CURRICULUM

Academic year 2026 – 2027

III & IV Semester

B. E. **ELECTRONICS AND COMMUNICATION ENGINEERING**

Batch – 2025

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
(Approved by AICTE, New Delhi & Govt. of Karnataka)
Accredited by NBA & NAAC with A^+ Grade

About the Institute:

In 1962, Dr. M. S. Ramaiah, a visionary philanthropist, established the Gokula Education Foundation with a noble mission to uplift society through education. The same year marked a pivotal moment in technical education in India with the founding of the M S Ramaiah Institute of Technology (MSRIT).

MSRIT offers an impressive array of 18 undergraduate and 15 postgraduate programs, all approved by the All India Council for Technical Education (AICTE). The National Board of Accreditation (NBA) has accredited all eligible programs at the undergraduate (UG) and postgraduate (PG) levels. In March 2021, MSRIT earned an 'A^+' grade from the National Assessment and Accreditation Council (NAAC), underscoring its unwavering commitment to academic excellence. Since 2007, the institute has proudly held Autonomous Status for its UG and PG programs, a prestigious recognition granted by the University Grants Commission (UGC) and Visvesvaraya Technological University (VTU). According to the Ministry of Education, Government of India's NIRF Ranking Framework, MSRIT ranks 75th among 1,584 leading engineering institutions and 31st among 131 architecture schools in India for 2025, highlighting its remarkable impact and leadership in education.

The institute participated in the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. To foster a research culture, the institute has established several specialized centres, including the Centre for Imaging Technologies, the Centre for Advanced Materials Technology, the Centre for Antennas and Radio Frequency Systems (CARFS), the Centre for Cyber Physical Systems, the Schneider Centre of Excellence, the Centre for Bio and Energy Materials Innovation, JSW Centre of Excellence in Power Systems and more. MSRIT boasts a faculty of 380 highly qualified members, 70% of whom hold doctoral degrees, and over 300 scholars currently pursuing Ph.D. degrees.

The Entrepreneurship Development Cell (EDC) and "Ramaiah Evolute" have been established on campus to support startup incubation. MSRIT features a dedicated Placement and Training department, a strong mentoring and proctorial system, a fully equipped sports department, and a spacious, air-conditioned library with a wide range of books and subscriptions to both international and national journals. The Digital Library provides access to online e-journals from renowned publishers, including Elsevier ScienceDirect, IEEE, Taylor & Francis, and SpringerLink. Additionally, the Institute is a member of DELNET, CMTI, and the VTU E- Library Consortium.

The institute features a state-of-the-art auditorium, a well-equipped recording studio, and multiple advanced conference halls with videoconferencing capabilities. Additionally, MSRIT provides excellent hostel accommodations for both boys and girls, ensuring a comfortable living environment. MSRIT alumni have achieved remarkable success, holding prominent positions in India and internationally. They maintain strong connections with the institute through an engaged and active Alumni Association.

Founded on Dr. Ramaiah's unwavering commitment to knowledge and innovation, this remarkable institution continues to inspire generations of students and shape the future of engineering and technology in the country.

About the Department:

The Department of Electronics and Communication was started in 1975 and has grown over the years in terms of stature and infrastructure. The department has well equipped simulation and electronic laboratories and is recognized as a Research Center under VTU. The department currently offers a B. E. program with an intake of 138, and two M. Tech programs, one in Digital Electronics and Communication, and one in VLSI Design and Embedded Systems, with intakes of 30 and 18 respectively. The department has a Center of Excellence in Food Technologies sponsored by VGST, Government of Karnataka. The department is equipped with numerous UG and PG labs, along with R & D facilities. Past and current research sponsoring agencies include DRDO, DST, VTU, ISRO, VGST and AICTE with funding amount worth Rs. 1 crore. The department has modern research ambitions to develop innovative solutions and products and to pursue various research activities focused towards national development in various advanced fields such as Signal Processing, Embedded Systems, Cognitive Sensors and RF Technology, Software Development and Mobile Technology.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

RIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To evolve into a department of national and international repute for excellence in education and cutting-edge research in the domain of Electronics and Communication Engineering

MISSION OF THE DEPARTMENT

The department will continuously strive to

1. Provide a world-class learning environment that caters to local and global technological and social requirements
2. Initiate research collaborations with academia and industries to perform cutting edge research leading to socio-technological innovations
3. Develop skills for pursuing innovation and entrepreneurial ventures for graduating engineers

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Acquire knowledge and skills to be employed as successful professionals in their chosen careers

PEO2: Emerge as technologists, researchers, and entrepreneurs through lifelong learning

PEO3: Demonstrate social, ethical, and leadership skills

PROGRAM OUTCOMES (POs):

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

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Circuit Design Concepts: Apply basic and advanced electronics for implementing and evaluating various circuit configurations.

PSO2: VLSI and Embedded Domain: Demonstrate technical competency in the design and analysis of components in VLSI and embedded domains.

PSO3: Communication Theory and Practice: Possess application level knowledge in theoretical and practical aspects required for the realization of complex communication systems

Semester wise Credit Breakdown for B.E Degree Curriculum Batch 2025-29

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Applied Science Courses (ASC)	08	08	03	---	---	---	---	---	**19**
Engineering Science Courses(ESC/ PLC/ETC)	10	05	---	---	---	---	---	---	**15**
Humanities, Social Sciences and Management (HSMC)	01	02	---	---	03	---	03	---	**09**
Ability Enhancement Course (AEC)	01	01	01	01	01	---	---	---	**05**
Skill Development Course (SDC)	---	---	---	---	---	01	---	---	**01**
Universal Human Values (UHV)	---	---	02	---	---	---	---	---	**02**
Professional Core Course (PCC)/ Program Specific Course (PSC)	---	04	11	12	11	11	04	---	**53**
Integrated Professional Core Course (IPCC)	---	---	04	04	04	---	04	---	**16**
Professional Electives Courses - (PEC)	---	---	---	03	03	03	03	---	**12**
Open Elective Courses (OEC)	---	---	---	---	---	03	03	---	**06**
Internship (INT)	---	---	---	---	---	---	---	04	**04**
Mini Project/ Project Work(PW)	---	---	---	---	---	04	02	12	**18**
Non Credit Mandatory Courses (NCMC)	---	---	Yes	Yes	Yes	Yes	---	---	**---**
Total Credits	**20**	**20**	**21**	**20**	**22**	**22**	**19**	**16**	**160**
Skill Lab	---	**01**	**01**	**01**	**01**	**01**	---	---	**05**

SCHEME OF TEACHING III SEMESTER

B.E. in Electronics & Communication
Scheme of Teaching – Batch : 2025

III SEMESTER

Sl. No.	Subject Code	Subject	Teaching Dept.	Category	Credits				Total contact hours /week			
					L	T	P	Total	L	T	P	S
1	25EC31	Engineering Mathematics – III	MAT	ASC	2	1	0	3	2	2	0	2
2	25EC32	Data Structures & Algorithms	EC	PCC(IC)	3	0	1	4	3	0	2	3
3	25EC33	Network Analysis	EC	PCC	3	0	0	3	3	0	0	3
4	25EC34	Digital Design and HDL	EC	PCC	3	0	0	3	3	0	0	3
5	25EC35	Analog Electronic Circuits	EC	PCC	3	0	0	3	3	0	0	3
6	25UHV36	Universal Human Value Course	UHV	UHV	2	0	0	2	2	0	0	2
7	25ECAEC37	Ability Enhancement Course- III	EC	AEC	1	0	0	1	1	0	0	1
8	25ECL38	Digital Design Lab	EC	PCC(L)	0	0	1	1	0	0	2	0
9	25ECL39	Analog Electronic Circuits Lab		PCC(L)	0	0	1	1	0	0	2	0
				Total	**17**	**1**	**3**	**21**	**17**	**2**	**6**	**17**
10	25PE69	Physical Education		NCMC	All students have to register compulsorily for any one of the courses with the **concerned coordinator** (Yoga Teacher/ Head, Sports. Dept./ NSS Coordinator) in the beginning of the III semester. Attending the registered course from III to VI semesters. Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree.							
	25YO69	Yoga										
	25NS69	NSS										
11	25AM31	Additional Mathematics - I *	MAT	NCMC	0	0	0	0	-			
12	25ECSL2	Skill Lab -II	EC	SDC	0	1	0	1	To be evaluated at the end of the semester but shall be reflected in the VIII semester grade card.			

*** Environmental Studies is under the category of NCMC, 1-hour teaching per week has to be allocated in the time table.**

NOTE: Minimum of 1 subject should have a Tutorial component of 1 Credit.

Nomenclature: IPCC: Integrated Professional Core Course**, PCC:** Professional Core Course**, HSMC:** Humanity and Social Science & Management Courses**, PEC:** Professional Elective Courses**, AEC–**Ability Enhancement Courses, **NCMC**: Non-credit Mandatory Course
L –Lecture, T – Tutorial, P- Practical/ Drawing
Note: ECE55x, where x=1,
Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE **(no SEE).** However, questions from the practical part of IPCC can be included in the SEE question paper.
Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group provides an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

SCHEME OF TEACHING IV SEMESTER

B.E. in Electronics & Communication Scheme of Teaching – Batch : 2025												
IV SEMESTER												
Sl. No.	**Subject Code**	**Subject**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**			
					L	**T**	**P**	**Total**	**L**	**T**	**P**	**S**
1	25EC41	Engineering Mathematics – IV	MAT	PCC	2	1	0	3	2	2	0	2
2	25EC42	Engineering Electromagnetics	EC	PCC(IC)	3	0	1	4	3	0	2	3
3	25EC43	Microprocessors	EC	PCC	3	0	0	3	3	0	0	3
4	25EC44	Signals and Systems	EC	PCC	3	0	0	3	3	0	0	3
5	25ECE45x	Program Elective Course – I	EC	PEC	3	0	0	3	3	0	0	3
6	25ECAEC46	Ability Enhancement Course - IV	EC	AEC	1	0	0	1	1	0	0	1
7	25ECL47	Microprocessors Lab	EC	PCC(L)	0	0	1	1	0	0	2	0
8	25ECL48	Signals and Systems Lab	EC	PCC(L)	0	0	1	1	0	0	2	0
9	25ECL49	HDL Lab	EC	PCC(L)	0	0	1	1	0	0	2	0
				Total	**15**	**1**	**4**	**20**	**15**	**2**	**8**	**15**
10	25AM41	Additional Mathematics II *****	MAT	NCMC	0	0	0	0	-			
11	25ECSL3	Skill Lab -III	EC	SDC	0	1	0	1	Tobe evaluated at the end of the semester but shall be reflected in the VIII semester grade card.			

