RAMAIAH
Institute of Technology

CURRICULUM

Academic year 2026 – 2027

VII & VIII Semester
B. E. **ELECTRONICS & COMMUNICATION ENGINEERING**
Batch – 2023

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 2023 – 2027

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	**08**	**08**	**03**	**03**	**--**	**--**	**--**	**--**	**22**
Engineering Sciences (ESC)	**09**	**11**	**--**	**--**	**--**	**--**	**--**	**--**	**20**
Humanities, Social Sciences and Management (HSMC)	**02**	**--**	**01**	**01**	**03**	**03**	**--**	**--**	**10**
Ability Enhancement Course (AEC)	**01**	**01**	**01**	**01**	**01**	**01**	**02**	**--**	**07**
Universal Human Values (UHV)	**--**	**--**	**02**	**--**	**--**	**--**	**--**	**--**	**02**
Professional Core Courses (PCC)	**--**	**--**	**11**	**12**	**12**	**06**	**04**	**--**	**45**
Integrated Professional Core Course (IPCC)	**--**	**--**	**03**	**03**	**03**	**--**	**04**	**--**	**13**
Professional Elective Courses (PEC)	**--**	**--**	**--**	**--**	**03**	**06**	**03**	**--**	**12**
Institutional Open Elective Courses (IOE)	**--**	**--**	**--**	**--**	**--**	**03**	**03**	**--**	**06**
Internship (INT)	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**05**	**05**
Mini Project / Project Work (PW)	**--**	**--**	**--**	**--**	**--**	**04**	**--**	**13**	**18**
Non Credit Mandatory Courses (NCMC)	**--**	**--**	✔	✔	✔	✔	**--**	**--**	**--**
Total Credits	**20**	**20**	**21**	**20**	**22**	**23**	**16**	**18**	**160**

SCHEME OF TEACHING VII SEMESTER

SI. No.	Course Code	Course Title	Category	Credits				Contact Hours/Week			
				L	T	P	Total	L	T	P	S
1.	EC71	Wireless Communication	IPCC	3	0	1	4	3	0	2	3
2.	EC72	Internet of Things	PCC	2	1	0	3	2	2	0	2
3.	ECE73x	Program Elective Course- 4	PEC	3	0	0	3	3	0	0	3
4.	ECOE0x	Institutional Open Elective – 2	IOE	3	0	0	3	3	0	0	3
5.	ECL74	Internet of Things Lab	PCC	0	0	1	1	0	0	2	0
6.	ECAEC791	Advance Computational Algorithms	AEC	0	1	1	2	0	2	2	0
		Total		**11**	**2**	**3**	**16**	**-**			

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

Nomenclature: IPCC: Integrated Professional Core Course**, PCC:** Professional Core Course**, PEC:** Professional Elective Courses, **IOE:** Institutional Open Elective, **AEC–**Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing
Note: ECE73x , where x=1,2,3,4 ECOE0x*, where x=6,7,8,9,… continued from previous
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.

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,

The candidate has studied the same course during the previous semesters of the program.

The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

A similar course, under any category, is prescribed in the higher semesters of the program.

The minimum students' strength for offering open electives is 10.

AICTE Activity Points to be earned by students admitted to BE program:

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. In case 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 VIII SEMESTER

Sl. No.	Course Code	Course Title	Category	Credits				Contact Hours/Week
				L	T	P	Total	
1.	ECP81	Project Work	PW	0	0	13	13	---
2.	INT82	Research/ Industrial Internship	INT	0	0	5	5	---
			Total	**0**	**0**	**18**	**18**	**---**

LIST OF DEPARTMENT ELECTIVES

SI. No.	Course Code	Course Title	Credits				Contact Hours
			L	T	P	Total	
VII Sem (ELECTIVE – IV)							
14	ECE731	Low Power VLSI Design	3	0	0	3	3
16	ECE732	Embedded Linux	3	0	0	3	3
17	ECE733	Computer Vision	3	0	0	3	3
18	ECE734	Micro Electro Mechanical Systems (MEMS)	3	0	0	3	3

Nomenclature: PW: Project Work, **NCMC**: Non-credit Mandatory Course**, INT –**Internship

L –Lecture, T – Tutorial, P- Practical/ Drawing

WIRELESS COMMUNICATION	
Course Code: EC71	**Credits: 3:0:1**
Prerequisite: Communication Systems-II	**Contact Hours: 42L+28P**
Course Coordinator: T D Senthilkumar	

Course Content

Unit I

Cellular Concepts: Frequency reuse, channel assignment, hand off, interference and system capacity, improving coverage and capacity in cellular systems – cell splitting, cell sectoring, microcell zone concept.

