit diagram 1 1 As Required
4.	Measurement of Voltage and Current in Three Phase Balanced Star and Delta Connected Loads 1. Three phase star& delta connected load / Single phase load bank of suitable rating 2. Ammeter and Voltmeter 3. Connecting wires	3 As per Circuit diagram As Required

5.	Load test on DC Shunt Motor. 1. Ammeter MC (0-20A) 2. Voltmeter MC (0-300)V 3. Tachometer 4. Field Rheostat 500 Ω , 1.5 A 5. Connecting wires	1 1 1 1 As Required
6.	Load test on Single phase Transformer 1. Ammeter (0-30) A, (0-5) A 2. Voltmeter (0-150)V, (0-300)V 3. Wattmeter – 300V, 5A, UPF 4. Autotransformer 5. Single phase Transformer 6. Connecting Wires	1 1 1 1 1 As Required
7.	Load Test on Three phase Induction Motor 1. Ammeter MI (0-20A) 2. Voltmeter MI (0-300)V 3. Wattmeter – 300V, 30 A 4. Tachometer – Digital 5. Three phase Induction motor 6. Connecting Wires	1 1 1 1 1 As required

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE23132.1	3	3	3	3	-	3	1	1	2	1	1	1	-	-	-
EE23132.2	3	3	3	3	-	3	1	1	2	1	1	1	-	-	-
EE23132.3	3	3	3	3	-	3	1	1	2	1	1	1	-	-	-
EE23132.4	3	3	3	3	-	3	1	1	2	1	1	1	-	-	-
EE23132.5	3	3	3	3	-	3	3	1	2	1	1	1	-	-	-
Average	3	3	3	3	-	3	1.4	1	2	1	1	1	-	-	-

Course Code	Course Title	Category	L	T	P	C
PH23232	PHYSICS FOR ELECTRONICS ENGINEERING	BS	3	0	2	4
Common to II sem. B.E. – Electronics and Communication Engineering & Electrical and Electronics Engineering						

Objectives:
<ul style="list-style-type: none"> To understand the essential principles of electron transport properties. To impart the knowledge on the properties of semiconductors. To become proficient in magnetic, superconducting and dielectric properties of materials. To expose the properties and applications of optical materials. To enhance the fundamental knowledge on quantum confinement and nano based devices.

UNIT-I	ELECTRICAL PROPERTIES OF MATERIALS	9
Classical free electron theory - expression for electrical conductivity - electrons in metals –Introduction to quantum physics-wave function-Schrodinger equation- particle in a box-one dimension - degenerate states - Fermi Dirac statistics - density of energy states – Quantum mechanical theory of electrical conductivity- electron effective mass – concept of hole.		
UNIT-II	SEMICONDUCTOR PHYSICS	9
Intrinsic semiconductors - energy band diagram - direct and indirect semiconductors - carrier concentration in intrinsic semiconductors-Band gap determination –extrinsic semiconductors - carrier concentration in N-type and P-type semiconductors. Hall effect-determination of Hall co-efficient and applications. PN and Metal–Semiconductor Junctions: Energy band diagram and Depletion Layer of a PN Junction, Built-in potential, Carrier injection under forward bias.		
UNIT-III	MAGNETIC, SUPERCONDUCTOR AND DIELECTRIC PROPERTIES OF MATERIALS	9
Magnetism in materials - magnetic field and induction - magnetization - magnetic permeability and susceptibility - types of magnetic materials - microscopic classification of magnetic materials. Ferromagnetism: domain theory. Superconductor: critical temperature, zero electric resistance, Meissner effect and critical magnetic field. Dielectric materials: Polarization processes - internal field -dielectric loss -high-k dielectrics.		
UNIT-IV	OPTOELECTRONICS	9
Classification of optical materials - carrier generation and recombination processes. Absorption, emission and scattering of light in metals, insulators and semiconductors (concepts only). Solar cell - photo detectors - LED - Organic LED –laser diodes - NLO materials-properties and applications.		
UNIT-V	NANOELECTRONIC DEVICES	9
Introduction - size dependence of Fermi energy- quantum confinement - quantum structures. quantum well, quantum wire and quantum dot structures. Tunnelling-Coulomb blockade effects - single electron phenomena and single electron transistor - magnetic semiconductors–spintronics - Quantum computing basics of q-bits, superposition and quantum entanglement (qualitative), MEMS: Cantilever.		
Contact Hours: 45		

List of Experiments:
1. Determination of Planck's constant using colour LED
2. Determination of Band gap of semiconducting material.
3. Determination of Hall coefficient of semiconductor.
4. Determine the hysteresis loss in the transformer core using B-H curve unit.
5. Determination of free space permeability using Helmholtz coil.
6. Determination of magnetic susceptibility of ferrous liquid using Quincke's Method.
7. Determination of Resonance frequency of LCR series circuit.
8. Determination of wavelength of diode laser using diffraction grating.
9. Determination of fill factor of solar cell.
10. Determination of quantum efficiency of photo diode from I-V Characteristic curve.
Contact Hours: 30
Total Contact Hours: 75

Course Outcomes: On completion of the course, students will be able to
• apply the concept of electron transport in devices.
• analyse the physical properties of semiconductors.
• analyse the properties of magnetic and dielectric materials.
• analyse the properties of optical materials used for optoelectronics.
• analyse the quantum behaviour of semiconductor MEMS and nanoelectronic devices.

Suggested Activities:
• Problem solving sessions

Suggested Evaluation Methods:
• Quizzes
• Class Presentation / Discussion

Text Book(s):
1. Kasap, S.O. Principles of Electronic Materials and Devices, McGraw-Hill Education, 2017.
2. Wahab, M.A. Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2020.

Reference Books(s) / Web links:
1. Garcia, N. & Damask, A. Physics for Computer Science Students: with emphasis on Atomic and Semiconductor Physics. Springer-Verlag, 2012.
2. Hanson, G.W. Fundamentals of Nanoelectronics. Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S. Nanotechnology: Understanding Small Systems. CRC Press, 2014.
4. S. O. Pillai, Solid State Physics (Multi colour Edition) , New Age International, 2018.
5. Umesh K Mishra & Jasprit Singh, Semiconductor Device Physics and Design, Springer, 2008.

Lab Equipment Required:

S. No	Name of the equipment	Quantity Required
1	Band gap of a semiconductor setup	8
2	Hall coefficient of semiconductor setup	4
3	B-H curve setup and CRO	6
4	Determination of permeability of free space - Helmholtz coil setup	5
5	Magnetic Susceptibility– Quincke’s tube, Electromagnet, Power supply Traveling Microscope	4
6	LCR circuit kit	7
7	Solar cell parameters setup	6
8	Determination of Plank’s constant - Rheostat, Multimeter, LED	8
9	Photo diode Characteristics.	6
10	Wavelength of Laser and Characteristics -Laser source and grating plate.	6

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH23232.1	3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
PH23232.2	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-
PH23232. 3	3	2	1	-	-	-	-	-	-	-	-	-	1	1	-
PH23232. 4	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-
PH23232.5	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-
Average	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-

Course Code	Course Title	Category	L	T	P	C
CS23231	DATA STRUCTURES	ES	3	0	4	5

Objectives:

•	To apply the concepts of Linked List in the applications of various linear data structures.
•	To demonstrate the understanding of stacks, queues and their applications.
•	To apply the concepts of Linked List in the applications of various nonlinear data structures.
•	To understand the implementation of graphs and their applications.
•	To be able to incorporate various sorting and hashing techniques in real time scenarios

UNIT-I	LINEAR DATA STRUCTURES – LIST	9
Self-Referential Structures, Dynamic Memory Allocation, Linked list implementation - Singly Linked List, Doubly Linked List, Circular Linked List, Applications of List.		
UNIT-II	LINEAR DATA STRUCTURES – STACKS, QUEUES	9
Stack – Operations, Array and Linked list implementation, Applications – Evaluation of Arithmetic Expressions, Queues- Operations, Array and Linked list Implementation.		
UNIT-III	NON LINEAR DATA STRUCTURES – TREES	9
Tree Terminologies, Binary Tree Representation, Tree Traversals, Binary Search Trees, Binary Heap, Height Balance trees – AVL Trees.		
UNIT-IV	NON LINEAR DATA STRUCTURES – GRAPHS	9
Representation of Graphs, Topological Sort, Depth First Search and Breadth-First Search , Minimum Spanning Tree – Prim's Algorithm, Shortest path algorithm – Dijkstra's Algorithm.		
UNIT-V	SEARCHING, SORTING AND HASHING TECHNIQUES	9
Sorting Techniques –Insertion Sort, Quick Sort, Merge Sort, Hashing- Hashing functions – Mid square, Division, Folding, Collision Resolution Techniques – Separate Chaining – Open Addressing – Rehashing.		
Contact Hours: 45		

Course Outcomes: On completion of the course, students will be able to
• Understand and apply the various concepts of Linear data structures
• Understand and apply the various concepts of Non Linear data structures.
• Understand and apply the various sorting and Hashing concepts.
• Analyse and apply the suitable data structure for their research.
• Choose efficient data structures and apply them to solve real world problems.

Suggested Activities:

- Role play- Linked List (Unit 1).
- Mind Map, Poster Design - Stack and Queue (Unit 2).
- Flipped Classroom - Binary Heap (Unit 3).
- Poster Design - Graph (Unit4).
- Implementation of small module- Hashing (Unit5).

Suggested Evaluation Methods:

- Assignment problems - Linked List (Unit 1).
- Tutorial problems - Applications – Evaluation of Arithmetic Expressions (Unit 2).
- Quizzes - BST and Binary Heap (Unit 3).
- Tutorial problems- Graph traversal (Unit 4).
- Quizzes - Hashing and Sorting (Unit5) .