NOTE: Minimum of 1 subject should have a Tutorial component of 1 Credit.

LIST OF DEPARTMENT ELECTIVES

SI. No.	**Course Code**	**Course Title**	**Credits**				**Contact Hours**
			L	**T**	**P**	**Total**	
IV Sem (ELECTIVE –I)							
1	25ECE451	Control Systems	3	0	0	3	3

Nomenclature, PCC: Professional Core Course**, PEC:** Professional Elective Courses, **IOE:** Institutional Open Elective, **PW:** Mini Project, **INT –** Internship
L –Lecture, T – Tutorial, P- Practical/ Drawing
Note: ECE63x , where x=1,2,3,4 ECE64x , where x=1,2,3,4 ECE73x , where x=1,2,3,4,5 ECOE0x*, where x=1,2,3,4,5.. continued from previous
L –Lecture, T – Tutorial, P- Practical/ Drawing/ Project work
Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added to supplement the latest trend and advanced technology in the selected

stream of engineering. Each group provides an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10.

Institutional Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent department. However, they can take an elective offered by other departments, provided they satisfy the prerequisite condition, if any. Registration to open electives shall be documented under the guidance of the Proctor.

Selection of an open elective shall not be allowed if,

1. The candidate has studied the same course during the previous semesters of the program.
2. The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
3. A similar course, under any category, is prescribed in the higher semesters of the program.
4. The minimum students strength for offering open electives is 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to a group having **not more than 4 students.** The CIE marks shall be awarded by a committee constituted by of the Head of the concerned department. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session as per the rubrics defined by the department. SEE will be conducted by the two examiners appointed by the Institute. SEE marks awarded for the mini project shall be based on the evaluation of project work report, project presentation skill and question and answer session.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

VECTOR SPACE AND TRANSFORM TECHNIQUES	
Course Code: 2 5 EC31	**Credits:** 2:1:0
Pre-requisites: Nil	C**ontact Hours:** 30L+15T
Course coordinators: Dr. Vijaya Kumar and Dr. A. Sreevallabha Reddy	

Course Contents

Unit I

Vector Space and Linear Transformation: Vector space, Linear combination and span, Linearly independent and dependent vectors, Basis and Dimension, Linear transformations, Composition of matrix transformations, Rotation about the origin, Dilation, Contraction and Reflection, Kernel and Range, Change of basis.

- Pedagogy / Course delivery tools: Chalk and talk, Power point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/
  https://nptel.ac.in/courses/111/102/111102152/
- Impartus Recording: https://a.impartus.com/ilc/#/course/621524/103
  https://a.impartus.com/ilc/#/course/619570/1030

Unit II

Dimensionality Reduction Techniques: Orthogonality of the Four Fundamental Subspaces, Projections. Orthonormal Bases and Gram - Schmidt orthogonalization, QR-Factorization, Least Squares approximation. Symmetric Matrices, Orthogonal diagonalization, The singular value decomposition (SVD), Principal Component Analysis (PCA),

- Pedagogy / Course delivery tools: Chalk and talk, Power point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/
  https://nptel.ac.in/courses/111/102/111102152/
- Impartus Recording: https://a.impartus.com/ilc/#/course/621524/103
  https://a.impartus.com/ilc/#/course/619570/1030

Unit III

Fourier Series: Review of orthogonal vectors and functions, Trigonometric Fourier series, orthonormal basis of Fourier series, Derivation of Fourier coefficients, Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period, Complex form of Fourier series, Half range Fourier series, Practical harmonic analysis,

Pedagogy / Course delivery tools:	Chalk and talk, Power point Presentation, Videos
Links:	https://nptel.ac.in/courses/111105134
Impartus Recording:	https://a.impartus.com/ilc/#/course/2975585/1331

Unit IV

Fourier Transforms: Derivation of Fourier transforms from Fourier series, Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transforms, Convolution theorem and its significance, Parseval's identity, Fourier transform of derivatives and integrals,

➢ Pedagogy / Course delivery tools:	➢ Chalk and talk, Power point Presentation, Videos
➢ Links:	➢ https://nptel.ac.in/courses/111105134
➢ Impartus Recording:	➢ https://a.impartus.com/ilc/#/course/2975585/1331

Unit V

Discrete Transforms: Z-transform of Standard functions, Linearity property, damping rule, shifting property, Initial and final value theorems, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem, Application of Z-transforms to solve difference equations. Discrete Fourier transform (DFT), Inverse DFT, Fast Fourier transform (FFT).

➢ Pedagogy / Course delivery tools:	➢ Chalk and talk, Power point Presentation, Videos
➢ Links:	➢ https://nptel.ac.in/courses/111107119
➢ Impartus Recording:	➢ https://a.impartus.com/ilc/#/course/2975585/1331

Text Books:

1. **Advanced Engineering Mathematics** – Erwin Kreyszig –Wiley publication – 10th edition-2015
2. **Higher Engineering Mathematics** – S. Grewal –Khanna Publishers – 44th edition – 2017
3. **Gilbert Strang,** Linear Algebra and its Applications, 5 th Edition (2016).

References:

1. **Fast Fourier Transform and Its Applications** – Oran Brigham E. – Pearson – 1st edition -1988
2. **Integral Transforms and Their Applications** – Debnath, L., & Bhatta, D. – Chapman and Hall/CRC 2nd edition – 2015
3. **David C. Lay, Steven R. Lay and Judi J. Mc. Donald** – Linear Algebra and its Applications – Pearson – 5 th edition – 2015.

Course Outcomes

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

1. Apply vector space and linear transformation concepts to solve engineering problems. **(PO – 1, 3 & PSO – 1, 2)**
2. Analyze engineering systems using orthogonal transformations and matrix decompositions. **(PO-1, 3, 4 & PSO – 2, 3)**
3. Apply Fourier series to represent and analyze periodic functions **(PO – 1, 2, 3 & PSO – 1, 3)**
4. Use Fourier transforms to solve engineering and mathematical problems **(PO – 1, 2, 3 & PSO – 2, 3)**
5. Apply Z-transforms and discrete Fourier transforms for the analysis of discrete-time systems. **(PO – 1, 2, 3, 5 & PSO – 2, 3)**

Course Assessment & Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components	Marks	Course outcomes addressed
Quiz	10	CO1, CO2, CO3
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination:	100	CO1, CO2, CO3, CO4, CO5

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's taxonomy) such as:

- Remembering and Understanding the course content (weightage: 25%)
- Applying the knowledge acquired from the course (weightage: 40%)
- Analyzing and evaluating the related information (weightage: 35%)

DATA STRUCTURES AND ALGORITHMS

Course Code: 25EC32 **Credits**: 3:0:1
Prerequisites: Fundamentals of C Program **Contact Hours**: 45L+30P
Course Coordinators: Dr. Lakshmi Shrinivasan

Course Contents

Unit I

Algorithmic Foundations and Linear Structures: Introduction to iterative and recursive algorithms, algorithm analysis and asymptotic notations, Abstract Data Types (ADTs), implementation and applications of stacks, operations and applications of queues, array implementation of circular queues, implementation of stacks using queues and queues using stacks, priority queue (concept and applications), applications of stacks, storage structures for arrays, sparse matrices.

- Pedagogy / Course delivery tools: ➢ Chalk and talk, Power Point Presentation, videos
- Links: ➢ nptel.ac.in/courses/106102064?
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/3054303/1331

Unit II

Linked Lists: Linked lists, singly, doubly and circular linked lists, search, insertion and deletion operations on linked lists, algorithms on linked lists (reversal of linked list, merging two sorted linked lists, detecting loop in linked list, finding middle element), linked list implementation of stacks and queues.

- Pedagogy / Course delivery tools: ➢ Chalk and talk, Power Point Presentation, videos
- Links ➢ nptel.ac.in/courses/106102064?
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/3054303/1331

Unit III

Trees and Hashing: Preliminaries of trees, binary tree, tree traversals, binary search trees and operations, AVL tree algorithm, B- tree and its variations, hashing ADT, hash functions, collision resolution techniques, separate chaining, open addressing, rehashing.

- Pedagogy / Course delivery tools: ➢ Chalk and talk, Power Point Presentation, videos
- Links: ➢ nptel.ac.in/courses/106102064?
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/3054303/1331

Unit IV

Graph Algorithms: Representation of graphs, breadth first search (BFS), depth first search (DFS), topological sorting, shortest path problems- Dijkstra's algorithm & Bellamon Ford algoritm, Greedy algorithm, Branch and bound algorithm, minimum spanning trees, Prim's algorithm, Kruskal's algorithm.

- Pedagogy / Course delivery tools: ➢ Chalk and talk, Power Point Presentation, Videos
- Links: ➢ nptel.ac.in/courses/106102064?
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/3054303/1331

Unit V

Algorithm Design, Sorting and Searching: Algorithm design paradigms – divide and conquer, binary search as divide and conquer, merge sort, quick sort, sorting algorithms – selection, insertion, merge, quick, heap and radix sort, address calculation, linear search, binary search, basic problem-solving algorithms (finding maximum and minimum, second largest element, frequency counting using arrays), pattern matching.

- Pedagogy / Course delivery tools: ➢ Chalk and talk, Power Point Presentation, videos
- Links: ➢ nptel.ac.in/courses/106102064?
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/3054303/1331

Text Books:

1. J. P. Tremblay and P. G. Sorenson, "An Introduction to Data Structures with applications", Second Edition, Tata McGraw Hil1,1981
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Second Edition, PHI, 2009.
3. Richard F. Gilberg, Behrouz A. Forouzan, “Data Structures A Pseudocode Approach with C++”, 2nd Edition, Cengage Learning India Pvt. Ltd. 2008.

References:

1. M. Tenenbaum and Augestien, “Data Structures using C”, Third Edition Pearson Education2007.
2. Michael T.Goodrich and Roberto Tamassia, “Algorithm Design: Foundations, Analysis and Internet Examples”, Second Edition, Wiley-India, 2006.

List of IPCC Laboratory programs to be executed:

Stacks & Queues operations and applications, Sparse matrix operations, Linked Lists, Trees, shortest path algorithm, Sorting & Searching, Graph traversal techniques, minimum spanning tree.