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://onlinecourses.nptel.ac.in/noc21_ee66/

Unit II

Mobile Radio Propagation: Relating power to electric field – Reflection.

Large Scale Path Loss: Free space propagation model, Link budget design, log- distance path loss models, log normal shadowing.

Small Scale Fading and Multipath: Small scale multipath propagation, Parameter of mobile multipath channels – Types of small scale fading.

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://onlinecourses.nptel.ac.in/noc21_ee66/

Unit III

Diversity Techniques: Polarization diversity, frequency diversity, time diversity and Space diversity. Diversity combining techniques – Selection diversity, Scanning diversity, Maximal ratio combining (MRC) and Equal gain combining (EGC)

Multiple Access Techniques: Introduction to multiple access techniques, FDMA, TDMA and CDMA

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://onlinecourses.nptel.ac.in/noc21_ee66/

Unit IV

Multiple Antenna Systems: Introduction to MIMO Wireless Communications – MIMO System Model – Singular Value Decomposition (SVD) of the MIMO Channel – SVD MIMO Capacity. Alamouti Space-Time Codes.

- Pedagogy/Course delivery tools:Chalk and talk
- Links:https://nptel.ac.in/courses/117104115

Unit V

Orthogonal Frequency Division Multiplexing (OFDM): Multicarrier modulation – OFDM transmitter and receiver – Cyclic Prefix in OFDM – Impact of Cyclic prefix on data rate. MIMO-OFDM. SC-FDMA transmitter and receiver.

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://nptel.ac.in/courses/117104115

Text Books:

1. T. S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Prentice Hall of India, Third Indian Reprint, 2010.
2. Aditya K Jagannatham, "Principles of Modern Wireless Communications Systems", McGraw Hill Education, 2017.

Reference Books:

1. David Tse, P. Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press New York, USA, 2005.

Course Outcomes (COs):

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

1. Appreciate the cellular capacity improvement via different techniques with the limited spectrum (POs- 1,2,3,4,5, 7,11 PSO-3)
2. Apply the small and large-scale multipath fading in the performance of the wireless link (POs- 1,2,3,4,5, 7,11 PSO-3)
3. Apply different diversity techniques to mitigate the effect of multipath fading (POs- 1,2,3,4,5, 7,11 PSO-3)
4. Appreciate the significance of multiple antenna systems in wireless communication (POs- 1,2,3,4,5, 7,11 PSO-3)
5. Employ multicarrier modulation in modern wireless communication systems (POs- 1,2,3,4,5, 7,11 PSO-3)

IPCC LAB COMPONENTS

1. Bit Error Rate (BER) for different digital modulation schemes under the AWGN and fading channel
2. Study of large-scale path loss models
3. Bit error rate analysis of digital communication receivers with Maximal Ratio Combining (MRC) receive diversity in frequency-flat and slowly varying fading channel
4. Bit error rate analysis of digital communication receivers with Equal Gain Combining (EGC) receive diversity in frequency-flat and slowly varying fading channel
5. BER performance of 2x2 MIMO under the Rayleigh fading channel
6. Analyze the performance of the multicarrier modulation scheme
7. OFDM transmitter and receiver in AWGN channel

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 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		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE):	100	CO1, CO2, CO3, CO4, CO5

INTERNET OF THINGS	
Course Code: EC72	**Credits: 2:1:0**
Prerequisite: Nil	**Contact Hours: 28L+28T**
Course Coordinator: Punya Prabha V	

Course Contents

Unit I

Introduction & concepts: Definition and Characteristics of IoT, Things in IoT, IoT Protocols, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, IoT Levels and Deployment Templates. IoT and M2M, SDN and NFV for IoT, IoT System Management with NETCONFIG-YANG

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://a.impartus.com/ilc/#/course/2126918/1174
  https://nptel.ac.in/courses/106105166

Unit II

Developing Internet of Things: IoT Platform Design Methodology, Specifications: Requirements, Process, Domain, Information, Services, Level, Functional, Operational, Integration, Application Development.