Text Book(s):

1. “Data Structures and Algorithm Analysis in C”, Mark Allen Weiss, 2nd Edition, Pearson Education, 2005
2. “Data Structures and Algorithm Analysis in C++ - Anna University, Mark Allen Weiss, Pearson Education, 2017.

Reference Books(s) :															
1. “Data Structures Using C and C++”, Langsam, Augenstein and Tanenbaum, 2 nd Edition, Pearson Education, 2015.															
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms”, Fourth Edition, Mcgraw Hill/ MIT Press, 2022.															

List of Experiments:	
1.	Implementation of Single Linked List (Insertion, Deletion and Display).
2.	Implementation of Doubly Linked List (Insertion, Deletion and Display).
3.	Implementation of Stack using Array and Linked List implementation.
4.	Implementation of Queue using Array and Linked List implementation.
5.	Implementation of Binary Search Tree and perform Tree Traversal Techniques.
6.	Program to perform Quick Sort
7.	Program to perform Merge Sort
8.	Program to perform Linear Probing.
9.	Program to perform Rehashing.
10.	Mini Project: <ul style="list-style-type: none">• Contact book application using Linked List.• Dictionary using Binary search trees.• Snake Game.• Chess Game.• Travel Planner (Shortest Path Algorithm).• Tic-Tac-Toe Game.• Library Management System.• Project Management System.• other projects.
Contact Hours: 60	
Total Contact Hours: 105	
Platform Needed: GCC Compiler for Windows/Linux	

Course Outcomes: On completion of the course students will be able to															
<ul style="list-style-type: none"> • Analyze the various data structure concepts. • Implement Stacks and Queue concepts for solving real-world problems. • Analyze and structure the linear data structure using tree concepts. • Critically Analyse various non-linear data structures algorithms. • Apply different Sorting, Searching and Hashing algorithms. 															

Web links for Theory & Lab(if any):															
Data Structures - GeeksforGeeks															
Data Structures DS Tutorial - javatpoint															
Data Structure and Types (programiz.com)															

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS23231.1	1	2	1	2	1	-	-	-	-	-	-	1	1	2	-
CS23231.2	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS23231.3	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS23231.4	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS23231.5	1	1	2	1	1	-	-	-	-	-	-	1	1	2	-
Average	1.0	1.2	1.8	1.2	1.0	-	-	-	-	-	-	1.6	1.6	2.0	-

Course Code	Course Title	Category	L	T	P	C
GE23111	ENGINEERING GRAPHICS	ES	2	0	4	4

Objectives:
<ul style="list-style-type: none"> To understand the importance of the drawing in engineering applications To develop graphic skills for communication of concepts, ideas and design of engineering products To expose them to existing national standards related to technical drawings. To improve their visualization skills so that they can apply this skill in developing new products. To improve their technical communication skill in the form of communicative drawings

CONCEPTS AND CONVENTIONS (Not for Examination)		1
Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications–Size, layout and folding of drawing sheets– Lettering and dimensioning. Basic Geometrical constructions.		
UNIT-I	PLANE CURVES AND PROJECTION OF POINTS	5 + 12
Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method – Cycloidal Curves–Construction of cycloid, epicycloid and hypocycloid – Construction of involutes of square and circle– Drawing of tangents and normal to the above curves.		
Principles of Projection and Projection of points.		
UNIT-II	PROJECTION OF LINES AND PLANE SURFACES	6 + 12
Projection of straight lines (First angle projection) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method		
Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
UNIT-III	PROJECTION OF SOLIDS AND PROJECTION OF SECTIONED SOLIDS	6 + 12
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.		
Sectioning of solids in simple vertical position when the cutting plane is inclined to HP and perpendicular to VP – obtaining true shape of the section.		
Practicing three-dimensional modeling of simple objects by CAD software (Not for examination)		
UNIT-IV	DEVELOPMENT OF SURFACE AND ISOMETRIC PROJECTIONS	6 + 12
Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		
Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones		
Model making of isometric projection of combination of solids as assignment (Not for End semester)		
UNIT-V	FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS	6 + 12
Free Hand sketching: Freehand sketching of multiple views from pictorial views of objects - Freehand sketching of pictorial views of object from multiple views		
Perspective projection of simple solids-Prisms, pyramids, cylinder and cone by visual ray method.		
Total Contact Hours: (L=30; P=60) 90 Periods		

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> To construct different plane curves and to comprehend the theory of projection To draw the basic views related to projection of lines and planes To draw the projection of simple solids and to draw the projection of development of surfaces of Sectioned solids in simple vertical position To draw the orthographic projection from pictorial objects and Isometric projections of simple solids To visualize Perspective view of simple solids

Text Book(s):															
1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50 th Edition, 2010.															
2. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2017.															

Reference Books(s) / Web links:															
1. Varghese P I., “Engineering Graphics”, McGraw Hill Education (I) Pvt.Ltd., 2013.															
2. V.B Sikka “Civil Engineering Drawing”, S.K Kataria & Sons, New Delhi.															
3. Venugopal K. and PrabhuRaja V., “Engineering Graphics”, New Age International (P)Limited, 2008.															
4. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2017.															
5. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill Publishing Company Limited, New Delhi, 2018.															

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23111.1	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.2	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.3	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.4	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.5	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
Average	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-

Course Code	Course Title	Category	L	T	P	C
GE23121	ENGINEERING PRACTICES – CIVIL AND MECHANICAL	ES	0	0	2	1

Objectives:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

List of Experiments:

CIVIL ENGINEERING PRACTICE	
1.	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2.	Preparation of basic plumbing line sketches for wash basins, water heaters, etc.
3.	Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.
Carpentry Works:	
4.	Study of joints in roofs, doors, windows and furniture.
5.	Hands-on-exercise: Woodwork, joints by sawing, planning and chiselling.
MECHANICAL ENGINEERING PRACTICE	
6.	Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
7.	Gas welding practice.
Basic Machining:	
8.	Simple Turning and Taper turning
9.	Drilling Practice
Sheet Metal Work:	
10.	Forming & Bending:
11.	Model making – Trays and funnels
12.	Different type of joints.
Machine Assembly Practice:	
13.	Study of centrifugal pump
14.	Study of air conditioner
Total Contact Hours: 30	

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

•	perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
•	perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
•	produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
•	perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine
•	perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays, funnels, etc.

Lab Equipment Required:

S.No.	Name of the Equipment	Quantity Required (For a Batch of 30 Students)
1	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings meter.	15 Sets
2	Plumbing vice (fitted to work bench)	15 Nos
3	Carpentry vice (fitted to work bench)	15 Nos
4	Standard woodworking tools	15 Sets
5	Models of industrial trusses, door joints, furniture joints	5 each
6	Power Tools: (a) Rotary Hammer (b) Circular Saw (c) Electric Planer (d) Hand Drilling Machine (e) Jigsaw (f) Cutoff Machine	Each 1 No.
7	Arc welding transformer with cables and holders	5 Nos
8	Welding booth with exhaust facility	5 Nos
9	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
10	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit	1 No
11	Centre lathe	5 Nos
12	Standard Sheet metal working tools	2 sets
13	Study-purpose items: centrifugal pump, air-conditioner	1 each

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23121.1	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
GE23121.2	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
GE23121.3	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
GE23121.4	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
GE23121.5	1	-	-	-	-	1	-	-	-	-	-	1	-	1	1
Average	1.0	-	-	-	-	1.0	-	-	-	-	-	1.0	-	1.0	1.0

Course Code	Course Title	Category	L	T	P	C
HS23221	TECHNICAL COMMUNICATION II	HS	0	0	2	1
Common to all branches of B.E/B. Tech programmes –Second Semester						

Objectives:
<ul style="list-style-type: none"> To facilitate students to improve their vocabulary for a better communication To enable learners to understand and reproduce language To aid students to write technical reports in a convincing manner To expose students to different sentence structures To equip learners to present their ideas in an efficient manner

UNIT-I	VOCABULARY FOR BETTER COMMUNICATION	6
Listening: Telephonic Conversations and TV News Reading: Newspapers and Magazines Speaking: Conversational Practice: Speaking in a given situation, Asking permission and requesting etc., Writing: Job Application Letter and Resume Grammar: Reference words: pronouns and determiners Vocabulary: Guessing meanings of words in different contexts.		
UNIT-II	FUNCTIONAL LANGUAGE ASPECTS	6
Listening: Motivational listening – listening to real life challenges Reading: Articles and Technical reports Speaking: Using Polite Expressions, Indirect Questions Writing: Paraphrasing a Text, Poem Grammar: Purpose Statements, Cause and Effect Expressions Vocabulary: Neologisms.		
UNIT-III	TECHNICAL REPORTWRITING	6
Listening: Empathetic Listening – Giving Solutions to Problems Reading: Inferential Reading Speaking: Dialogues – Interviewing Celebrities / Leaders / Sportspersons, etc., Writing: Report Writing Grammar: Functional Usage of Expressions – used to, gone / been, etc., Vocabulary: Words Often Confused		
UNIT-IV	STRUCTURAL GRAMMAR	6
Listening: Comprehension (IELTS practice tests) Reading: Intensive Reading for specific information Speaking: Pick and Talk Writing: Proposals Grammar: Sentence Structures – Simple, Compound, Complex Sentences Vocabulary: Replacing dull words with vivid ones		
UNIT-V	PRESENTATION SKILLS	6
Listening: Discriminative listening – sarcasm, irony, pun, etc., Reading: Practice of chunking – breaking up reading materials Speaking: Mini presentation on some topic Writing: Minutes of the meeting Grammar: Correction of Errors Vocabulary: Advanced vocabulary – fixing appropriate words in the given context.		
Total Contact Hours: 30		