Course Outcomes

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

1. Apply iterative, recursive algorithms and linear data structures to solve problems. **(PO-1, 2,5,11)**
2. Implement linked-list structures and algorithms for problem solving. **(PO- 1,2,3, 5 ,11)**
3. Analyze tree and hashing techniques for efficient data organization. **(PO-1, 2, 4, 5, 11)**
4. Analyze graph algorithms for traversal, shortest paths and minimum spanning trees. **(PO-1, 2, 4, 5, 11)**
5. Evaluate sorting, searching and algorithm design techniques based on computational performance. **(PO-1, 2,3,4, 5 ,11)**

NETWORK ANALYSIS

Course Code: 25EC33 **Credits**: 3:0:0

Prerequisites: Basics of Electrical Engineering **Contact Hours**: 45 Hours (L)

Course Coordinators: Mr. Manjunath C Lakkannavar, Dr. Punya Prabha V

Course Contents

Unit I

Network Elements, Circuit Laws and Basic Network Analysis

Voltage and Current Sources, Nodes, Paths, Loops, and Branches, Kirchhoff's Current Law, Kirchhoff's Voltage Law, The Single-Loop Circuit, The Single-Node-Pair Circuit, Series and Parallel Connected Sources, Voltage and Current Division, Nodal Analysis, Super node, Mesh Analysis, Super mesh.

- Pedagogy / Course delivery tools: ➢ Chalk and talk
- Links: ➢ https://nptel.ac.in/courses/108105159
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/81473/295

Unit II

Network Theorems and Network Transformations

Linearity and Superposition, Source Transformations, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion

- Pedagogy / Course delivery tools: ➢ Chalk and talk
- Links: ➢ https://nptel.ac.in/courses/108105159
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/81473/295

Unit III

Transient Analysis

The Source-Free RC Circuit, The Source-Free RL Circuit, The Unit-Step Function, The Source-Free Parallel Circuit, The Source-Free Series RLC Circuit, The Complete Response of The RLC Circuit.

- Pedagogy / Course delivery tools: ➢ Chalk and talk
- Links: ➢ https://nptel.ac.in/courses/108105159
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/81473/295

Unit IV

Sinusoidal Steady-State, AC Power and Resonance

Characteristics of Sinusoids, Forced Response to Sinusoidal Functions, The Phasor, Impedance and Admittance, Instantaneous Power, Average Power, Maximum Power Transfer, Transfer Function, Parallel Resonance, Bandwidth and High-Q Circuits, Series Resonance

- Pedagogy / Course delivery tools: ➢ Chalk and talk
- Links: ➢ https://nptel.ac.in/courses/108105159
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/81473/295

Unit V

Laplace Transform and Two-Port Network Analysis

Definition of The Laplace Transform, Laplace Transforms of Simple Time Functions, Inverse Transform Techniques, The Initial-Value and Final-Value Theorems, Z(S) And Y(S), One-Port Networks, Admittance Parameters, Impedance Parameters, Hybrid Parameters, Transmission Parameters.

- Pedagogy / Course delivery tools: ➢ Chalk and talk
- Links: ➢ https://nptel.ac.in/courses/108105159
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/81473/295

TEXTBOOKS:

1. W. H. Hayt Jr., J. E. Kemmerly, S. M. Durbin, "Engineering Circuit Analysis", Tenth Edition; Tata McGraw-Hill; 2024.
2. F. F. Kuo, "Network Analysis and Synthesis", 2nd Edition; Wiley, 1966.

REFERENCES:

1. M. Nahvi, J. A. Edminister, "Electric Circuits", Fourth Edition; Tata McGraw-Hill; 2007.
2. C. K. Alexander, M. N. O. Sadiku, "Fundamentals of Electric Circuits", Third Edition; Tata McGraw-Hill, 2008.

Course Outcomes:

1. Explain the fundamental network elements, circuit laws, and apply basic network analysis techniques to analyze electrical circuits. (PO – 1, 2, 3, 4, 5. PSO – 1)
2. Apply network theorems and transformation techniques to solve electrical network problems. (PO – 1, 2, 3, 4, 5. PSO – 1)
3. Analyze the transient response of RC, RL, and RLC circuits under various operating conditions. (PO – 1, 2, 3, 4, 5. PSO – 1)
4. Determine the steady-state response, AC power, and resonance characteristics of circuits. (PO – 1, 2, 3, 4, 5. PSO – 1)
5. Apply Laplace transform techniques and evaluate two-port network parameters for circuit analysis. (PO – 1, 2, 3, 4, 5. PSO – 1)

Digital Design and HDL	
Course Code: 25EC34	**Credits**: 3:0:0
Prerequisites: Fundamentals of Electronics and Communication Engineering	
Course Coordinators: Dr. Reshma Verma, Pavitha U S, C Sharmila Suttur	**Contact Hours:** 45

Course Contents

UNIT – I

Principles of Combinational Logic: Gate-Level Minimization: Introduction, Canonical forms, Karnaugh maps, Quine- Mc Cluskey Minimization technique, Exclusive-OR Functions, Combinational Circuits, Analysis of Combinational Circuits, Design Procedure, Binary Adder– Subtractor, Decimal Adder.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/ 117106011
- Impartus Recording: https://a.impartus.com/ilc/#/course/591142/1030

UNIT – II

Combinational Logic Design and Programmable Logic Devices: Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers, RAM, Memory decoding, Programmable Logic Devices(PLDs).

- Pedagogy / Course delivery tools: chalk and talk.
- Links: https://nptel.ac.in/courses/11710611
- Impartus Recording: https://a.impartus.com/ilc/#/course/591142/1030

UNIT – III

Sequential Logic design: Flip flops, Registers, Shift Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counters, Analysis of clocked sequential circuits, Models of sequential circuits moore machine and mealy machine.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/117106011
- Impartus Recording: https://a.impartus.com/ilc/#/course/591142/1030

UNIT – IV

Introduction to Verilog: Basic concepts, Structure of Verilog module, Ports, Operators, Data flow modelling, Gate level modeling, HDL models of combinational circuits.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/117106011
- Impartus Recording: https://a.impartus.com/ilc/course/591142/1030

UNIT – V

Verilog Behavioral Description: Structured Procedures, Procedural assignments, loop statements, Verilog Behavioral Description of combinational and sequential circuits.
Verilog Structural description: Highlights of Structural description, Organization of structural Description, Structural descriptions of combinational and sequential circuits.

- Pedagogy / Course delivery tools: Chalk and talk.

- Links: https://nptel.ac.in/courses/117106011
- Impartus Recording: https://a.impartus.com/ilc/course/591142/1030

Text Books:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog" 6th Edition, Pearson Education, 2017
2. Digital Principles and Design by Donald D Givone, McGrawHill, 2002.
3. Samir Palnitkar- VERILOG HDL-A Guide to digital design and synthesis-, 2nd Edition, Pearson education. 2003.

References:

1. Michael D Ciletti, "Advanced Digital Design with Verilog HDL", 2nd Edition, Pearson Education, 2018
2. John F Wakerly - Digital design principles and practices with Verilog, 5th Edition, Pearson education. 2018
3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint, Dream techpress.

Course Outcomes (COs):

1. Apply gate-level minimization techniques and design, analyze, and implement combinational logic circuits. (PO-1, 2, 3, PSO-1, 2)
2. Design combinational logic circuits and implement programmable logic devices. (PO-1, 2, 3, PSO-1, 2)
3. Analyze and design sequential logic circuits. (PO-1, 2, 3, PSO-1, 2)
4. Develop combinational digital circuits using Verilog HDL using dataflow and gate-level modeling techniques. (PO-1, 2, 3, PSO-1, 2)
5. Model the digital circuits using Verilog HDL behavioral and structural techniques. (PO-1, 2, 3, PSO-1, 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test – I	30	CO1,CO2
Internal test – II	30	CO3,CO4,CO5
Average of the two internal tests will be taken for 30 marks.		
Other components	**Marks**	**Course outcomes addressed**
Quiz/Assignment	10	CO1,CO2
Quiz/Assignment	10	CO3,CO4,CO5
Semester End Examination (SEE)	100	CO1,CO2,CO3,CO4,CO5

ANALOG ELECTRONIC CIRCUITS	
Course Code: 25EC35	**Credits: 3:0:0**
Prerequisites: Fundamentals of Electronics and Communication Engineering	
Course Coordinators: Dr. M Nagabushanam	**Contact Hours:** 45

Course Contents:

UNIT – I

BASIC PHYSICS OF SEMICONDUCTOR: Semiconductor Materials and Their Properties: Charge Carriers in Solids, Modification of Carrier Densities, Transport of Carriers: *pn* Junction, **pn** Junction in Equilibrium, *pn* Junction Under Reverse Bias, *pn* Junction Under Forward Bias I/V Characteristics, constant voltage model, Reverse Breakdown: Zener Breakdown, Avalanche Breakdown. Voltage doublers, Diode as level shifters and switches.

UNIT – II

PHYSICS OF MOS TRANSISTOR AND CS-AMPLIFIER: Structure of MOSFET, Operation of MOSFET: Qualitative Analysis, Derivation of I-V Characteristics. MOS Trans conductance, Small-Signal Model, PMOS Transistor, Comparison of Bipolar and MOS Devices. General considerations, MOS amplifier topologies, biasing techniques, and the realization of current sources. Common-Source (CS) amplifier, CS core, CS stage with current-source load, CS stage with diode-connected load, CS stage with source degeneration, and CS core with biasing.

UNIT – III

CG, CD AND DIFFERENTIAL AMPLIFIERS: Common-Gate (CG) core, Source follower core.
General considerations, differential signals (discussion with MOS), MOS differential pair including qualitative small-signal analysis, common-mode rejection, and differential pair with active load including qualitative analysis.

UNIT – IV

OPERATIONAL AMPLIFIER: General considerations, op-amp-based circuits including noninverting amplifier, inverting amplifier, integrator and differentiator, and voltage adder. Nonlinear functions including precision rectifier, logarithmic amplifier, and square-root amplifier. Op-amp nonidealities including DC offsets, input bias current, speed limitations, and finite input and output impedances.