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies. UWB special sensors for IoT.

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://a.impartus.com/ilc/#/course/2126918/1174
  https://nptel.ac.in/courses/106105166

Unit III

Data Collection, Storage and Computing Using a Cloud Platform: Introduction, Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud Service Models, IoT Cloud-Based Services Using the Xively Platform, Basic SQL Operations

Data and Analytics for IoT: An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology: Hadoop, Mapreduce, Apache spark, Apache storm

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://a.impartus.com/ilc/#/course/2126918/1174
  https://nptel.ac.in/courses/106105166

Unit IV

Securing IoT: A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk, Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://a.impartus.com/ilc/#/course/2126918/1174
- https://nptel.ac.in/courses/106105166

Unit V

IoT Case Studies: Home automation: Supply of Gas and Water, Smart Meters, Smart lighting, Home intrusion detection; Smart parking environment: Weather monitoring system, Air Quality and monitoring pollutants, Agriculture – Smart irrigation, Healthcare, Smart City: Waste management, Electricity, Water.

- Pedagogy/Course delivery tools: Chalk and talk
- Links:https://a.impartus.com/ilc/#/course/2126918/1174
  https://nptel.ac.in/courses/106105166

Text Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547) Edition, McGraw Hill Education, 2017.

Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint).
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

Course Outcomes (COs):

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

1. Understanding the building blocks of Internet of Things, characteristics and related communication protocols. (POs- 1, 2, 5,6, 7, 9,11, PSO-3)
2. Describe the basics of design methodology, integration and applications of IoT models and interpret the appropriate IoT devices and sensors to set up the connection between them. (POs-1, 2, 3, 6, 7, 9, 11, PSO-3)
3. Illustrate the relationship between IoT, cloud computing, big data and SQL operations. (POs-1, 2, 3, 5, 11, PSO-3)
4. Introduction to IoT security. (POs-1, 2, 4, 11, PSO- 3)
5. Appraise the various IoT case studies. (POs-1, 2, 3, 4, 5, 11, PSO-3)

Course Assessment and Evaluation:

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

INTERNET OF THINGS LABORATORY	
Course Code: ECL74	**Credits: 0:0:1**
Prerequisite: Microcontroller, Fundamentals of Computing & Python	**Contact Hours: 28P**
Course Coordinator: Manjunath Lakkannavar	

Course Contents

LIST OF EXPERIMENTS:

The following experiments are interfaced using components and Raspberry Pi kit

1. Control of LED/Buzzer with delays: Design of Binary Counter
2. Interfacing IR/LDR sensor based on detection: Switching multiple LED with and without delays
3. Interface Humidity sensor to print temperature and humidity readings
4. Interface sensor data to Thingspeak
5. Interface Bluetooth to send and receive data to/from phone: Controlling LED
6. Interface a motor relay for on/off control: Rotating motor relay in both directions (clockwise and anti-clockwise), Interfacing Soil moisture sensor and control motor using relay.
7. Use UDP for client service: Exchanging messages within same IP and between two different IP.
8. Perform basic SQL operations
9. Building Automation experiments part-1 (Demo)
10. Building Automation experiments part-2 (Demo)
11. **Virtual Lab Link:** https://python-iitk.vlabs.ac.in/List%20of%20experiments.html

Reference Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands -On-Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547) Edition, McGraw Hill Education, 2017.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint).

Course Outcomes (COs):

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

1. Write programs for local processing of the sensor nodes. (POs – 1, 2, 3, 5, 8, 9, 11, PSO –3)
2. Integrate IoT devices at the edge and to the cloud. (POs – 1, 2, 3, 5, 8, 9, 11, PSO –3)
3. Analyze and process the data offline and in the cloud. (POs – 1, 2, 3, 5, 7, 8, 9, 11, PSO –3)
4. Illustrate basic SQL operations. (POs – 1, 2, 3, 5, 7, 8, 9, 11, PSO –3)
5. Demonstration of building automation experiments. (POs – 1, 2, 3, 5, 7, 8, 9, 11, PSO –3)