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> communicate effectively using appropriate vocabulary use the acquired language skills to comprehend various types of language contents evaluate different texts and write effective technical content use appropriate sentence structures to convey their thoughts in varied contexts present their concepts and ideas in an effective manner

Suggested Activities:

- Story Lines
- One truth and two lies
- Hang Man
- Pictionary
- Word Scramble
- Case study

Suggested Evaluation Methods:

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Book(s):

1. Raymond Murphy, "Intermediate English Grammar," Second Edition , Cambridge University Press, 2018
2. Meenakshi Raman & Sangeeta Sharma, "Technical Communication" Third Edition, Oxford University Press, 2015
3. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMeng Goh, Cambridge University Press

Reference Books(s) / Web links:

1. Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor), "Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English With Answers" 2nd Edition
2. Dale Carnegie, "The Art of Public Speaking," Insight Press
3. Jack C. Richards & Theodore S. Rodgers, " Approaches and Methods in Language Teaching, Second Edition, Cambridge University Press

PO/PSO CO	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
HS23221. 1	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-
HS23221. 2	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23221. 3	-	2	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23221. 4	-	-	-	1	-	-	-	-	2	3	-	-	-	-	-
HS23221. 5	-	-	-	1	-	-	-	-	2	2	-	-	-	-	-
Average	-	2	-	1	-	-	-	-	2	2.6	-	-	-	-	-

Course Code	Course Title	Category	L	T	P	C
HS23222	ENGLISH FOR PROFESSIONAL COMPETENCE	HS	0	0	2	1
Common to all branches of B.E/B. Tech programmes –Second Semester						

Objectives:
<ul style="list-style-type: none"> To facilitate the learners in acquiring listening and reading competence To enable the learners to communicate effectively through written and oral medium To assist the learners in preparing for competitive examinations To train the students in acquiring corporate skills To inculcate professional standards among the students and make them realize their responsibility in addressing the challenges

UNIT-I	RECEPTIVE SKILLS	6
Listening – Comprehensive Listening – Watching the news – Listening to a peer giving presentation, etc. – Critical Listening – Watching a televised debate, Listening to poems – Reading – Extensive Reading – Short stories and One-act Plays – Intensive Reading – Articles or Editorials in Magazines, Blog posts on topics like science and technology, arts, etc.		
UNIT-II	PRODUCTIVE SKILLS	6
Speaking – Demonstrative Speaking – Process description through visual aids – Persuasive Speaking – Convincing the listener with the speaker’s view – Writing – Descriptive Writing - Describing a place, person, process – Subjective Writing – Autobiography, Writing based on personal opinions and interpretations		
UNIT-III	ENGLISH FOR COMPETITIVE EXAMS	6
An introduction to International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service, Indian Economic Service Examination, Indian Statistical Service Examination, Combined Defence Services Examination, Staff Selection- (Language Related) – Aptitude tests.		
UNIT-IV	CORPORATE SKILLS	6
Critical Thinking and Problem Solving – Case Study, Brainstorming, Q & A Discussion – Team work and Collaboration – Activities like Office Debates, Perfect Square, Blind Retriever, etc. – Professionalism and Strong Work Ethics – Integrity, Resilience, Accountability, Adaptability, Growth Mind set		
UNIT-V	PROJECT WORK	6
Case Study based on the challenges faced by the employers and the employees – Devise Plan, Provide Solution		
Total Contact Hours: 30		

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> interpret and respond appropriately in the listening and reading contexts. express themselves effectively in spoken and written communication apply their acquired language skills in writing the competitive examinations exhibit their professional skills in their work place identify the challenges in the work place and suggest strategies solutions

Suggested Activities:
<ul style="list-style-type: none"> Online Quizzes on Vocabulary Online Quizzes on grammar Communication Gap Exercises Presentations Word Building Games Case study

Suggested Evaluation Methods:

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books:

1. How to Read Better & Faster, Norman Lewis, Goyal Publishers
2. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine Chuen Meng Goh, Cambridge University Press
3. The Official Cambridge Guide To IELTS by Pauline Cullen, Cambridge University Press
4. The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK

Reference Books(s) / Web links:

1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.
2. Hartley, Mary. "The Power of Listening," Jaico Publishing House; First Edition (2015).
3. Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS23222. 1	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 2	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 4	-	-	-	-	-	-	2	2	-	3	-	-	-	-	-
HS23222. 5	-	-	1	-	-	-	2	-	-	3	-	-	-	-	-
Average	-	1	1	-	-	-	2	2	-	3	-	-	-	-	-

Course Code	Course Title	Category	L	T	P	C
MC23112	ENVIRONMENTAL SCIENCE AND ENGINEERING	MC	3	0	0	0
Common to B.E. /B.Tech all branches except CSBS						

Objectives:
<ul style="list-style-type: none"> To develop the understanding of environmental and associated issues To develop an attitude of concern for the environment To promote enthusiasm in participating environmental protection initiatives To nurture skills to solve environmental degradation issues To develop the knowledge about the environmental laws

UNIT-I	AIR AND NOISE POLLUTION	9
Definition –sources of air pollution –chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, ozone depletion, particulate pollutants-Air quality standards-Air quality indices - control of particulate air pollutants-gravitational settling chambers,cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP)-catalytic converters. Noise pollution –sources - health effects - standards- measurement and control methods.		
UNIT-II	WATER POLLUTION AND ITS MANAGEMENT	9
Definition-causes-effects of water pollution-point and nonpoint sources of wastewater-marine pollution - thermal pollution - Control of water pollution by physical, chemical and biological methods – wastewater treatment-primary, secondary and tertiary treatment-sources and characteristics of industrial effluents- zero liquid discharge.		
UNIT-III	SOLID WASTE AND HAZARDOUS WASTE MANAGEMENT	9
Solid waste – types- municipal solid waste management: sources, characteristics, collection, and transportation- sanitary landfill, recycling, composting, incineration, energy recovery options from waste - Hazardous waste – types, characteristics, and health impact - hazardous waste management: neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal. E-waste-definition-sources-effects on human health and environment- E-waste management- steps involved - Role of E-waste management within the initiatives of the Govt. of India- Swachh Bharat Mission.		
UNIT-IV	SUSTAINABLE DEVELOPMENT	9
Sustainable development- concept-dimensions-sustainable development goals - value education- gender equality – food security - poverty – hunger - famine - Twelve principles of green chemistry - Green technology - definition, importance - Cleaner development mechanism - carbon credits, carbon trading, carbon sequestration, eco labeling-International conventions and protocols-Disaster management.		
UNIT-V	ENVIRONMENTAL MANAGEMENT AND LEGISLATION	9
Environmental Management systems - ISO 14000 series- Environmental audit-Environmental Impact Assessment- life cycle assessment- human health risk assessment - Environmental Lawsand Policy- Objectives - Polluter pays principle, Precautionary principle - The Environment (Protection) Act 1986 - Role of Information technology in environment and human health.		
Total Contact Hours:45		

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> Associate air and noise quality standards with environment and human health. Illustrate the significance of water and devise control measures for water pollution. Analyze solid wastes and hazardous wastes. Outline the goals of sustainable development in an integrated perspective. Comprehend the significance of environmental laws.

Suggested Evaluation Methods:

- Continuous assessment tests
- Assignments
- Case studies, class room presentations (or) site visit

Text Book(s):

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016
2. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publisher, 2018.
3. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

Reference Books(s) / Web links:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017 Elsevier
4. NPTEL course url
https://onlinecourses.nptel.ac.in/noc19_ge22/NPTEL
<https://news.mit.edu/2013/ewaste-mit>
5. For downloading text/reference books the weblink is given below can be used
<http://libgen.rs/>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MC23112.1	1	2	3	1	-	2	2	2	1	1	1	2	-	-	-
MC23112.2	1	2	3	1	-	2	2	2	1	1	1	2	-	-	-
MC23112.3	-	-	3	1	-	2	3	2	1	-	1	2	-	-	1
MC23112.4	-	1	2	1	1	3	3	2	1	1	1	2	-	-	-
MC23112.5	-	1	2	-	-	2	2	2	1	2	2	2	-	-	-
Average	0.4	1.2	2.6	0.8	0.2	2.2	2.4	2	1	1	1.2	2	-	-	0.2

SEMESTER – III

Course Code	Course Title	Category	L	T	P	C
MA23312	FOURIER SERIES AND NUMBER THEORY	BS	3	1	0	4
Common to III Sem. B.E. – EEE, ECE, BME, CSE and B.Tech. IT.						

Objectives:

- To express Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- To represent continuous function arising in wave and heat propagation, signals and systems using Fourier Transforms
- To provide various numerical methods in solving problems that occurs in the field of Engineering and Technology.
- To introduce and apply the concepts of finite fields and congruences.
- To present a rigorous development of Number Theory using axioms, definitions, examples, theorems and their proofs.

UNIT-I	FOURIER SERIES	12
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.		
UNIT-II	FOURIER TRANSFORMS	12
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application to boundary value problems.		
UNIT-III	NUMERICAL SOLUTIONS OF BOUNDARY VALUE PROBLEMS	12
Finite difference method for solving second order differential equations - Finite difference techniques for the solution of two-dimensional Laplace and Poisson equations on rectangular domain – One dimensional heat flow equation by implicit and explicit methods – One Dimensional Wave Equation by Explicit method		
UNIT-IV	CONGRUENCES	12
Finite Fields -Linear Diophantine equations – Congruence's – Linear Congruence's – Applications: Divisibility tests – Modular exponentiation-Chinese remainder theorem – 2 x 2 linear systems.		
UNIT-V	CLASSICAL THEOREMS IN NUMBER THEORY	12
Wilson's theorem – Fermat's little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.		
Total Contact Hours:60		

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

- Demonstrate Fourier series to study the behaviour of periodic functions and their applications in engineering problems such as system communications, digital signal processing and field theory.
- Apply the shifting theorems, Fourier integral theorems, Inverse Fourier sine and cosine transforms appropriate problems in engineering and technology.
- Solve differential equations numerically that arise in course of solving complex engineering problems.
- Explain the fundamental concepts of finite fields and congruence, and their role in modern mathematics and applied contexts.
- Work effectively as part of a group to solve challenging problems in Number Theory.