UNIT – V

COMPARATORS AND DATA CONVERTERS: Comparators: Zero-crossing Detectors, Inverting Schmitt Trigger, D/A Converters: Weighted Resistor DAC, R-2R Ladder Network DAC, A/D Converters: Counter, SAR, Flash

Timer 555: Functional Block diagram, Monostable, Astable Multivibrators

Text Books:

1. Behzad Razavi, Fundamentals of Microelectronics, Second Edition, John Wiley & Sons, Inc., 2014.

References:

2. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Third Edition, Oxford University Press, 2012.
3. Mohammad H Rashid, "Microelectronic Circuits Analysis and Design, PWS Publishing
    - Company, First Edition, 2007

Course Outcomes:

1. Explain the physics of semiconductor materials, PN junctions, diode characteristics, and the operation of diode-based electronic circuits. (POs - **1, 2, PSO -1,2)**
2. Understand the structure, operation, characteristics, and models of MOS transistors and analyse the Common Source amplifier. (POs - **1, 2, 3, 11, PSO -1, 2)**
3. Analyze the operation and performance of amplifiers and differential amplifiers using MOS transistors. (POs - **1, 2, 3, PSO -1)**
4. Design and analyze operational amplifier-based linear and nonlinear circuits. (POs -**1, 2, 3, PSO -1)**
5. Design and analyse comparators, data converters and multivibrator. (POs -**1, 2, 3, PSO -1)**

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test – I	30	CO1,CO2
Internal test – II	30	CO3,CO4,CO5
Average of the two internal tests will be taken for 30 marks.		
Other components	**Marks**	**Course outcomes addressed**
Quiz/Assignment	10	CO1,CO2
Quiz/Assignment	10	CO3,CO4,CO5
Semester End Examination (SEE)	100	CO1,CO2,CO3,CO4,CO5

Universal Human Values	
Course code: 25**UHV36**	Course Credits : **2:0:0**
Pre-requisites: NIL	Contact hours: 28L
Course coordinator: Department Faculty	

Course Contents

UNIT –I:

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

(6 Lectures)

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? – it's content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Holistic Development and Role of Education: https://youtu.be/sGZtTPe-lhQ

UNIT –II:

Understanding Harmony in the Human Being - Harmony in Myself!

(6 Lectures)

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' – *Sukh and Suvidha*.
3. Understanding the Body as an instrument of 'I'(I being the does, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: *Sanyam and Swasthya*; correct appraisal of physical needs, meaning of Prosperity in detail.
6. Program to ensure *Sanyam and Swasthya*

-Practice Exercises and Case studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Human Being- Self and Body https://youtu.be/0ERSMkRPQBM
- Links: Harmony in Human Being- Self https://youtu.be/83oGJ4oDeIg
- Links: Harmony between Self and Body Prosperity https://youtu.be/aJ_BU2OgpKs

UNIT –III:

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

(6 Lectures)

1. *Understanding Harmony in the family – the basic unit of human interaction.*
2. Understanding values in a human-human relationship; the meaning of *Nyaya* and the program for its fulfillment to ensure *Ubhay-tripti;* Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship.
3. Understanding the meaning of *Vishwas*; Difference between intention and competence.

4. Understanding the meaning of *Samman*, the Difference between respect and differentiation; the other salient values in the relationship.
5. Understanding the harmony in the society (society being an extension of the family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals.
6. Visualizing a universal harmonious order in society- Undivided Society *(Akhand Samaj)*, Universal Order *(Sarvabhaum Vyawastha)*- from family to world family!

- Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab component / Practical Topics: Survey and polls for self-exploration
- Links: Harmony in Family- Trust https://youtu.be/F2KVW4WNnS8
- Links: Harmony in family- Respect https://youtu.be/iLqNRPuv0_8
- Links: Harmony in family- Other Feeling Justice https://youtu.be/TcYJB7reKnM
- Links: Harmony in the Society https://youtu.be/BkWgFinrnPw

UNIT—IV:

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

(4 Lectures)

1. Understanding the harmony in the Nature.
2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence

- Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos
- Lab component / Practical Topics: Survey and polls for self-exploration
- Links: Harmony in Nature: https://youtu.be/K1Jpd_ojydw
- Links: Harmony in Existence: https://youtu.be/mormUeZ_RUE

UNIT –V:

Implications of the above Holistic Understanding of Harmony on Professional Ethics

(6 Lectures)

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics:
   a) Ability to utilize the professional competence for augmenting universal human order
   b) Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,
   c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems.
6. Strategy for transition from the present state to Universal Human Order:
   a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers.
   b) At the level of society: as mutually enriching institutions and organizations.

a) Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
b) Lab component / Practical Topics: Survey and polls for self-exploration

Suggested Learning Resources:

Text Books:

1. **R.R Gaur, R Sangal, G P Bagaria**, A foundation course in Human Values and Professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

Reference Books:

1. **B L Bajpai**, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted2008.
2. **PL Dhar, RR Gaur**, 1990, *Science and Humanism*, Common wealth Publishers.
3. **Sussan George**, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991
4. **Ivan Illich**, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
5. **Donella H. Meadows, Dennis L. Meadows, Jorgen Randers**, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
6. **Subhas Palekar**, 2000, *How to practice Natural Farming*, Pracheen(Vaidik) Krishi Tantra Shodh,Amravati.
7. **A Nagraj**, 1998, *Jeevan Vidya ek Parichay*, Divya Path Sansthan,Amarkantak.
8. **E.F. Schumacher**, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
9. **A.N. Tripathy**, 2003, *Human Values*, New Age International Publishers.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
2. https://www.youtube.com/watch?v=P4vjfE-YnVk&list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4
3. Course handouts: https://drive.google.com/drive/folders/1zioX_4L2fCNX4Agw282PN86pcZZT3Osr?usp=sharing
4. Presentation Slides: https://drive.google.com/drive/folders/1rMUKh1s0HPRB1pp_blmpS-duNRcwS6YH?usp=sharing

Course Outcomes

At the end of the course, Students will be able to:

1. Apprehend the need of Value Education over Human aspirations (PO6)
2. Assimilate Harmony over the physical needs and to overcome the self- needs for a prosperous life. (PO6)
3. Recognize the need of Harmony in the Family and Society for a better World. (PO6)
4. Explain the need of mutual understanding for Holistic Harmony in all the Levels of Human Existence. (PO6)
5. Explain the Holistic understanding of Harmony and Professional Ethics at Individual Level and Society. PO6, PO8)

Course Assessment and Evaluation :

Continuous Internal Evaluation (CIE)		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
Other components	**Marks**	**Course outcomes addressed**
• Assignment • Quiz • Presentation • Model / mini project • Any other	20 (10 + 10)	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)		

Course end examination (Answer any one question from each unit – Internal choice)	100	CO1, CO2, CO3, CO4, CO5

Python Programming	
Course Code: 25ECAEC37	Credits: 1:0:0
Pre – requisites: Nil	Contact Hours: 15
Course Coordinator: Dr Shruthi K , Dr.Mamtha Mohan	

Course Contents

Unit I

Introduction to python, basic syntax, variables, data types, operators and strings.

- Pedagogy: PPT and Hands-on sessions
- Recommended Resources / Links: https://spoken-tutorial.org/tutorial-search/?search_foss=Python%203.4.3&search_language=English&page=1
- Impartus Recording: https://a.impartus.com/ilc/#/globalsearch?q=Python%20programming&page=1

Unit II

Decisions (if-else,conditional expressions) and loops (for and while), Lists(modifying, traversing, sorting, common operations) and Dictionaries(creations, operations).

- Pedagogy: PPT and Hands-on sessions
- Recommended Resources / Links: https://spoken-tutorial.org/tutorial-search/?search_foss=Python%203.4.3&search_language=English&page=1
- Impartus Recording: https://a.impartus.com/ilc/#/globalsearch?q=Python%20programming&page=1

Unit III

Functions(defining and calling function, variable scope) and modules(defining, importing names).

- Pedagogy: PPT and Hands-on sessions
- Recommended Resources / Links: https://spoken-tutorial.org/tutorial-search/?search_foss=Python%203.4.3&search_language=English&page=1
- Impartus Recording: https://a.impartus.com/ilc/#/globalsearch?q=Python%20programming&page=1

Unit IV

File handling(reading from and writing to files) and managing Input-Output (command line arguments).

- Pedagogy: PPT and Hands-on sessions
- Recommended Resources / Links: https://spoken-tutorial.org/tutorial-search/?search_foss=Python%203.4.3&search_language=English&page=1
- Impartus Recording: https://a.impartus.com/ilc/#/globalsearch?q=Python%20programming&page=1

Unit V

Introduction to Data analysis (NumPy, Pandas) and data visualization (Matplotlib).

- Pedagogy: PPT and Hands-on sessions
- Recommended Resources / Links: https://spoken-tutorial.org/tutorial-search/?search_foss=Python%203.4.3&search_language=English&page=1
- Impartus Recording: https://a.impartus.com/ilc/#/globalsearch?q=Python%20programming&page=1

Text Books:

1. Wesley J Chun, "Core Python Programming", 2nd edition, Prentice Hall.
2. Kenneth Lambart, "Fundamentals of Python",2012, Cengage Learning.
3. Udayan Das, Aubrey Lawson, "Introduction to Python Programming", 2024, OpenStax, Rice University.
4. Paul Barry "Head First Python", 2011, O'reilly
5. Yashwant kanetkar, Aditya Kanetkar, "let us Python", 3rd edition, BPB.