SKILL ENHANCEMENT LAB ADVANCED COMPUTATIONAL ALGORITHMS	
Course Code: ECAEC791	**Credits: 0:1:1**
Pre – requisites:	**Contact Hours: 28T+ 28P**
Course Coordinator: Sara Mohan George	

Course Content

1. Excel
   - Table Operations
   - Querying and Transforming Data
   - Data Preparation and Formatting in Excel
2. LLM Introduction and Hugging Face
   - Introduction to Hugging Face
   - NLP Tasks and Model Fine-Tuning
   - Model Deployment and Applied Case Study
3. LangChain
   - Introduction and Environment Setup for LangChain
   - Core Components and Integrations
   - Advanced Features: Agents and Memory
4. RAG
   - Embedding Techniques
   - Retrieval and Chain Architectures
   - Prompt Engineering and Multi-LLM Workflows
5. Memory/Chatbot
   - Memory Architecture and Configuration
   - Conversational Workflow Design
   - Multi-Document Interaction Tools
6. Agents/ Tools
   - Tool Integration with Agents
   - Building Agent-Driven Applications
   - Multi-Tool Agent Workflows
7. Applications of Queues and Stacks
   - Parenthesis Checker
   - Stack using two queues
8. Manipulations on Linked Lists
   - Reverse a linked list
   - Merge two sorted linked lists
9. Operations on Heaps
   - Heap Sort
   - Relative Sorting
10. Recursion: Functions calls itself directly or indirectly
    - Fibonocci Sequence
    - Sum of array elements using recursion

11. Graph Algorithm: Techniques used to analyze and process graphs
    - Depth First Traversal
    - Shortest Source to Destination Path
12. Basics of hash table

Course Outcomes (COs)

CO1: Perform data processing requirements using Excel operations. (PO-1,2,3,4,5,11)
CO2: Apply LLM and LangChain frameworks for AI application development (PO-1,2,3,4,5,11)
CO3: Develop advanced AI systems using RAG, conversational architectures, and agent frameworks (PO-1,2,3,4,5,11)
CO4: Implement fundamental data structures with stacks, queues, and linked lists for complex problem-solving applications (PO-1,2,3,4,5,11)
CO5: Analyze computational problems using recursion, heap operations, and graph algorithms efficiently (PO-1,2,3,4,5,11)

Reference Books:

1. Machine Learning and Deep Learning using Python and Tensor Flow, Venkata Reddy Konasani, Mc Graw Hill,
2. Python Course Material, D V Analytics
3. Data Scientist Course Material, D V Analytics

VII Sem Electives

LOW POWER VLSI DESIGN	
Course Code: ECE731	**Credits: 3:0:0**
Prerequisite: CMOS VLSI Design	**Contact Hours: 42L**
Course Coordinator: V Anandi	

Course Contents

Unit I

Power Dissipation in CMOS: Introduction: Need for low power VLSI chips, Sources of power consumption, Introduction to CMOS inverter power dissipation, Low power VLSI design limits, Basic principle of low power design.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://archive.nptel.ac.in/courses/106/105/106105034/# https://drive.google.com/file/d/1LbYQNyw1oaAsU99YpGlh035tbtkd5f9S/view

Unit II

Logical Level Power Optimization: Gate reorganization, Local restructuring, Signal gating, Logic encoding, State machine encoding, Pre-computation logic.
Circuit Level Power Optimization: Transistor and gate sizing, Equivalent pin ordering, Network restructuring and re-organization, Special latches and flip-flops.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://drive.google.com/file/d/1RutCfSyV1K7Ln2J-TxILf3lOlhS3VhiZ/view

Unit III

Low Voltage Low Power Adders: Standard adder cells, CMOS adder's architecture, Low voltage low power design techniques, Current mode adders
Special Techniques: Power reduction and clock networks, CMOS floating gate, Low power bus, Delay balancing.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://drive.google.com/file/d/1nEB6-KMX5OQiwtQNbNG6xHpIT2IE6laT/view

Unit IV

Low Voltage Low Power Multipliers: Overview of multiplication, Types of multiplier architectures, Braun multiplier, Baugh-Wooley multiplier, Booth multiplier, Wallace tree multiplier, Delay balancing in multipliers
Low Voltage Low Power Random Access Memories: Basics of SRAM and DRAM, Memory cell, Types of DRAM