Suggested Activities:

- Problem solving sessions
- Tutorial sessions by involving two faculty members

Suggested Evaluation Methods:

- Problem solving in tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2015.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd.,New Delhi, Second reprint, 2016.
3. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007.
4. Koshy, T., "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.
5. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.

Reference Books / Web links:

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016
3. Grewal B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 11th Edition, Khanna Publishers, New Delhi, 2013.
4. Lidl, R. and Pitz, G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition, 2006.
5. Niven, I., Zuckerman.H.S., and Montgomery, H.L., "An Introduction to Theory of Numbers", John Wiley and Sons , Singapore, 2004.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23312.1	3	3	3	2	1	-	-	-	-	-	-	1	2	1	2
MA23312. 2	3	3	3	2	1	-	-	-	-	-	-	1	2	1	2
MA23312.3	3	3	3	2	2	-	-	-	-	-	1	2	1	2	2
MA23312. 4	3	3	3	2	2	-	-	-	-	-	1	2	1	2	2
MA23312. 5	3	3	3	3	2	-	-	-	-	-	-	2	1	2	2
Average	3	3	3	2.2	1.6	-	-	-	-	-	1	1.6	1.4	1.6	2

Course Code	Course Title	Category	L	T	P	C
EC23311	ANALOG CIRCUITS- I	PC	3	0	0	3

Objectives:						
<ul style="list-style-type: none"> To analyse the BJT amplifiers using small signal model 						
<ul style="list-style-type: none"> To analyse the FET amplifiers using small signal model 						
<ul style="list-style-type: none"> To determine the frequency response of BJT and FET amplifiers 						
<ul style="list-style-type: none"> To analyse Feedback Amplifiers and Oscillators 						
<ul style="list-style-type: none"> To understand the concepts of Power Amplifiers and IC MOSFET 						

UNIT-I	BJT SMALL SIGNAL AMPLIFIERS	9
Small signal analysis of common emitter, common collector and common base amplifiers, Differential amplifiers, Cascaded amplifier, Cascode amplifier		
UNIT-II	JFET AND MOSFET AMPLIFIERS	9
Small signal analysis of JFET and MOSFET- common source amplifier, voltage swing limitations, source follower and common gate amplifier, BiMOS Cascode amplifier		
UNIT-III	FREQUENCY ANALYSIS OF BJT AND FET AMPLIFIERS	9
Low frequency analysis of BJT and FET, Miller effect, High frequency analysis of CE and FET CS amplifier, short circuit current gain of CC amplifier, cut-off frequencies of CE and CB amplifiers (f_a and f_b), Gain bandwidth product, determination of bandwidth for multistage amplifiers		
UNIT-IV	FEEDBACK AMPLIFIERS AND OSCILLATORS	9
Feedback topologies-voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, noise and non-linear distortion. Oscillators-Introduction, Barkhausen Criterion, Analysis of RC oscillators, LC oscillators.		
UNIT-V	POWER AMPLIFIERS AND IC MOSFET	9
Power amplifiers-Class A, Class B, Class C and Class D, Buck and Boost converter, IC biasing- current steering circuit using MOSFET, Amplifier with active loads – Enhancement and depletion load, CMOS- common source amplifier, source follower and differential amplifier- CMRR.		
Total Contact Hours: 45		

Course Outcomes: On completion of course, students will be able to	
<ul style="list-style-type: none"> Identify DC and AC characteristics of BJT amplifier circuits 	
<ul style="list-style-type: none"> Explain DC and AC characteristics of FET amplifier circuits 	
<ul style="list-style-type: none"> Determine the frequency response of BJT and FET amplifiers 	
<ul style="list-style-type: none"> Analyse Feedback Amplifiers and Oscillators 	
<ul style="list-style-type: none"> Design the Power Amplifiers and IC MOSFET Amplifier 	

Suggested Activities:	
<ul style="list-style-type: none"> Problem solving sessions – Design of CS MOSFET Amplifiers with emphasis on aspect ratio of the channel 	
<ul style="list-style-type: none"> Flipped classroom – CMOS Memory devices 	

Suggested Evaluation Methods:	
<ul style="list-style-type: none"> Tutorial problems 	
<ul style="list-style-type: none"> Assignment problems – Design a CMOS inverter for a high noise margin. 	
<ul style="list-style-type: none"> Quizzes – Frequency response of BJT, FET, gain bandwidth product. 	

Text Book(s):	
1. Donald. A. Neamen, Electronic Circuit Analysis and Design – 2 nd Edition, Tata McGraw Hill, 2009.	
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10 th Edition, Pearson Education / PHI, 2008	
3. R.S.Sedha, "A Text Book of Applied Electronics" S.Chand publishing 2008.	

Reference Books(s) / Web links:															
<ul style="list-style-type: none"> Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2007. Millman J. and Halkias C.C, "Integrated Electronics", McGraw Hill, 2001. D.Schilling and C.Belove, "Electronic Circuits", 3rd Edition, McGraw Hill, 1989. David A., "Bell Electronic Devices and Circuits", Oxford Higher Education Press, 5th Edition, 2010 															

PO/PSO CO	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
EC23311.1	3	3	3	1	3	-	-	-	1	-	2	1	1	1	3
EC23311.2	3	3	3	2	3	-	-	-	1	-	2	1	1	1	3
EC23311.3	3	2	1	3	3	-	-	-	1	-	2	1	1	1	3
EC23311.4	3	3	3	3	-	1	1	-	1	-	2	3	2	3	3
EC23311.5	3	2	1	3	-	1	1	-	1	-	-	3	2	3	3
Average	3	2.6	2.2	2.4	1.8	0.4	0.4	-	1	-	1.6	1.8	1.4	1.8	3

Course Code	Course Title	Category	L	T	P	C
EC23312	ELECTROMAGNETIC FIELDS	PC	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To understand the basics of static electric field and the associated laws. To attain knowledge on the basics of static magnetic field and Maxwell's equations. To study the waves in homogeneous medium. To learn the reflection and refraction of plane waves. To impart knowledge on applications of static field and FEM.

UNIT-I	STATIONARY ELECTRIC FIELDS	9
Coulomb's law and field intensity, Electric flux density, Gauss's law, Applications of Gauss law for point and infinite line charge distributions, Electric potential, Relationship between E and V, an electric dipole. Boundary conditions for dielectric-dielectric interface. Poisson's and Laplace equation. Capacitance, Capacitance of various geometries using Laplace equations.		
UNIT-II	STATIONARY MAGNETIC FIELDS & MAXWELL'S EQUATIONS	9
Biot-Savart Law, Magnetic field Intensity, Magnetic flux and magnetic flux density, Estimation of Magnetic field intensity for finite straight conductor. Ampere's circuital law, Application of Ampere's law on infinitely long coaxial transmission line. Scalar and Vector magnetic potentials. Inductance of Solenoid and Toroid. Magnetic boundary condition. Integral and differential form of Maxwell's equations.		
UNIT-III	ELECTROMAGNETIC WAVES IN A HOMOGENOUS MEDIUM (Qualitative only)	9
Constitutive relations, Solution for free-space conditions, Uniform plane-wave propagation, Uniform plane waves, Relation between E and H in a uniform plane wave, Wave equation for a conducting medium, Wave propagation in lossless medium, Wave propagation in a conducting medium. Conductors and dielectrics, Wave propagation in good dielectric, Wave propagation in good conductor, Depth of penetration, Polarization of uniform plane wave.		
UNIT-IV	REFLECTION AND REFRACTION OF PLANE WAVES (Qualitative only)	9
Reflection by a perfect conductor – Normal incidence. Reflection by a perfect conductor – Oblique incidence, E perpendicular to the plane of incidence, E parallel to the plane of incidence. Reflection by a perfect dielectric – Normal incidence. Reflection by a perfect insulator – Oblique incidence, perpendicular polarization, parallel polarization, Snell's law, Brewster angle, Total internal reflection. Poynting's Theorem. Power flow for a plane wave, Power flow in a concentric cable. Instantaneous, average and complex Poynting vector.		
UNIT-V	COMPUTATIONAL ELECTROMAGNETICS AND APPLICATIONS	9
The finite element method – finite element discretization, element governing equations, assembling all the elements, solving the resulting equations by iteration method and band matrix method. Applications – Electrostatic discharge, Magnetic Levitation.		
Total Contact Hours: 45		

Course Outcomes: On completion of course, students will be able to
<ul style="list-style-type: none"> Describe electro-static theory and apply them for modelling and analysis of capacitors. Explain magneto-static theory for modelling and analysis of inductors. Characterize uniform plane wave and its propagation in various media. Analyse the reflection and refraction of waves at media interface. Apply the static field concepts for various applications.

Suggested Activities:

- Problem solving sessions- Coulomb's law and field intensity , Electric flux density, Poisson's and Laplace equation, Magnetic field Intensity, Magnetic flux and magnetic flux density.
- Flipped classroom - Snell's law, Brewster angle.
- Survey on various applications of Gauss law and Ampere's circuital law.

Suggested Evaluation Methods:

- Tutorial problems
- Assignment problems
- Quizzes - Capacitance of various geometries using Laplace equations and Integral and differential form of Maxwell's equation.
- Class Presentation/Discussion – Finite Element Method.