Course Outcomes (COs):

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

1. Understand fundamental concepts of python programming.(PO 1,2,5,7,8,9,11, PSO-2)
2. Write simple python programs for computational problems using lists and dictionaries.(PO 1,2,5,7,8,9,11, PSO-2)
3. Design and modularize programs using user-defined functions and employ modules to enhance code reusability and organization.(PO 1,2,5,7,8,9,11, PSO-2)
4. Perform file handling operations, including reading from and writing to files, and manage input-output operations in Python applications.(PO 1,2,5,7,8,9,11, PSO-2)
5. Use foundational data science libraries like NumPy for numerical computation, Pandas for data manipulation and Matplotlib for creating basic visualizations.(PO 1,2,5,7,8,9,11, PSO-2)

DIGITAL DESIGN LAB	
Course Code: 25ECL38	**Credits: 0:0:1**
Prerequisites: Fundamentals of Electronics and Communication Engineering	
Course Coordinators: Dr Reshma Verma, Pavitha U S, C Sharmila Suttur	**Contact Hours: 30**

List of Experiments

The following experiments are realized using ICs

- Logic gates
  - Realizing basic gates using universal NAND gates
  - Simply using K map and implement the Boolean function using NAND/NOR gate and verify the truth table
- Combinational circuits
  - Adder – Subtractor using IC 7483
  - BCD Adder using IC 7483
- Comparators
  - Implementation of 1-bit Comparator using Logic Gates
  - 4-bit Magnitude Comparator using IC
- Code Converters
  - Binary code to Gray code
  - BCD to Excess 3code
- Decoder Implementation
  - Implementation of Combinational circuits using decoder
  - BCD to seven segment decoder
- Implementation of 8:3 Encoders
- Multiplexers and Demultiplexers
  - Implementing Boolean functions using mux
  - Full adder with mux
  - Demultiplexer
- Flip Flops
  - Convert JK flip flop to D flip flop
  - Convert T flip flop to JK flip Flop
  - Convert D to JK flip flop
- Asynchronous Counters (IC 7476 and external gates)
  - Ripple counter using IC 7476 (Up/Down)
  - Asynchronous decade counter using IC 7490
- Synchronous Counter
  - Design and implement 3-bit Synchronous Counters
  - Presetable Counters
- Shift registers (IC 74195)
  4. Left/Right Shift register
  5. Ring Counter
- Programming RAM using IC 611

Text Books:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog" 6th Edition, Pearson Education, 2018.

References:

1. Michael D Ciletti, "Advanced Digital Design with Verilog HDL", 2nd Edition, Pearson Education, 2018

Course Outcomes:

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

1. Design and implement Boolean functions using universal gate ICs. (POs – 1, 9,10, PSO – 1,2)
2. Design and realize combinational logic circuits using ICs. (POs – 1, 9,10, PSO – 1,2)
3. Analyze, design, and convert between flip-flop types (D, T, JK) (POs – 1, 2, 3, 9,10, PSO – 1,2)
4. Design and implement Counters and Registers sequential logic circuits using ICs. (POs–1, 2, 3, 9,10, PSO –1, 2)
5. Implement Read and Write operations using Memories. (POs – 1, 2, 3, 9,10, PSO –1, 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test	20	CO1, CO2, CO3, CO4, CO5
Other components	**Marks**	**Course outcomes addressed**
Record (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Conduction (10 marks)	10	CO1, CO2,CO3, CO4, CO5
Observation (10 marks)	10	CO1,CO2,CO3,CO4,CO5
Semester End: Examination	50	CO1, CO2, CO3, CO4, CO5

ANALOG ELECTRONIC CIRCUITS LABORATORY

Course Code: 25ECL39 **Credits: 0:0:1**
Prerequisites: Fundamentals of Electronics and Communication Engineering
Course Coordinators: Dr. M Nagabushanam, H Mallika **Contact Hours:** 30

LIST OF EXPERIMENTS

A. Hardware Experiments

1. Study and Analysis of a Zener Diode Voltage Regulator Circuit
2. Study of drain /transfer characteristics and determine parameters of N-channel MOSFET
3. To study the operation of a MOSFET common-source amplifier and determine its **voltage gain, trans conductance, and output impedance** experimentally
4. Design of Inverting Schmitt trigger circuit using Op-amp
5. Design and Analysis of an Op-Amp-Based Precision Rectifiers

B. Simulation Experiments(LT-Spice)

1. Design and test R-2R DAC convertor.
2. Design and test Astable and Monostable multivibrators using IC 555
3. Design of voltage doubler circuit using diodes.
4. Design and Analysis of a Triangular Wave Generator using Op-amp.
5. Design and Analysis of a 3-Bit Flash ADC

Text Books:

1. Robert L. Boylestad and Louis Nashelsky**,** "Electronic Devices and Circuit Theory", 11th Edition, PHI, 2019.
2. D. Roy Choudhury, Shail B Jain," Linear Integrated Circuits", 4th Edition, New Age International limited, 2019.

Reference Books:

1. Behzad Razavi, Fundamentals of Microelectronics, Second Edition, John Wiley & Sons, Inc., 2014.
2. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Third Edition, Oxford University Press, 2012.

Course outcomes:

1. Analyze the characteristics and operating parameters of semiconductor devices such as Zener diodes and MOSFETs through experimental measurements. (POs – 1, 2, 8, PSO - 1)
2. Design, and experimentally evaluate analog circuits such as MOSFET common-source amplifier, voltage doublers and precision rectifiers. (POs – 1, 2, 3, 5, 8, PSO - 1)
3. Design and simulate basic analog pulse circuits like Schmitt trigger, Astable/monostable multivibrators and triangular-wave generators (POs – 1, 2, 3, 5, 8 PSO - 1)
4. Design, simulate and evaluate performance of data-conversion circuit such as R–2R DAC (POs – 1, 2, 3,5,8, PSO – 1,3)
5. Design, simulate and evaluate performance of data-conversion circuit such as 3-bit flash ADCs. (POs – 1, 2, 3, 5, 8 PSO – 1, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test	20	CO1, CO2, CO3, CO4, CO5
Other components	**Marks**	**Course outcomes addressed**
Record (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Conduction (10 marks)	10	CO1, CO2,CO3, CO4, CO5
Observation (10 marks)	10	CO1,CO2,CO3,CO4,CO5
Semester End: Examination	50	CO1, CO2, CO3, CO4, CO5

SKILL LAB COURSE – II PCB Design	
Course Code: 25ECSL02	**Credits: 0:1:0**
Prerequisites: --	
Course Coordinators: Dr Sara Mohan George	**Contact Hours: 30**

Skill Lab Course: is a 1-credit Lab course with 30 contact hours. This course is designed to improve the practical and technical skills of students, focusing on developing industry-relevant and job-oriented skills, and enhance employability of the students. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. The course shall be evaluated through Continuous Internal Evaluation (CIE) for 100 marks. The result of the course will be reflected in the Grade card of VIII semester.

IV SEM SYLLABUS

STATISTICS AND PROBABILITY FOR MACHINE LEARNING	
Course Code: 2 5 EC41	**Credits: 2**:1:0
Pre-requisites: Nil	C**ontact Hours:** 30L+30T
Course coordinators: Dr. Vijaya Kumar, Dr. A. Sreevallabha Reddy	

Course Contents

Unit I

Regression Analysis: Curve fitting by the method of least squares, Fitting linear, quadratic and geometric curves. Correlation and Regression.

Random Variables and Discrete Probability Distributions: Random variables, Binomial and Poisson distributions.

➢ Pedagogy / Course delivery tools:	➢ Chalk and talk, Power point Presentation, Videos
➢ Links:	➢ https://nptel.ac.in/courses/111/105/111105035/ ➢ https://nptel.ac.in/courses/111/107/111107119/ ➢ https://nptel.ac.in/courses/111/105/111105035/ ➢ https://nptel.ac.in/courses/111/107/111107119
➢ Impartus Recording:	➢ https://a.impartus.com/ilc/#/course/619570/1030 ➢ https://a.impartus.com/ilc/#/course/96127/452 ➢ https://a.impartus.com/ilc/#/course/119635/593

Unit II

Continuous Probability Distributions: Uniform, Exponential, Normal and Gamma distributions.

Joint Probability Distributions: Joint and marginal probability distributions of discrete and continuous random variables, Covariance and Correlation of discrete and continuous random variables, Conditional probability distribution.

➢ Pedagogy / Course delivery tools:	➢ Chalk and talk, Power point Presentation, Videos
➢ Links:	➢ https://nptel.ac.in/courses/111/105/111105035/ ➢ https://nptel.ac.in/courses/111/107/111107119 ➢ https://nptel.ac.in/courses/111/105/111105035/
➢ Impartus Recording:	➢ https://a.impartus.com/ilc/#/course/96127/452 ➢ https://a.impartus.com/ilc/#/course/119635/593

Unit III

Stochastic Processes: Introduction, Classification of stochastic processes, Stationary stochastic processes, Autocorrelation, Ergodicity.

Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states.

➢ Pedagogy / Course delivery tools:	➢ Chalk and talk, Power point Presentation, Videos
➢ Links:	➢ https://nptel.ac.in/courses/111103022
➢ Impartus Recording:	➢ https://a.impartus.com/ilc/#/course/96127/452 ➢ https://a.impartus.com/ilc/#/course/119635/593

Unit IV

Sampling and Statistical Inference: Sampling distributions, central limit theorem, concepts of standard error and confidence interval, level of significance, type I and type II errors, one tailed and two tailed tests, Z-test: for single mean, for single proportion and for difference between means, Student's t –test: for single mean and for difference between two means, F – test for equality of two variances, Chi-square test: for goodness of fit and for independence of attributes.

➢ Pedagogy / Course delivery tools:	➢ Chalk and talk, Power point Presentation, Videos
➢ Links:	➢ https://nptel.ac.in/courses/111105035 ➢ https://nptel.ac.in/courses/111107119
➢ Impartus Recording:	➢ https://a.impartus.com/ilc/#/course/96151/1112

Unit V

Vector calculus and Matrix differentiation: Review of partial derivatives, gradients and directional derivatives, Jacobian, Hessian, Gradients of vector valued functions, Matrix derivatives – AX, A^T AX, Trace, Norm.

Continuous Optimization: Maxima, Minima, Notion of objective/cost functions, Least square solutions and pseudo inverse, Gradient descent Algorithm, Constrained optimization and Lagrangian multipliers.

➢ Pedagogy / Course delivery tools:	➢ Chalk and talk, Power point Presentation, Videos
➢ Links:	➢ https://nptel.ac.in/courses/106108702?utm ➢ https://nptel.ac.in/courses/111105134
➢ Impartus Recording:	➢ https://a.impartus.com/ilc/#/course/107625/1030

Text Books:

1. Advanced Engineering Mathematics – Erwin Kreyszig – Wiley publication – 10th edition-2015
2. Probability and Statistics – Murray R Spiegel, John Schiller & R. Alu Srinivasan – Schaum's outlines – 4nd edition – 2013
3. Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong - Mathematics for machine learning - Cambridge University Press – 2020

References:

1. Probability and Statistics for Engineers and Scientists – R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye –Pearson Education – Delhi – 9th edition – 2012
2. Higher Engineering Mathematics – B. S. Grewal – Khanna Publishers – 44th edition – 2017
3. Pattern Recognition and Machine Learning - Christopher M. Bishop – 3rd edition – 2009.