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://drive.google.com/file/d/1W96DHjGQ0RNkMSJyaqu6vPBEC5twU3Rv/view

Unit V

Architecture and System: Power and performance management, Switching activity reduction, parallel architecture with voltage reduction, and flow graph transformation.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://archive.nptel.ac.in/courses/106/105/106105034/# https://drive.google.com/file/d/14GPVPpyjozDMMXUIfq65z7FPw2bbiGCy/view

Text Books:

1. Gary Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Publishers, 2008.
2. Kiat-Seng Yeo, Kaushik Roy, "Low Voltage Low Power VLSI Subsystems", Tata McGraw Hill Publications, 2009.ABCD

Reference Books:

1. Jan M. Rabaey, Massoud Pedram, "Low Power Design Methodologies", Kluwer Academic Publishers, 2010.
2. 2. Prof.Ajit Pal, IIT Kharagpur, NPTEL Lecture series on "Low Power Circuits and Systems", June 2012.
3. 3. P. Chandrakasan, R.W. Broadersen, "Low Power Digital CMOS Design", Kluwer Academic Publishers, 1995.

Course Outcomes (COs):

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

1. Apply low-power design concepts to classify power dissipation mechanisms in CMOS integrated circuits. (POs – 1, 2, 4, 7, 8, 11, PSO – 2)
2. 2. Classify various power optimization techniques at the circuit and logic level. (POs –1, 2, 4, 6, 7, 11 PSO – 2)
3. 3. Design low-power low voltage adders and special circuits. (POs – 1, 2, 5, 6, 7, 11, PSO – 2)
4. 4. Design low-power low voltage memory circuits using the current generation design style. (POs –1, 2, 4, 5, 7, 10, 11, PSO – 2)
5. 5. Analyse different low-power transforms and logic synthesis techniques (POs –1, 2, 4, 5, 7, 11, PSO – 2)

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		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination:	100	CO1, CO2, CO3, CO4, CO5

EMBEDDED LINUX	
Course Code: ECE732	**Credits: 3:0:0**
Prerequisite: Nil	**Contact Hours: 42L**
Course Coordinator: Lakshmi Shrinivasan	

Course Contents

Unit I

Introduction: History of Embedded Linux, Why Embedded Linux, Embedded Linux Versus Desktop Linux, Frequently Asked Questions, Embedded Linux Distributions, Porting Roadmap. Getting Started: Architecture of Embedded Linux, Linux Kernel Architecture, User Space, Linux Start-Up Sequence.

- Pedagogy/Course delivery tools: Chalk and talk, power point presentations
- Links: https://busybox.net/live_bbox/live_bbox.html
  http://vlabs.iitkgp.ernet.in/rtes/index.html

Unit II

Board Support Package: Inserting BSP in Kernel Build Procedure, Memory Map, Interrupt Management, the PCI Subsystem, Timers, UART and Power Management

- Pedagogy/Course delivery tools: Chalk and talk, power point presentations
- Links:https://busybox.net/live_bbox/live_bbox.html
  http://vlabs.iitkgp.ernet.in/rtes/index.html

Unit III

Embedded Storage: Flash Map, MTD—Memory Technology Device, MTD Architecture, Sample MTD Driver for NOR Flash, The Flash-Mapping Drivers, MTD Block and Character Devices, MTD utils Package, Embedded File Systems.

- Pedagogy/Course delivery tools: Chalk and talk, power point presentations
- Links:https://busybox.net/live_bbox/live_bbox.html
  http://vlabs.iitkgp.ernet.in/rtes/index.html

Unit IV

Embedded Drivers: Linux Serial Driver, Ethernet Driver, I2C Subsystem on Linux, Watchdog Timer and Kernel Modules.

- Pedagogy/Course delivery tools: Chalk and talk, power point presentations
- Links:https://busybox.net/live_bbox/live_bbox.html
  http://vlabs.iitkgp.ernet.in/rtes/index.html

Unit V

Porting Applications: Architectural Comparison, Application Porting Roadmap, Programming with Pthreads, Operating System Porting Layer (OSPL)

Real Time Linux: Real-Time operating system, Linux and Real-time – Interrupt latency, ISR duration, Scheduler Latency, scheduler duration, User-Space Real-Time.