Text Book(s):

- Mathew N. O. Sadiku, 'Principles of Electromagnetics', 4th Edition, Oxford University Press Inc., First Indian edition, 2009. (Unit I, II & V).
- E.C.Jordan and K.G. Balmain, 'Electromagnetic Waves and Radiating Systems', Prentice Hall of India, 2006. (Unit III, IV).

Reference Books(s) / Web links:

- W.H.Hayt and A.Buck, Engineering Electro Magnetics , 8th Edition, Mc Graw Hill, 2011
- R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005.
- Ramo, Whinnery and Van Duzer: "Fields and Waves in Communications Electronics" John Wiley & Sons, 3rd edition 2003.
- Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
- G.S.N Raju, 'Electromagnetic Field Theory and Transmission Lines' Pearson Education, First edition, 2005.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
EC23312.1	3	2	2	2	1	1	1	1	2	1	1	2	2	2	1
EC23312.2	3	2	2	2	1	1	1	1	2	1	1	2	2	2	1
EC23312.3	3	2	2	1	1	1	1	1	1	1	1	1	2	2	1
EC23312.4	3	2	2	1	1	1	1	1	1	1	1	1	2	2	1
EC23312.5	3	3	2	2	1	1	2	1	1	3	2	3	3	2	3
Average	3	2.2	2	1.6	1	1	1.2	1	1.4	1.4	1.2	1.8	2.2	2	1.4

Course Code	Course Title	Category	L	T	P	C
EC23313	DIGITAL PRINCIPLES AND SYSTEM DESIGN	PC	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To learn basic postulates of Boolean algebra and infer the methods for simplifying Boolean expressions. To illustrate the formal procedures for the design of Combinational circuits and HDL models for the same. To extrapolate the design of Synchronous Sequential circuits using Flip-Flops. To know the design procedure of Asynchronous Sequential circuits and its problems. To understand the concept of Programmable Logic Devices for the design of digital circuits.

UNIT-I	MINIMIZATION TECHNIQUES AND LOGIC GATES	9
Fundamentals: Boolean postulates and laws, De-Morgan's Theorem, Principle of Duality, Boolean expression, Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS). Minimization Techniques: Minimization of Boolean expressions using Boolean laws, Karnaugh map, Quine McCluskey method of minimization, don't care conditions. Logic Gates: Implementation of Logic Functions using gates, NAND-NOR implementations.		
UNIT-II	COMBINATIONAL CIRCUITS	9
Half adder and Full adder, Half subtractor and Full subtractor, Binary to Gray and Gray to Binary Code converters, 3-bit Parity generator and 4-bit Parity checker, 2-bit Magnitude Comparator, Multiplexer – Logical function using Multiplexer and Demultiplexer, Encoder, Decoder, BCD to Seven Segment Display Decoder. Verilog HDL: Introduction to HDL, Module declaration, Gate delays, Boolean expressions, Modelling Techniques – Gate Level, Data Flow and Behavioral. HDL models for combinational circuits - Full adder, full subtractor, multiplexer and demultiplexer, decoder.		
UNIT-III	SYNCHRONOUS SEQUENTIAL CIRCUITS	9
Memory elements: Latches, Flip-flops: RS, JK, D, T, Master-Slave, Triggering of Flip Flops, Realization of one flip flop using other flip flop. Design: Synchronous and Asynchronous counters - Up/Down counter, Modulo-N counter. Shift Registers - SISO, SIPO, PISO, PIPO, Shift Register Counters - Ring counter, Shift counter. Verilog HDL: HDL models for Sequential circuits - Flip-Flops - JK, D, shift register, Ripple counter.		
UNIT-IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS	9
Analysis of Fundamental and Pulse mode asynchronous sequential circuits, Design of Fundamental and Pulse mode Circuit, Problems in Asynchronous Sequential Circuits- Races, Cycles and Hazards.		
UNIT-V	PROGRAMMABLE LOGIC DEVICES & HDL	9
Programmable Logic Devices (PLD): Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA), Complex Programmable Logic Devices (CPLD), Implementation of Combinational Logic Circuits using PROM, PLA, PAL.		
Total Contact Hours: 45		

Course Outcomes: On completion of course, students will be able to
<ul style="list-style-type: none"> Simplify the Boolean expressions using basic postulates of Boolean algebra with suitable minimization. Apply the procedure to design and implement combinational circuits and HDL models for the same. Construct Synchronous Sequential circuits using Flip-Flops. Design Asynchronous Sequential circuits and analyse its problems. Implement digital circuits using Programmable Logic Devices.

Suggested Activities:
<ul style="list-style-type: none"> Problem solving sessions - Tabulation method Flipped classroom - FPGA, CPLD

Suggested Evaluation Methods:
<ul style="list-style-type: none"> Tutorial problems - Fundamental and pulse mode asynchronous sequential circuits. Assignment problems - K-map, Quine Mc-Cluskey method Quizzes - Boolean postulates and Flip-flop tables

Text Book(s):															
1. M. Morris Mano, “Digital Design”, 4 th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.															
2. Charles H.Roth. “Fundamentals of Logic Design”, 7 th Edition, Thomson Learning, 2014.															

Reference Books(s) / Web links:															
1. Thomas L. Floyd, “Digital Fundamentals”, 10 th Edition, Pearson Education Inc, 2011.															
2. John F.Wakerly, “Digital Design”, Fourth Edition, Pearson/PHI, 2008															
3. John.M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006.															

PO/PSO CO	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
EC23313.1	3	2	2	2	1	1	1	1	1	1	-	1	3	1	1
EC23313.2	3	3	3	2	2	3	2	1	2	1	2	1	3	3	2
EC23313.3	3	3	3	3	2	3	2	2	2	1	2	2	3	3	2
EC23313.4	3	3	3	3	2	2	2	2	2	1	2	2	3	3	2
EC23313.5	3	3	3	3	3	3	2	2	2	2	2	3	3	3	2
Average	3	2.8	2.8	2.6	2	2.4	1.8	1.6	1.8	1.2	2	1.8	3	2.6	1.8

Course Code	Course Title	Category	L	T	P	C
EC23332	PRINCIPLES OF MICROPROCESSOR AND MICROCONTROLLERS	PC	3	0	2	4

Objectives:
<ul style="list-style-type: none"> To learn the concepts of 8086 architecture and multi-processor configuration. To understand the methods of interfacing peripheral devices to a microprocessor. To recognize the functionality of 8051 microcontroller. To realize the functionality of ARM Processor. To interpret the Arduino usage and its applications.

UNIT-I	THE 8086 MICROPROCESSOR	9
8086 architecture – 8086 signals – Addressing modes –Instruction set– Assembly Language Programming– Maximum mode and Minimum mode. Coprocessor, closely coupled and Loosely Coupled multiprocessor configurations.		
UNIT-II	PERIPHERALS & INTERFACING	9
Introduction to IO – Programmable peripheral interface (8255)–Programmable Timer/controller (8253) –Keyboard /display controller (8279) – Serial communication interface (8251) – D/A and A/D Interface–Programmable Interrupt controller (8259).		
UNIT-III	THE 8051 MICROCONTROLLER	9
Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports- Timers – Interrupts – Serial communication - Instruction set - Addressing modes - Assembly language programming. Case study –Stepper motor & traffic light control using 8051.		
UNIT-IV	ARM PROCESSOR	9
Introduction to ARM Processor-ARM Processor–Processor Families – Features of ARM - ARM7 TDMI Architecture – Programmer’s Model – Interrupts and Exceptions- Operating Modes– Addressing Modes – ARM Instruction Set.		
UNIT-V	ARDUINO MICROCONTROLLER	9
ATmega328P microcontroller Pin configuration and architecture - Concept of digital and analog ports- Serial Communication with Arduino - Basics of Embedded C programming for Arduino- Interfacing of Led, Switch, Temperature, Motion, Light and Gas Sensor with Arduino-Interfacing of Relay Switch and Servo Motor with Arduino.		
Total Contact Hour : 45		

Description of the Experiments:	Total Contact Hours: 30
8086 Microprocessor	
1. 16-bit Arithmetic Operations	
2. Logical operations	
3. String manipulations	
8086 Programs using MASM	
4. Display a message	
5. Password checking	
Peripherals and Interfacing	
6. 8279 - Key board and Display Controller	
7. 8255 - Parallel interface	
8. 8253– Timer interface	
8051 Microcontroller	
9. 8-bit Arithmetic Operations	
10. Stepper Motor Control	
Tinkercad Experiment: Interfacing with Sensors and Actuators	
11. LED and switch Interfacing with ARDUINO	
12. Motion Sensor Interfacing and Light Sensor Interfacing with ARDUINO	
13. Gas Sensor Interfacing and Servo Motor Interfacing with ARDUINO	

Course Outcomes: On completion of course, students will be able to
<ul style="list-style-type: none"> • Compose Assembly-language program to perform basic operations using 8086 Microprocessor. • Code and Interface various peripherals with 8086 and 8051. • Perform Assembly-language program to perform basic operations using 8051 Microcontroller. • Develop project for different applications using advanced Microcontrollers. • Interface various peripherals with Arduino.

Suggested Activities:
<ul style="list-style-type: none"> • Problem solving sessions - Solving simple programming • Flipped classroom – Instruction set 8051

Suggested Evaluation Methods:
<ul style="list-style-type: none"> • Assignment problems – Programming of 8086, 8051 • Quizzes – Architecture, Instruction set topics • Class Presentation/Discussion- Architecture topics

Text Book(s):
1. A.K. Ray, K.M. Bhurchandi, - Advanced Microprocessor and Peripherals, Second edition, Tata McGraw-Hill, 2010.
2. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.
3. Massimo Banzi, “Getting started with Arduino” 2 nd Edition, Orelly 2011.