Course Outcomes:

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

1. Apply regression and probability distribution models to analyze data and random phenomena. **(PO – 1, 3, 4 & PSO – 2, 3)**
2. Model uncertainty using continuous and joint probability distributions. **(PO-1, 3, 4 & PSO – 2, 3)**
3. Apply stochastic processes and Markov chains to model and analyze random systems. **(PO – 1, 3, 5 & PSO – 2, 3)**
4. Apply sampling theory and statistical hypothesis testing for data-driven decision making **(PO – 1, 3, 4 & PSO – 2, 3)**
5. Apply vector calculus and optimization techniques to solve engineering and data analysis problems. **(PO – 1, 2, 3, 5 & PSO – 2, 3)**

Course Assessment & Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components	Marks	Course outcomes addressed
Quiz	10	CO1, CO2, CO3
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination:	100	CO1, CO2, CO3, CO4, CO5

Engineering Electromagnetics	
Course Code: 25EC42	**Credits: 3:0:1**
Pre-requisites: Engineering Physics and Mathematics	**Contact Hours: 45L + 30P**
Course Coordinator: Dr. Imaculate Rosaline	

Course Contents

Unit I

Electrostatics: Introduction to Orthogonal co-ordinate systems – Rectangular, cylindrical, spherical, Gauss's law, Concept of Divergence and its theorem (only statement). **Energy and Potential:** Electric potential as a function of field, Electric Potential due to point charges, Maxwell's equation for Electrostatics, Laplace and Poisson's Equation.

Interactive Lab Module 1: Concepts of Gradient, Divergence, Electrostatic Field and Potential due to Charges

- Pedagogy/Course Delivery Tools
- Links
- Impartus Recording
- Chalk and Talk
- https://onlinecourses.nptel.ac.in/noc22_ee69/course
- https://a.impartus.com/ilc/#/course/81472/295

Unit II

Magnetostatics: Ampere's circuital law, Curl, stokes' theorem, Magnetic flux density, Scalar and Vector magnetic potentials, Maxwell's Equations for Magnetostatics **Time-varying Fields and Maxwell's Equations**: Faraday's law, Displacement current, Maxwell's equations for Time Varying Fields.

Interactive Lab Module 2: Concept of Curl, Magnetic Field due to Line Sources, Circular Loop in Time Varying Magnetic Field, Displacement Current.

- Pedagogy/Course Delivery Tools
- Links
- Impartus Recording
- Chalk and Talk
- https://onlinecourses.nptel.ac.in/noc22_ee69/course
- https://a.impartus.com/ilc/#/course/81472/295

Unit III

Uniform Plane Wave: Wave Equations, Plane wave propagation in Lossless Media Uniform Plane Waves, relation between **E** and **H** (only expression, no derivation), Plane Wave propagation in Loss Media, Low Loss Media and Good Conductors, Skin Depth, Poynting's theorem (Statement only).

Interactive Lab Module 3: Linking E to H, Plane Wave, Wave attenuation

- Pedagogy/Course Delivery Tools
- Links
- Impartus Recording
- Chalk and Talk
- https://onlinecourses.nptel.ac.in/noc22_ee69/course
- https://a.impartus.com/ilc/#/course/81472/295

Unit IV

Transmission Line Theory: Lumped element model for a transmission line, wave propagation on a transmission line and line equations, Lossless transmission line, Voltage reflection coefficient, Standing waves, Wave Impedance of lossless line, special cases of terminated lossless line, Smith chart: construction and applications, conventional and graphical solution of line parameters.

- Pedagogy/Course Delivery Tools
- Links
- Chalk and Talk
- https://onlinecourses.nptel.ac.in/noc22_ee69/course

- MSRIT Video Recording
- http://103.170.244.45/~electronics/4%20SEMESTER/EC43_Fields,%20Lines%20and%20Waves/L1_10.5_Lumped%20Element%20circuit%20model.mp4

Interactive Lab Module 4: Transmission-Line Simulator, Wave and Input Impedance, Interactive Smith Chart.

Unit V

Impedance Matching: Matching with lumped elements using smith chart, Single stub matching: shunt and series stubs using only Smith chart, Quarter wave transformer

Interactive Lab Module 5: Lumped Element Matching Design, Single-Stub Tuning Design, Quarter-Wavelength Transformer Design

- Pedagogy/Course Delivery Tools
- Chalk and Talk
- Links
- https://onlinecourses.nptel.ac.in/noc22_ee69/course
- MSRIT Video Recording
- http://103.170.244.45/~electronics/4%20SEMESTER/EC43_Fields,%20Lines%20and%20Waves/

Textbooks:

1. Ulaby, F. T., & Ravaioli, U., *Fundamentals of Applied Electromagnetics*, **8th Edition**, Pearson, 2020.
2. Hayt, W. H., Jr., & Buck, J. A., *Engineering Electromagnetics*, **9th Edition**, McGraw-Hill Education, 2019.

References:

1. M. N. O. Sadiku, *Elements of Electromagnetics*, 7th ed. Oxford University Press, 2021.
2. J. D. Ryder, *Networks, Lines and Fields*, 2nd ed. Pearson Education India, 2015.

Interactive Lab Module References:

- Interactive Modules -- Java Web Start Applications - Ulaby, F. T., & Ravaioli, U., *Fundamentals of Applied Electromagnetics*, **8th Edition**, Pearson, 2020.

Course Outcomes:

1. Apply vector calculus and coordinate system concepts to analyze electrostatic fields, potentials, and charge distributions. (POs – 1, 2,3,4,5, PSOs – 1, 3)
2. Analyze Magnetostatics and time-varying electromagnetic fields using Maxwell's equations and related integral theorems. (POs – 1, 2,3,4,5, PSOs – 1, 3)
3. Analyze uniform plane wave propagation in different media using electromagnetic field relations. (POs – 1, 2,3,4,5, PSOs –1, 3)
4. Apply transmission line theory to determine wave behavior, reflection, standing waves, and line parameters using analytical and graphical methods. (POs – 1, 2,3,4,5, PSOs – 1, 3)
5. Design impedance matching networks using Smith chart techniques and quarter-wave transformers for RF and microwave applications. (POs – 1, 2,3,4,5, PSOs – 1, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Addressed**
Internal Test-I	30	CO1,CO2
Internal Test-II	30	CO3,CO4,CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components	**Marks**	**Course Outcomes Addressed**
Quiz	10	CO1,CO2,CO3
Interactive Lab module Test	10	CO1,CO2,CO3, CO4,CO5
Semester End Examination	100	CO1,CO2,CO3,CO4,CO5

MICROPROCESSORS	
Course Code: 25EC43	**Credits: 3:0:0**
Prerequisites: Digital Electronics	**Contact Hours: 45**
Course Coordinators: Dr. Sara Mohan George	

Course Contents

Unit I

Introduction to Processor Architecture: Evolution of microprocessors and popular processor families — Intel, Motorola, MIPS and ARM, basic processor organization, instruction execution cycle, Fetch–Decode–Execute operation, Von Neumann architecture and bottleneck, Harvard and Modified Harvard architecture, RISC and CISC - design philosophy and comparison, introduction to RISC-V, ARM design philosophy, ARM processor families — Cortex-A, Cortex-R and Cortex-M, Thumb-2 technology, clock frequency, CPI and throughput.

- Pedagogy / Course delivery tools: ➢ Chalk and talk, Power Point Presentation, videos

Unit II

ARM Cortex-M4 Architecture and Programmer's Model: Block diagram, core components, bus interfaces, NVIC, FPU and MPU, general purpose registers, special registers, program status registers, Thumb state.

Processor Modes, Stack Operation and Pipeline: Thread mode and Handler mode, privileged and unprivileged execution, Main Stack Pointer and Process Stack Pointer, stack growth direction and alignment, three-stage pipeline, branch penalty and instruction prefetch buffer.

➢Pedagogy / Course delivery tools: ● Chalk and talk, Power Point Presentation, videos

Unit III

ARM Instruction Set: Instruction format, Thumb-2 encoding, data processing instructions — arithmetic, logical and comparison operations, S suffix and flag update behaviour, barrel shifter and shift operations.

Memory Access and Branch Instructions: Load-store architecture, single and multiple register load and store instructions, addressing modes — offset, pre-indexed and post-indexed, stack types, PUSH and POP, branch instructions, conditional execution and IT block.

➢Pedagogy / Course delivery tools: ● Chalk and talk, Power Point Presentation, videos

Unit IV

Pipeline Hazards and Memory System: Structural, data and control hazards, pipeline stall, memory hierarchy, ARM Cortex-M fixed memory map, endianness, memory-mapped I/O, bit band region and bit band alias address calculation.

Program Execution and Assembly Programming: Program memory sections, stack and heap, volatile keyword, read-modify-write pattern, assembly programming — arithmetic, logical, loop and array operations.

➢Pedagogy / Course delivery tools: ● Chalk and talk, Power Point Presentation, Videos

Unit V

Exceptions and Interrupt Architecture: Exception types, vector table and VTOR, NVIC — priority levels, nesting and preemption, SysTick as periodic interrupt source, exception entry and exit mechanism.

Fault Handling and Low Power Concepts: HardFault, BusFault, MemManage fault and UsageFault — causes and identification, dynamic and static power, sleep mode, deep sleep mode, WFI and WFE.