Reference Books(s) / Web links:
1. DouglasV.Hall, “Microprocessors and Interfacing, Programming and Hardware”, TMH, 2012
2. Kenneth J. Ayala, “The 8086 Microprocessor: Programming & Interfacing the PC”, Delmar Publishers, 2007.
3. Steve Furber, “ARM system On Chip Architecture”, Addison Wesley, 2000

Lab equipment required:

S. No	Name of the Equipment	Quantity Required
1	8086 Microprocessor trainer kit	18
2	8051 Microcontroller trainer kit	18
3	PC with MASM software	5
4	8255 Parallel Interface	3
5	8253 timer Interface	3
6	8279 Keyboard display Interface	3
7	CRO	3
8	Stepper motor interface	3

Suggested Evaluation Methods:

- Experiment based viva
- Quizzes
- Mini Project

Web links for virtual lab (if any):

- [Real Time Embedded Systems Laboratory \(iitkgp.ac.in\)](http://iitkgp.ac.in)

PO/PSO CO	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
EC23332.1	3	3	3	2	1	1	1	1	2	2	3	3	2	3	3
EC23332.2	3	3	3	2	1	1	1	1	2	2	3	3	2	3	3
EC23332.3	3	3	3	2	1	1	1	1	2	2	3	3	2	3	3
EC23332.4	3	3	3	2	1	1	1	1	2	2	3	3	3	3	3
EC23332.5	3	3	2	3	2	1	1	1	2	2	3	3	2	3	3
Average	3	3	2.8	2.2	1.2	1	1	1	2	2	3	3	2.2	3	3

Course Code	Course Title	Category	L	T	P	C
CS23336	INTRODUCTION TO PYTHON PROGRAMMING	ES	1	0	4	3
Common to all branches of B. E. / B.Tech program (Except–CSE, CSBS, CSD, IT, AI/ML, CYBER SECURITY, AI/DS)						

Objectives:

- To understand computers, programming languages and their generations and essential skills for a logical thinking for problem solving.
- To write, test, and debug simple Python programs with conditionals, and loops and functions
- To develop Python programs with defining functions and calling them
- To understand and write python programs with compound data-lists, tuples, dictionaries
- To search, sort, read and write data from /to files in Python.

List of Experiments:

1. Study of algorithms, flowcharts and pseudocodes.
2. Introduction to Python Programming and Python IDLE/Anaconda distribution.
3. Experiments based on Variables, Data types and Operators in Python.
4. Coding Standards and Formatting Output.
5. Algorithmic Approach: Selection control structures.
6. Algorithmic Approach: Iteration control structures.
7. Experiments based on Strings and its operations.
8. Experiments based on Lists and its operations.
9. Experiments based on Tuples and its operations.
10. Experiments based on Sets and its operations.
11. Experiments based on Dictionary and its operations.
12. Functions: Built-in functions.
13. Functions: User-defined functions.
14. Functions: Recursive functions.
15. Searching techniques: Linear and Binary.
16. Sorting techniques: Bubble and Merge Sort.
17. Experiments based on files and its operations.

Contact Hours:75

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

- Understand the working principle of a computer and identify the purpose of a computer programming language and ability to identify an appropriate approach to solve the problem.
- Write, test, and debug simple Python programs with conditionals and loops.
- Develop Python programs step - wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Apply searching, sorting on data and efficiently handle data using flat files.

Suggested Evaluation Methods:

- Experiment based viva

Text Book(s):															
1. Allen B. Downey, Think Python : How to Think Like a Computer Scientist, Second edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)															
2. Guido Van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python3.2, Network Theory Ltd., 2011.															

Reference Books(s) / Web links:															
1. John V. Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.															
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd, 2016.															
3. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.															
4. Kenneth A. Lambert, Fundamentals of Python: First Programs, Cengage Learning, 2012.															
5. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.															
6. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python3, Second edition, Pragmatic Programmers, LLC, 2013.															

Lab Requirements:

Python3 interpreter for Windows/Linux

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS23336.1	2	2	2	2	1	-	-	-	1	1	1	1	3	3	-
CS23336.2	2	1	1	1	1	-	-	-	-	-	1	1	3	2	-
CS23336.3	1	1	2	1	2	-	-	-	-	-	1	1	2	3	2
CS23336.4	2	2	3	2	2	-	-	-	-	-	2	1	2	2	2
CS23336.5	2	2	3	2	3	-	-	-	-	-	2	1	2	2	2
Average	1.8	1.6	2.2	1.6	1.8	0.0	0.0	0.0	0.2	0.2	1.4	1	2.4	2.4	2

Course Code	Course Title	Category	L	T	P	C
EC23321	ANALOG AND DIGITAL CIRCUITS LABORATORY	PC	0	0	4	2

Objectives:
<ul style="list-style-type: none"> To understand the characteristics, design and analyse the frequency response of CE, CB, CC and CS amplifiers. To analyse the CMRR value of differential amplifier and frequency response of Feedback amplifiers. To design and implement combinational circuits like Converter, Mux/ Demux. To design and implement sequential circuits like Counters, Shift Registers. To simulate analog circuits using PSPICE and digital circuits using Verilog HDL.

Description of the Experiments:
List of Analog Experiments
1. Frequency Response of CE, CB, CC amplifiers.
2. Frequency Response of CS amplifier.
3. Differential amplifier- CMRR measurement.
4. Frequency Response of Feedback amplifiers.
5. Realization of Common Emitter and Common Source amplifiers using PSPICE.
List of Digital Experiments
6. Design and Implementation of Binary to Gray and Gray to Binary code converters using logic gates.
7. Design and Implementation of Multiplexer and De-multiplexer using logic gates.
8. Design and Implementation of BCD Synchronous and Decade, Mod-14 Asynchronous counters.
9. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- Flop.
10. Realization of digital circuits using Verilog HDL Combination Circuits: Half adder, Full adder, Half subtractor, Full subtractor, Multiplexer, Demultiplexer Sequential circuits: Flip Flops, Shift Registers, Counters.
Total Contact Hours: 60

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> Design and analyse CE, CB, CC and CS amplifiers. Measure CMRR of differential amplifier and frequency response of feedback amplifiers. Design and implement combinational circuits. Design and implement sequential circuits. Simulate analog and digital circuits.

Suggested Evaluation Methods:
<ul style="list-style-type: none"> Experiment based viva

Reference Books(s) / Web links:
1. Donald .A. Neamen, Electronic Circuit Analysis and Design – 2 nd Edition, Tata McGraw Hill, 2009.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10 th Edition, Pearson Education / PHI, 2008.
3. M. Morris Mano, “Digital Design”, 4 th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
4. Charles H.Roth. “Fundamentals of Logic Design”, 7 th Edition, Thomson Learning, 2014.

Lab equipment required:

S. No	Name of the Equipment	Quantity Required
1	CRO (30MHz)	15
2	Signal Generator /Function Generators (3 MHz)	15
3	Dual Regulated Power Supplies (0 - 30V)	15
4	Standalone desktop PCs with SPICE software (any public domain or commercial software)	15
5	Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	50
6	Dual power supply/single mode power supply	15
7	Resistors, Capacitors, Inductors	50
8	Diodes, Zener diode	10
9	IC Trainer Kit	15
10	Bread Boards	15
11	Computer with HDL software (any public domain or commercial software)	15
12	Seven segment display	15
13	Multimeter	15
14	ICs 7400/ 7402 / 7404 / 7486 / 7408 /7432 / 7483 / 74150 / 74151 / 74147 /7445 / 7476/7491/ 555 / 7494 / 7447 /74180 / 7485 / 7473 / 74138 / 7411 /7474	50

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EC23321.1	3	3	3	3	2	2	2	2	3	3	2	2	2	2	2
EC23321.2	3	3	3	3	2	2	2	2	3	3	2	2	2	2	2
EC23321.3	3	3	3	3	2	2	2	2	3	3	2	2	2	2	2
EC23321.4	3	3	3	3	2	2	2	2	3	3	2	2	2	2	2
EC23321.5	3	3	3	2	3	2	2	2	3	3	2	3	2	2	2
Average	3	3	3	2.8	2.2	2	2	2	3	3	2	2.2	2	2	2

SEMESTER – IV

Course Code	Course Title	Category	L	T	P	C
EC23411	SIGNALS AND SYSTEMS	PC	3	0	0	3

Objectives:

- To understand the basic properties of Signals & Systems and the various methods of classification
- To learn Fourier transform, Laplace transform & Z- transform for signals and systems analysis
- To learn the characteristics of CT and DT LTI systems using Laplace transform & Z- transform

UNIT-I	CONTINUOUS TIME AND DISCRETE TIME SIGNALS	9
Continuous time signals (CT signals) & Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Complex exponential and Sinusoidal signals. Classification of CT and DT signals- Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals, Even and Odd signals.		
UNIT-II	CONTINUOUS TIME AND DISCRETE TIME SYSTEMS	9
CT systems and DT systems - Classification of systems: Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable. Convolution integrals and Convolution sum.		
UNIT-III	FOURIER ANALYSIS FOR CT SIGNALS AND SYSTEMS	9
Trigonometric Fourier series analysis - Fourier Transforms, Properties of Fourier transform, Fourier Transforms in CT signal analysis, CT system characterization using Fourier transforms.		
UNIT-IV	LAPLACE TRANSFORM FOR CT SIGNALS AND SYSTEMS	9
Laplace Transforms, The region of convergence for Laplace transform, Properties of Laplace transform, Laplace Transforms in CT signal analysis, LTI systems characterized by differential equations.		
UNIT-V	Z-TRANSFORM FOR DT SIGNALS AND SYSTEMS	9
Z-Transforms, ROC, Properties of Z-transform, Inverse Z- Transform- long division method and partial fraction expansion, Z-Transforms in DT signal analysis, Z-transforms in analysis of DT systems.		
Total Contact Hours:45		