➢Pedagogy / Course delivery tools: ● Chalk and talk, Power Point Presentation, Videos

Text Books:

1. Joseph Yiu, *The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors*, 3rd Edition, Elsevier, 2013
2. William Stallings, *Computer Organization and Architecture*, 8th Edition, Pearson Education, 2010

References:

1. David Harris and Sarah Harris, *Digital Design and Computer Architecture — ARM Edition*, Morgan Kaufmann, 2015
2. Trevor Martin, *The Designer's Guide to the Cortex-M Processor Family*, Elsevier, 2013
3. ARM Limited, *ARM Cortex-M4 Technical Reference Manual*, ARM Holdings, 2010

Course Outcomes

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

1. Compare Von Neumann, Harvard, RISC and CISC architectures and explain ARM processor families and performance concepts (PO 1,2)
2. Describe the ARM Cortex-M4 internal architecture, programmer's model, processor modes, stack operation and pipeline (PO 1,2)
3. Explain ARM Thumb-2 instruction set — data processing, shift operations, memory access and branch instructions (PO 1,2,3,5)
4. Apply knowledge of pipeline hazards, ARM memory organization and program sections to write assembly programs (PO 1,2,3,4,5)
5. Describe ARM exception handling, fault types and low power operation at the processor level (PO 1,2,3,4,5,7)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test – I	30	CO1,CO2,CO3
Internal test – II	30	CO3,CO4,CO5
Average of the two internal tests will be taken for 30 marks.		
Other components	**Marks**	**Course outcomes addressed**
Quiz/Assignment/Mini-Project	10	CO1,CO2,CO3
Quiz/Assignment/Mini-Project	10	CO3,CO4,CO5
Semester End Examination (SEE)	100	CO1,CO2,CO3,CO4,CO5

SIGNALS AND SYSTEMS

Course Code: 25EC44 **Credits: 3:0:0**
Prerequisites: Engineering Mathematics **Contact Hours: 45**
Course Coordinators: H. MALLIKA

Course Contents

Unit I

Introduction to Signals and Systems: Continuous time (CT) and Discrete time (DT) signals, transformations of the independent variable, Exponential and Sinusoidal signals, unit impulse and step functions, CT and DT systems, basic system properties.

- Pedagogy/Course delivery tools: ➢ Chalk and talk
- Links ➢ https://nptel.ac.in/courses/108104100
- Impartus recording ➢ http://a.impartus.com/ilc/#/course/59755/295

Unit II

Linear Time-Invariant Systems: Discrete time LTI systems: The Convolution Sum, Continuous time LTI systems: The Convolution Integral, properties of LTI systems.

- Pedagogy/Course delivery tools: ➢ Chalk and talk
- Links ➢ https://nptel.ac.in/courses/108104100
- Impartus recording ➢ http://a.impartus.com/ilc/#/course/59755/295

Unit III

Fourier Transform: Representation of aperiodic signals, Fourier Transform of periodic signals, properties of CTFT: Linearity, time shifting, conjugation and conjugate symmetry, differentiation and integration, time and frequency scaling, duality, Parseval's relation, convolution, multiplication.

- Pedagogy/Course delivery tools: ➢ Chalk and talk
- Links ➢ https://nptel.ac.in/courses/108104100
- Impartus recording ➢ http://a.impartus.com/ilc/#/course/59755/295

Unit IV

z Transform: z transform, ROC of z transform, inverse z transform (partial fraction and power series only), properties of z transform: Linearity, time shifting, scaling in the z domain, time reversal, time expansion

- Pedagogy/Course delivery tools: ➢ Chalk and talk
- Links ➢ https://nptel.ac.in/courses/108104100
- Impartus recording ➢ http://a.impartus.com/ilc/#/course/59755/295

Unit V

Analysis using z transform and unilateral z transform: Conjugation, convolution, differentiation in z domain, initial value theorem, Analysis and characterization of LTI system using z transform, system function algebraic representations, unilateral z transform

- Pedagogy/Course delivery tools: ➢ Chalk and talk
- Links ➢ https://nptel.ac.in/courses/108104100
- Impartus recording ➢ http://a.impartus.com/ilc/#/course/59755/295

Text Books:

1. Alan V. Oppenheim, Alan S. Wilsky with S. Hamid Nawab, "Signals and Systems", 2nd Edition, Pearson Education India, 2015.
2. J. G. Proakis, D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", 5th Edition, Pearson Education, 2021.

References:

1. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, John Wiley & Sons, 2007.
2. B.P. Lathi, "Principles of Signal Processing and Linear Systems", Oxford International Student Edition, 2017

Course Outcomes:

1. Identify continuous and discrete time signals and systems. (POs – 1, 2, 3, 7, 10, PSO – 3)
2. Calculate the response of LTI system using Convolution Sum and Convolution Integral. (POs – 1, 2, 3, 7, PSO – 3)
3. Analyze Continuous time signals by Fourier transform. (POs – 1, 2, 3, 7, PSO – 3)
4. Classify discrete time signals using z-transform. (POs – 1, 2, 3, 7, 10, PSO – 3)
5. Analyze discrete time systems using z-transform. (POs –1, 2, 3, 7, PSO – 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Addressed**
Internal Test-I	30	CO1,CO2
Internal Test-II	30	CO3,CO4,CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components	**Marks**	**Course Outcomes Addressed**
Quiz	10	CO1,CO2,CO3
Assignment	10	CO4,CO5
Semester End Examination	100	CO1,CO2,CO3,CO4,CO5

CONTROL SYSTEMS	
Course Code: 25ECE451	**Credits: 3:0:0**
Prerequisites: - Network Analysis	**Contact Hours: 45**
Course Coordinators: Dr. Nuthan Prasad, Dr. Punya Prabha V	

Unit I

Laplace Transformation: Solution by the Laplace Transformation, transfer function and impulse response, Initial and Final Value theorems

Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems –Mechanical Systems, Electrical Systems, Electromechanical systems, Analogous Systems.

- Pedagogy / Course delivery tools: ➢ Chalk and talk
- Links: ➢ https://nptel.ac.in/courses/107106081
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/96235/452

Unit II

Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra, reduction technique & Signal Flow graphs.

- Pedagogy / Course delivery tools: ➢ Chalk and talk
- Links ➢ https://nptel.ac.in/courses/107106081
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/96235/452

Unit III

Time Response of feedback control systems: Standard test signals, Unit step response of First and Second Order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants.
Stability analysis: Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis: more on the Routh stability criterion.

- Pedagogy / Course delivery tools: ➢ Chalk and talk, Power Point Presentation, videos
- Links: ➢ https://nptel.ac.in/courses/107106081
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/96235/452

Unit IV

Introduction to **Root-Locus Techniques**, The root locus concepts, Construction of root loci.

Frequency domain analysis and stability: Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function.

- Pedagogy / Course delivery tools: ➢ Chalk and talk, Power Point Presentation, Videos
- Links: ➢ https://nptel.ac.in/courses/107106081
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/96235/452

Unit V

Controller design: Design of P, PI, PID, lag, lead, lead-lag compensator design.
State Variable Models: state-space representation of dynamic systems, state space transfer function, design based on state space models.

- Pedagogy / Course delivery tools: ➢ Chalk and talk
- Links: ➢ https://nptel.ac.in/courses/107106081
- Impartus recording: ➢ https://a.impartus.com/ilc/#/course/96235/452

Text Book:

1. J. Nagarath an d M.Gopal, " Control System s Engineering", New Age International(P) Limited, Publishers, 8th edition- 2025, ISBN: 9789360748463.
2. Richard C. Dorf, Robert H. Bishop; Modern Control Systems, 12th ed, Pearson Education Limited, 2014

Reference Books:

1. Ajit. K. Mandal, "Introduction to Control Engineering Modeling, Analysis and Design", 3rd Edition, New Age International Publishers, 2016
2. Dhanesh N. Manik, "Control Systems", Cengage Learning, 1st Edition, 2012.

Course Outcomes:

1. Employ Laplace transformation techniques to obtain transfer functions and analyze basic control systems and their mathematical models for mechanical, electrical, and electromechanical systems. (PO – 1, 2, 3, 4, 5. PSO – 1)
2. Demostrate the use of block diagram reduction techniques and signal flow graph methods to determine the overall transfer function of control systems. (PO – 1, 2, 3, 4, 5. PSO – 1)
3. Analyze the time response of first and second order systems using Steady state analysis and RH criterion to determine the stability of a system. (PO – 1, 2, 3, 4, 5. PSO – 1)
4. Analyze root-locus techniques and frequency-domain characteristics of feedback control systems using Bode plots and experimental transfer-function determination. (PO – 1, 2, 4, 5. PSO – 1)
5. Design various controllers and compensators, formulate state-space models for dynamic systems to improve system performance (PO – 1, 2, 4, 5. PSO – 1)

DATA ANALYTICS USING EXCEL	
Course Code: 25ECAEC46	**Credits:** 1:0:0
Pre-requisites: --	C**ontact Hours: 15**
Course coordinator: Dr. Sara Mohan George	

Course Contents

Unit I

Introduction to Excel: Basic Navigation Tab, Concept of Cell and Cell address, row, column concept – Selecting Columns & Rows, Changing and autofitting Column Width & Row Height, Hiding/Unhiding Columns & Rows, perform calculations by using SUM, MIN, MAX, COUNT, AVERAGE functions, perform conditional operations using SUMIF, AVERAGEIF.

- Pedagogy / Course delivery tools: ➢ PPT & Online Hands-on sessions
- Links: ➢ http://www.princeton.edu/~otorres/Excel/
- Links: ➢ https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Unit II

Reading and Manipulating Data: Data introduction, Currency Format – Formatting Dates, Managing Worksheets Moving, Copying, Deleting and Hiding Grouped Worksheets, manual data input, copy data, import data, sort and filter data, paste data, remove duplicates, find and replace,

- Pedagogy / Course delivery tools: ➢ PPT & Online Hands-on sessions
- Links: ➢ http://www.princeton.edu/~otorres/Excel/
- Links: ➢ https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Unit III

Pivot Table and Objects: Introduction to Pivot table, create pivot table, layout, options, summary of values, show values, subtotals, analyze, design, Insert text boxes and shapes – Insert images, Modify object properties, Printing a Worksheet,

- Pedagogy / Course delivery tools: ➢ PPT & Online Hands-on sessions
- Links: ➢ http://www.princeton.edu/~otorres/Excel/
- Links: ➢ https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Unit IV

Forecast and Charts: Introduction to Forecast, goal seeker, scenario manager, data table, forecast sheet, Create a new chart, types of charts, Resize charts, Add and modify chart elements, Apply chart layouts and styles, Move charts to a chart sheet

- Pedagogy / Course delivery tools: ➢ PPT & Online Hands-on sessions
- Links: ➢ http://www.princeton.edu/~otorres/Excel/
- Links: ➢ https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Unit V

Data Analysis for statistics: Scatter plots, descriptive statistics, histogram, correlation, linear regression, explanation of regression output

- Pedagogy / Course delivery tools: ➢ PPT & Online Hands-on sessions

- Links: ➢ http://www.princeton.edu/~otorres/Excel/
- Links: ➢ https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Text Books:

1. Wayne Winston, "Microsoft Excel Data Analysis and Business Modeling", Pearson Education 2019.
2. Michael Alexander, Richard Kusleika, John Walkenbach, Excel Bible, Wiley 2018.
3. https://www.tutorialspoint.com/data-analysis-with-microsoft-excel/index.asp
4. https://corporatefinanceinstitute.com/course/excel-data-analysis/

Course Outcomes

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

1. Understand working and use of MS-EXCEL at workplace. (POs:1, 2, 3, 5, 7, 8, 9, 10, 11, PSO – 1)

2. Perform data analysis with formulas and functions. (POs:1, 2, 3, 5, 7, 8, 9, 10, 11, PSO – 1)

3. Analyze data with PivotTables and print. (POs:1, 2, 3, 5, 7, 8, 9, 10, 11, PSO – 1)

4. Apply tools for data visualization and forecasting. (POs:1, 2, 3, 5, 7, 8, 9, 10, 11, PSO – 1)

5. Analyze data for business decision making. (POs:1, 2, 3, 5, 7, 8, 9, 10, 11, PSO – 1)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components	**Marks**	**Course outcomes addressed**
Sample Report	10	CO1, CO2, CO3, CO4, CO5
Quiz	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination:	100	CO1, CO2, CO3, CO4, CO5

MICROPROCESSOR LAB	
Course Code: 25ECL47	**Credits: 0:0:1**
Prerequisites: Microprocessors	**Contact Hours: 30**
Course Coordinators: Dr. Sara Mohan George	

Course Content

List of Experiments

A. ARM Cortex M4 Assembly Language Programs

1. Programs involving Data Transfer and Arithmetic Instructions
   i. Block move using LDM and STM
   ii. Sum of N numbers and factorial of a given number
2. Programs involving Logical and Shift Instructions
   i. Bit masking - setting, clearing and toggling of bits
   ii. Multiplication and division using shift operations
3. Multi-precision Arithmetic
   i. 64-bit addition using carry flag
   ii. 64-bit subtraction using borrow
4. Programs involving Branch and Loop Instructions
   i. Finding maximum and minimum element in an array
   ii. Bubble sort : arranging numbers in ascending order
5. Programs involving String Operations
   i. String length and string copy
   ii. String reversal and palindrome check
6. Programs involving Subroutines
   i. Factorial using subroutine call
   ii. Fibonacci series using recursive subroutine
7. Mixed C and Assembly Programming
   i. Calling an ARM assembly function from C - argument passing and return value using AAPCS
   ii. Finding maximum element of an array using assembly subroutine called from C

B. Interface Experiments — ARM Cortex-M4

8. LED Blinking: GPIO output control using memory-mapped register access
9. Counter with Seven Segment Display : sequential counting 0–9 using digit lookup table
10. DAC Waveform Generation : square, triangular, sawtooth and sine wave generation using lookup table
11. Stepper Motor Control : clockwise and anticlockwise rotation, direction change using external interrupt

Text Books:

1. Joseph Yiu, *The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors*, 3rd Edition, Elsevier, 2013
2. William Stallings, *Computer Organization and Architecture*, 8th Edition, Pearson Education, 2010

Reference Books:

1. David Harris and Sarah Harris, *Digital Design and Computer Architecture — ARM Edition*, Morgan Kaufmann, 2015
2. Trevor Martin, *The Designer's Guide to the Cortex-M Processor Family*, Elsevier, 2013
3. ARM Limited, *ARM Cortex-M4 Technical Reference Manual*, ARM Holdings, 2010

Course Outcomes

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

1. Write ARM assembly language programs using data transfer, arithmetic and multi-precision arithmetic instructions (PO 1,2,3,5)

2. Write ARM assembly language programs for logical, shift, branch and loop operations (PO 1,2,3,5)
3. Implement string operations and subroutine calls including recursive programs using ARM assembly (PO 1,2,3,5)
4. Write mixed C and assembly programs demonstrating the ARM procedure call standard (PO 1,2,3,5)
5. Interface output devices and control hardware using memory-mapped register access and interrupt-driven programming (PO 1,2,3,5)

SIGNALS AND SYSTEMS LAB	
Course Code: 25ECL48	**Credits: 0:0:1**
Prerequisites: Engineering Mathematics	**Contact Hours: 30**
Course Coordinators: Dr. V. Nuthan Prasad	

List of Experiments

- Discrete Time Signal generation
- Continuous Time Signal generation
- Operations on Discrete Time Signals
- Operations on Continuous Time Signals
- Convolution of Discrete Time Signals
- Convolution of Continuous Time Signals
- Response of Discrete LTI systems by Solving the difference equation
- Inverse z-transform by Long division method (both Causal and Anti-causal System)
- Display the transfer function, pole zero gain representation, pole-zero plot of the system function
- Analysis of systems using Root Locus, Bode plot and Routh's array

Text Books:

1. Dr. Shailendra Jain, "Modeling and Simulation using MATLAB-Simulink", Wiley, 2nd Edition, 2014.
2. Anoop K. Jairath and Saketh Kumar, "Control Systems – The state variable approach (Conventional and MATLAB)", 2nd Edition, Ane Books, 2013.

Reference Books:

1. P. Ramakrishna Rao and Shankar Prakriya, "Signals and Systems", McGraw Hill Education, 2nd Edition, 2013.
2. Akilesh Kumar, "Programming Using SCILAB, Theory and Practicals"
3. https://www.scilab.org/scilab-for-beginners-tutorial

Course Outcomes:

1. Demonstrate the generation and various operations on signals. (POs – 1, 2, 5, PSO – 3)
2. Solve for the response of LTI systems by convolution (POs – 1, 2, 3, 5, PSOs – 3)
3. Analyze the response of Discrete LTI systems by difference equation. (POs – 1, 2, 3, 5, PSOs - 3)
4. Employ z-Transform on Discrete time systems. (POs – 1, 2, 3, 5, PSO – 3)
5. Analyze the stability of control systems. (POs – 1, 2, 3, 4, 5, PSO – 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Addressed**
Record, Conduction and Observation	30	CO1,CO2,CO3,CO4,CO5
Lab Test	20	CO1,CO2,CO3,CO4,CO5
Semester End Examination	100	CO1,CO2,CO3,CO4,CO5

VERILOG HDL SIMULATION AND FPGA DESIGN LABORATORY	
Course Code: 25ECL49	**Credits: 0:0:1**
Prerequisites: Digital Design and HDL –25EC34	**Contact Hours: 15**
Course Coordinators: Dr. Parameshwara M C, C Sharmila Suttur, Dr. Reshma Verma	

Session No.	LIST OF EXPERIMENTS	No. of Hours
1.	**Data flow Modeling:** • Half adder, • Full adder, and • 4-bit Ripple Carry Adder	02 Hours
2.	**Data flow Modeling:** • Mux 4:1 using conditional operator, • 4:2 Priority Encoder, • 4-bit Magnitude Comparator using relational operators.	02 Hours
3.	**Behavioral Modeling using UDP:** • AOI22 and OAI22 logic gates. • 3-input Majority and Minority logic gates. • Any given Boolean expression.	02 Hours
4.	**Behavioral Modeling using sequential operators:** • JK, T, and D latches • JK, T, and D Flip-flops	02 Hours
5.	**Behavioral Modeling using sequential operators:** • 4-bit Synchronous and Asynchronous Binary Counters • Mod-N counter	02 Hours
6.	**Behavioral Modeling using Function and Task:** • 4-bit ALU with 3-bit OPCODE using Function • Finding Max number under two given numbers using Task	02 Hours
7.	**Structural Modeling:** • 1-bit Half and Full subtractor • 1:4 Demux and 2:4 Decoder • 4-bit adder cum subtractor	02 Hours
8.	**Structural Modeling:** • Truth table verification of buf, not, bufif and notif logic gates. • 4:1 Mux using bufif logic gates	02 Hours
9.	Design of 3-bit Sequence Counter using **Moore and Mealy FSM**	02 Hours
10.	**Functional Verification using Verilog Test Benches** • Writing Test bench to verify 1-bit adder using system tasks. • Writing Test bench for 4:1 mux.	02 Hours
11.	**FPGA Design Flow:** • Implement and verify functionality of 1-bit Adder. • Implement 4-bit Synchronous Counter.	02 Hours
12.	**FPGA Design Flow:** • Design and Implement 4-bit Phase Accumulator. • Design and Implement waveform generation using using DAC interface.	02 Hours

Text Books:

3. J. Bhasker, A Verilog HDL Primer, 3rd Edition, BS Publications, Hyderabad, ISBN: 978-81-7800-142-5.
4. S. Brown and Z. Vranesic, Fundamentals of Digital Logic with Verilog Design, 2nd Edition, Tata McGraw-Hill, New Delhi, ISBN: 978-0-07-066724-2.

Reference Books:

3. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, 2nd Edition, Pearson Education
4. J. Bhasker, Verilog HDL Synthesis: A Practical Primer, BS Publications.

Course outcomes:

1. Design combinational circuits using Verilog HDL modeling techniques. (PO1, PO2, PO3, PO5, PSO-1, PSO-2)
2. Develop digital systems using behavioral modeling, UDPs, functions, and tasks. (PO1, PO2, PO3, PO5, PSO-1, PSO-2)
3. Design sequential circuits and FSMs using Verilog HDL. (PO1, PO2, PO3, PO5, PSO-1, PSO-2)
4. Verify Verilog designs using test benches and simulation. (PO1, PO2, PO3, PO5, PO12, PSO-1, PSO-2)
5. Implement Verilog designs on FPGA platforms. (PO1, PO2, PO3, PO5, PO12, PSO-1, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test	20	CO1, CO2, CO3, CO4, CO5
Other components	**Marks**	**Course outcomes addressed**
Record (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Conduction (10 marks)	10	CO1, CO2,CO3, CO4, CO5
Observation (10 marks)	10	CO1,CO2,CO3,CO4,CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

SKILL LAB COURSE – III FPGA Programming	
Course Code: 25ECSL03	**Credits: 0:1:0**
Prerequisites: Verilog HDL	
Course Coordinators: Dr Parameshwara M C	**Contact Hours: 30**

Skill Lab Course: is a 1-credit Lab course with 30 contact hours. This course is designed to improve the practical and technical skills of students, focusing on developing industry-relevant and job-oriented skills, and enhance employability of the students. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. The course shall be evaluated through Continuous Internal Evaluation (CIE) for 100 marks. The result of the course will be reflected in the Grade card of VIII semester.