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

- Distinguish the basic properties of Signals
- Identify the basic properties of Systems
- Extrapolate the properties of Fourier transform in signals and systems analysis
- Characterize continuous time LTI systems using Laplace Transforms
- Analyze discrete time signals and LTI systems using Z transform

Suggested Activities:

- Problem solving sessions for all units

Suggested Evaluation Methods:

- Tutorial problems
- Assignment problems
- Quizzes

Text Book(s):

1. Allan V. Oppenheim, S. Willsky and S. H. Nawab, "Signals and Systems", Second edition, Pearson, 2007.
2. B. P. Lathi, "Principles of Linear Systems and Signals", Third edition, Oxford, 2017.
3. P. Ramakrishna Rao & Shankar Prakriya, Signals and Systems, 2e, Tata McGraw Hill, 2013

Reference Books(s) / Web links:

1. R. E. Zeimer, W. H. Tranter and R. D. Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.
2. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.
3. M. J. Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill, 2007.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EC23411.1	3	3	2	2	1	1	-	-	1	1	1	3	2	3	1
EC23411.2	3	3	2	2	1	1	-	-	1	1	1	3	2	3	2
EC23411.3	3	3	2	2	1	1	-	-	1	1	1	3	2	3	2
EC23411.4	3	3	2	2	1	1	-	-	1	1	1	3	2	3	2
EC23411.5	3	3	2	2	1	1	-	-	1	1	1	3	2	3	2
Average	3	3	2	2	1	1	-	-	1	1	1	3	2	3	1.8

Course Code	Course Title	Category	L	T	P	C
EC23412	TRANSMISSION LINES AND WAVEGUIDES	PC	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To impart knowledge on filter design. To introduce the basics of transmission lines and losses. To expose the usage of Smith Chart for impedance matching techniques. To impart knowledge on propagation of waves between parallel planes. To provide exposure on the wave propagation in waveguides.

UNIT-I	PASSIVE FILTERS	9
Filter fundamentals, Design of filters: Constant K - Low Pass, High Pass, Band Pass, Band elimination, m- derived sections - low pass, high pass.		
UNIT-II	TRANSMISSION LINE THEORY	9
A line of cascaded T sections- The transmission line: general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - The distortion-less line -Inductance loading – Campbell’s Equation- Line not terminated in Z_0 - Reflection coefficient - Standing waves, Nodes, Standing Wave Ratio – Line calculation- Input and transfer impedance - Open and short-circuited lines.		
UNIT-III	IMPEDANCE MATCHING IN HIGH FREQUENCY LINES	9
Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching design using Smith chart.		
UNIT-IV	GUIDED WAVES BETWEEN PARALLEL PLANES	9
Application of the restrictions to Maxwell’s equations – Transmission of TM waves between parallel planes – Transmission of TE waves between parallel planes. Transmission of TEM waves between parallel planes. Velocities of the waves – Characteristic impedances of planes.		
UNIT-V	WAVEGUIDES	9
Application of Maxwell’s equations to the rectangular wave guide. TM waves in the rectangular guide. TE waves in the rectangular guide, Bessel functions- Introduction to cylindrical waveguides.		
Total Contact Hours: 45		

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> Design different types of filters using Constant-K and m-derived sections. Recall general solution for the transmission lines and identify issues in lines. Construct stub matching networks using Smith chart. Determine the field components, wave impedance and characteristic parameters when TE, TM propagate between parallel planes. Analyze the propagation of waves in waveguides.

Suggested Activities:

- Problem solving sessions.
- Flipped classroom – Open circuited and short circuited lines.

Suggested Evaluation Methods:

- Tutorial problems- Smith chart
- Assignment problems

Text Book(s):

1. John D Ryder, “Networks, lines and fields”, 2nd Edition, Prentice Hall India, 2010.

Reference Books(s) / Web links:

1. E.C.Jordan and K.G. Balmain, —Electromagnetic Waves and Radiating Systems, Prentice Hall of India, 2006.
2. G.S.N Raju "Electromagnetic Field Theory and Transmission Lines, Pearson Education, First edition 2005.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EC23412.1	3	3	2	2	1	1	-	-	1	1	1	3	2	3	1
EC23412.2	3	3	2	2	1	1	-	-	1	1	1	3	2	3	2
EC23412.3	3	3	2	2	1	1	-	-	1	1	1	3	2	3	2
EC23412.4	3	3	2	2	1	1	-	-	1	1	1	3	2	3	2
EC23412.5	3	3	2	2	1	1	-	-	1	1	1	3	2	3	2
Average	3	3	2	2	1	1	-	-	1	1	1	3	2	3	1.8

Course Code	Course Title	Category	L	T	P	C
EC23413	COMMUNICATION THEORY	PC	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To introduce the concepts of amplitude modulation and demodulation with spectral characteristics To learn the concepts of angle modulation To know the effect of noise on communication systems To understand the concepts of source coding techniques To learn the concepts of pulse modulation techniques and mathematical models of communication channel

UNIT-I	AMPLITUDE MODULATION	9
Amplitude Modulation-DSBFC, DSBSC, SSB, VSB , Modulation index, Spectra, Power relations and Bandwidth, AM Generation – Square law modulator, DSBSC Generation–Balanced modulator, SSB Generation – Phase Shift method, VSB Generation – Filter Method, Demodulation-DSBFC-Envelope detector, DSBSC-coherent detector, SSB-SC-Coherent detector, Hilbert Transform, Pre-envelope & complex envelope–Comparison of different AM techniques, Superhetrodyne Receiver, Frequency Division Multiplexing.		
UNIT-II	ANGLE MODULATION	9
Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra and Transmission Bandwidth –FM modulation–Direct and Indirect methods, FM Demodulation – FM to AM conversion, FM Discriminator – PLL as FM demodulator, Stereo FM.		
UNIT-III	NOISE CHARACTERIZATION	9
Noise sources and types, Noise figure and noise temperature in cascaded amplifiers, Narrow band noise, Representation of narrow band noise in terms of In-phase and quadrature components, Noise performance in AM systems-DSBFC, DSBSC, Noise performance in FM system, Pre-emphasis and De-emphasis, Capture effect.		
UNIT-IV	INFORMATION THEORY	9
Measure of Information, Rate of information, Entropy, Source coding theorem - Shannon-Fano codes & Huffman codes, Discrete Memoryless channel, Mutual information, Channel Capacity, Shannon-Hartley theorem.		
UNIT-V	PULSE MODULATION & MATHEMATICAL MODELS OF COMMUNICATION CHANNEL	9
Generation of PAM, PWM and PPM, Comparison of different pulse modulation techniques, Communication Channel Classification, Performance Measure of Communication Systems, Additive Noise channel, Linear Filter Channel, Linear Time-Variant Filter Channel.		
Total Contact Hours: 45		

Course Outcomes: On completion of course, students will be able to
<ul style="list-style-type: none"> Compare the various amplitude modulation and demodulation techniques and bandwidth requirement Describe the principles of angle modulation techniques Analyze the noise performance on various AM and FM systems Apply the various source coding techniques on communication systems Describe the various pulse code modulation techniques and mathematical models of communication channel

Suggested Activities:

- Problem solving sessions.
- Flipped classroom.

Suggested Evaluation Methods:

- Tutorial problems
- Assignment problems
- Quiz

Text Book(s):

1. Simon Haykin, "Communication Systems", 4th Edition John Wiley & sons, 2001

Reference Books(s)

1. Amitabha Bhattacharya, "Digital Communication", 7th reprint, McGraw Hill Education, 2017.
2. Dennis Roddy & John Coolen, "Electronic Communications" 4th Edition, Pearson Education, 2008.
3. J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", 2nd Edition, Pearson Education, 2006.
4. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, 2007

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EC23413.1	3	2	2	2	1	1	-	-	1	1	1	2	3	3	2
EC23413.2	3	2	2	1	1	1	-	-	1	1	1	2	3	3	2
EC23413.3	3	2	2	1	1	1	-	-	1	1	1	2	3	3	2
EC23413.4	3	3	3	2	1	1	-	-	1	1	1	2	3	3	3
EC23413.5	3	1	1	1	1	1	-	-	1	1	1	2	3	3	2
Average	3	2	2	1.4	1	1	-	-	1	1	1	2	3	3	2.2

Course Code	Course Title	Category	L	T	P	C
EC23431	ANALOG CIRCUITS II	PC	3	0	2	4

Objectives:
<ul style="list-style-type: none"> To study the characteristics of OP-AMP To understand the functioning of OP-AMP and design OP-AMP based circuits To learn the applications of analog multipliers and PLL To study OP-AMP based ADC and DAC To gain knowledge on special function ICs

UNIT-I	OPERATIONAL AMPLIFIER AND ITS CHARACTERISTICS	9
Introduction, ideal op-amp, Op-amp-internal circuit, Inverting, non-inverting and DC and AC characteristics, slew rate, frequency compensation techniques.		
UNIT-II	APPLICATIONS OF OPERATIONAL AMPLIFIER	9
Differential amplifiers, Instrumentation amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger, comparator and their applications, oscillators and multivibrator. Active filters: Low pass, high pass.		
UNIT-III	ANALOG MULTIPLIER AND PLL	9
Analog Multiplier using Emitter Coupled Transistor pair, Gilbert Multiplier cell, Operation of the basic PLL, closed loop analysis, Voltage controlled oscillator, application of PLL for AM detection, FM detection, FSK modulator and demodulator, Frequency synthesizers.		
UNIT-IV	DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS	9
Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, Analog to-digital converters (ADC): Single slope, dual slope, successive approximation, flash type.		
UNIT-V	SPECIAL FUNCTION ICs	9
Timer IC 555, IC Voltage regulators: Three terminal fixed and Adjustable voltage regulators, IC 723 general purpose regulator, Monolithic switching regulator. Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Optocouplers and fibre optic IC.		
Contact Hours: 45		

Description of the Experiments:	Contact Hours: 30
1. Inverting, non-inverting and differential amplifiers using op-amp	
2. Integrator and differentiator using op-amp	
3. Astable multivibrator and Schmitt trigger using op-amp	
4. RC phase shift oscillator using op-amp	
5. Monostable multivibrator using IC 555 timer	
6. R-2R Ladder DAC	
7. DC power supply using LM317 (or) LM723	
8. P-SPICE Simulation of:	
(a) Multivibrator and Schmitt Trigger Circuit	
(b) Low pass and band stop active filters	
9. Mini project	

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> Describe the op-amp characteristics Analyse and design op-amp based circuits Implement ADC and DAC Design Analog multipliers and PLL Design and demonstrate the performance of Multivibrators and Power supplies

Suggested Activities:
<ul style="list-style-type: none"> Problem solving sessions- Op amp applications ADC DAC Flipped classroom – Timers, Switched Mode Power Supply Activity based learning- Quiz- Instruction set

Suggested Evaluation Methods:

- Tutorial problems – ADC and DAC
- Assignment problems – Active filters
- Quizzes-Op Amp and Regulators
- Class Presentation/Discussion- 555 timer and SMPS

Text Book(s):

1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2000
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 3rd Edition, Tata Mc Graw-Hill, 2007
3. Adel.S. Sedra, Kenneth C. Smith, “Micro Electronic Circuits”, 6th Edition, Oxford University Press, 2010.
4. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015.

Reference Books(s) / Web links:

1. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2007.
2. Paul Gray, Hurst, Lewis, Meyer “Analysis and Design of Analog Integrated Circuits”, 4th Edition, John Wiley & Sons 2005
3. Millman.J. and Halkias C.C, “Integrated Electronics”, McGraw Hill, 2001.
4. Analog Electronics, L.K. Maheshwari, Laxmi Publications
5. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
6. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989
7. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition
8. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992

Web links for virtual lab:

1. <http://www.vlab.co.in/ba-nptel-labs-electronics-and-communications>
2. <https://www.circuitlab.com/>

Lab equipment required:

S. No	Name of the Equipment	Quantity Required
1	Power Supply +15 or -15 volts	15
2	Power Supply +5 Volts	15
3	DSO / CRO	15
4	Function Generator	15
5	IC Tester	1
6	Multimeter	5

Suggested Evaluation Methods:

- Experiment based viva
- Online and offline quizzes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EC23431.1	3	2	2	2	2	1	1	1	2	1	1	2	2	2	2
EC23431.2	3	2	2	2	2	1	1	1	2	1	1	2	2	2	2
EC23431.3	3	2	2	1	2	1	1	1	2	1	1	2	2	2	2
EC23431.4	3	2	2	1	2	1	1	1	3	2	3	2	2	2	2
EC23431.5	3	2	2	2	2	1	1	1	3	2	3	2	2	2	2
Average	3	2	2	1.4	2	1	1	1	2.4	1.4	1.8	2	2	2	2

Course Code	Course Title	Category	L	T	P	C
MA23436	PROBABILITY AND RANDOM PROCESSES	BS	3	0	2	4
Common to IV sem. B.E - ECE and BME						

Objectives:
<ul style="list-style-type: none"> To apply the theoretical discrete and continuous probability distributions in the relevant application areas.
<ul style="list-style-type: none"> To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
<ul style="list-style-type: none"> To classify random processes and to know the concepts of strict stationary, wide-sense stationary and ergodicity.
<ul style="list-style-type: none"> To provide necessary concepts in spectral densities and correlation analysis.
<ul style="list-style-type: none"> To explain linear time invariant systems with random inputs.

UNIT-I	ONE DIMENSIONAL RANDOM VARIABLES	9
One dimensional Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions .		
UNIT-II	TWO DIMENSIONAL RANDOM VARIABLES	9
Two Dimensional Random Variables: Joint distributions – Marginal and conditional distributions - Moments – Covariance – Correlation and Linear regression – Transformation of random variables-Applications of Central Limit Theorem.		
UNIT-III	RANDOM PROCESS	9
Classification of Random Process: Stationary process – Binomial process – Gaussian process - Markov process - Poisson process and its properties – Discrete parameter Markov chain – Chapman Kolmogorov Theorem (without proof) – Limiting distributions.		
UNIT-IV	SPECTRAL DENSITIES	9
Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.		
UNIT-V	LINEAR SYSTEMS WITH RANDOM INPUTS	9
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and Cross correlation functions of input and output.		
Total Contact Hours: 45		

List of Experiment (using MATLAB Software)	Total Contact Hours: 30
1.Basic functions in MATLAB	
2.Mathematical functions in MATLAB	
3.Plotting data sets using MATLAB	
4.Control flow -Loops	
5.Reading and writing data sets – importing data sets	
6. Probability Distributions - PDF, CDF for Binomial, Poisson, Exponential, Uniform and Normal Distributions.	
7.Correlation and regression	
8.Fourier Transform using MATLAB	
9.Linear system with random inputs	
10.Analysis of Power spectral density – signal processing tool box.	
Lab Requirements: 30 Personal Computers	

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> Apply the basic concepts of probability, one dimensional and two dimensional Random Variables in the engineering and technology problems.
<ul style="list-style-type: none"> Analyse the data using correlation and regression in real life situation.
<ul style="list-style-type: none"> Classify random processes and to apply the concepts of strict stationary, wide-sense stationary and ergodicity in the solution of complex engineering problems.
<ul style="list-style-type: none"> Develop skills in solving problems on power spectral density function relevant to the various branches of engineering.
<ul style="list-style-type: none"> Interpret linear time invariant systems with random inputs.

Suggested Activities:
<ul style="list-style-type: none"> Problem solving sessions Smart classroom sessions

Suggested Evaluation Methods:
<ul style="list-style-type: none"> Problem solving in tutorial sessions Assignment problems Quizzes and class test Discussion in classroom

Text Book(s):
1. Veerarajan T, 'Probability, Statistics and Random Processes with Queuing Theory and Queuing Networks'.
2. McGraw Hill, 2016. 2 Johnson R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7 th Edition, 2007.
3. Oliver Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, 1 st Indian Reprint, 2014.
4. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill, second Edition, New Delhi, 2000.

Reference Books(s) / Web links:
1. Jhon wiley & Sons .Erwin Kreyszig., "Advanced Engineering Mathematics", Pearson Education, Asia, 7 th Edition, 2007.
2. Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
3. Yates R. D. and Goodman. D.J., "Probability and Stochastic Processes- A Friendly Introduction for Electrical and Computer Engineers ", 2 nd Edition, Wiley India Pvt. Ltd., Bangalore, 2014
4. Stark H., and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing", 3 rd Edition, Pearson Education, Asia, 2002.
5. Miller S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO															
MA23436.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	1
MA23436.2	2	2	1	1	-	-	-	-	-	-	-	1	-	-	1
MA23436.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	1
MA23436.4	3	2	1	-	-	-	-	-	-	-	-	1	1	-	1
MA23436.5	3	2	1	-	-	-	-	-	-	-	-	1	1	-	1
Average	2.8	2	1	1	-	-	-	-	-	-	-	1	1	-	1

Course Code	Course Title	Category	L	T	P	C
CS23422	PYTHON PROGRAMMING FOR MACHINE LEARNING	ES	0	0	4	2

Objectives:
<ul style="list-style-type: none"> To understand the relationship of the data collected for decision making.
<ul style="list-style-type: none"> To know the concept of principal components, factor analysis and cluster analysis for profiling and interpreting the data collected.
<ul style="list-style-type: none"> Lay the foundation of machine learning and its practical applications and prepare students for real-time problem-solving in data science.
<ul style="list-style-type: none"> Develop self-learning algorithms using training data to classify or predict the outcome of future datasets.
<ul style="list-style-type: none"> Distinguish overtraining and techniques to avoid it such as cross-validation.

List of Experiments:
1. NumPy Basics: Arrays and Vectorized Computation
2. Getting Started with pandas
3. Data Loading, Storage, and File Formats
4. Data Cleaning and Preparation
5. Data Wrangling: Join, Combine, and Reshape
6. Plotting and Visualization
7. Data Aggregation and Group Operations
8. Time Series
9. Supervised Learning
10. Unsupervised Learning and Pre-processing
11. Representing Data and Engineering Features
12. Model Evaluation and Improvement
Contact Hours: 60

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> Develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.
<ul style="list-style-type: none"> Analyze and perform an evaluation of learning algorithms and model selection.
<ul style="list-style-type: none"> Compare the strengths and weaknesses of many popular machine learning approaches.
<ul style="list-style-type: none"> Appreciate the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and unsupervised learning.
<ul style="list-style-type: none"> Design and implement various machine learning algorithms in a range of real-world applications.

Text Book(s):
1. Wes McKinney, Python for Data Analysis - Data wrangling with pandas, Numpy, and ipython, Second Edition, O'Reilly Media Inc, 2017.
2. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python - A Guide for Data Scientists, First Edition, O'Reilly Media Inc, 2016.

Reference Books(s) / Web links:
1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2 nd Edition, O'Reilly Media Inc, 2019.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS23422.1	2	2	2	2	1	-	-	-	1	1	1	1	3	3	-
CS23422.2	2	1	1	1	1	-	-	-	-	-	1	1	3	2	-
CS23422.3	1	1	2	1	2	-	-	-	-	-	1	1	2	3	2
CS23422.4	2	2	3	2	2	-	-	-	-	-	2	1	2	2	2
CS23422.5	2	2	3	2	3	-	-	-	-	-	2	1	2	2	2
Average	1.8	1.6	2.2	1.6	1.8	0.0	0.0	0.0	0.2	0.2	1.4	1	2.4	2.4	2