- Pedagogy/Course delivery tools: Chalk and talk, power point presentations
- Links:https://busybox.net/live_bbox/live_bbox.html
  http://vlabs.iitkgp.ernet.in/rtes/index.html

Reference Books:

1. P.Raghvan, Amol Lad and Sriram Neelakandan, "Embedded Linux System Design And Development", 1st Edition, Auerbach Publications, September 2019.
2. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, "Building Embedded Linux Systems", 2nd edition, O'Reilly publications, 2008.

Course Outcomes (COs):

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

1. Understand the embedded Linux development environment. (POs – 1,2,3,11)
2. Appraise the need of BSP in an embedded system. (POs – 1,2,3,11)
3. Select the appropriate Linux model for embedded storage devices. (POs – 1, 3, 4,5,11)
4. Appreciate various embedded Linux drivers. (POs – 1,2,3,4,11)
5. Acquire the knowledge of porting applications to embedded Linux from a traditional RTOS. (POs – 1,2,3, 4,5,11)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 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		
Quiz/Seminar	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE):	100	CO1, CO2, CO3, CO4, CO5

COMPUTER VISION	
Course Code: ECE733	**Credits: 3:0:0**
Prerequisite: Image and Video Processing	**Contact Hours: 42L**
Course Coordinator: Mamtha Mohan	

Course Contents

Unit I

Early Vision: Local image features, Local texture representation using filters, Pooled texture representation by discovering textons, Binocular camera geometry and epipolar constraint, Local methods for binocular fusion, Using more cameras, Application: Robot navigation, Internally calibrated perspective cameras

- Pedagogy/Course delivery tools: Chalk and talk

Unit II

Mid-level Vision: Segmentation by clustering**,** Human Vision: Grouping and Gestalt, Important applications, Image segmentation by clustering pixels, Segmentation, Clustering and Graphs, Image segmentation in practice

- Pedagogy/Course delivery tools: Chalk and talk

Unit III

Mid-level Vision: Grouping and model fitting**,** Hough transform, Fitting lines and planes, Fitting curved structures, Robustness, Fitting using probabilistic models, Motion segmentation by parameter estimation, Model selection, Simple tracking strategies, Tracking using matching

- Pedagogy/Course delivery tools: Chalk and talk

Unit IV

High-level Vision: Registering rigid objects, Elements of differential geometry, Active range sensors, Kinect

- Pedagogy/Course delivery tools: Chalk and talk

Unit V

High-level Vision: Learning to classify, Classification, error and loss, Major classification strategies, Practical methods for building classifiers, Classifying images, Building good image features, Classifying images as single objects, Image classification in practice, Detecting objects in images, Sliding window method, Detecting deformable objects, Object detection, Object recognition

- Pedagogy/Course delivery tools: Chalk and talk

Text Books:

1. David A. Forsyth, Jean Ponce, "Computer Vision – A Modern Approach", 2nd edition, PHI Learning, 2015

Reference Books:

1. E. R. Davies, "Computer and Machine Vision – Theory, Algorithms and Practicalities", 5th edition, Elsevier (Academic Press), 2018
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd edition, Springer, 2021
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, analysis and Machine Vision", 4th edition, Thomson Press India Ltd., 2015.

Course Outcomes (COs):

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

1. Appreciate the concepts of image formation and transformation techniques in computer vision (POs – 1, 2, 3, 4, 11, PSOs – 1, 3)
2. Apply various intermediate level vision-based algorithms on images (POs – 1, 2, 3, 4, 5, 11, PSOs – 1, 3)
3. Elaborate on the concept of 3-D vision and motion-based algorithms. (POs – 1, 2, 3, 4, 5, 11, PSOs – 1, 3)
4. Employ different feature extraction and motion analysis algorithms for computer vision. (POs – 1, 2, 3, 4, 5, 11, PSOs – 1, 3)
5. Analyze various classification and object detection algorithms which aid in computer vision. (POs – 1, 2, 3, 4, 5, 11, PSOs – 1, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 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		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

MICRO ELECTRO MECHANICAL SYSTEMS	
Course Code: ECE734	**Credits: 3:0:0**
Prerequisite: VLSI Design	**Contact Hours: 42L**
Course Coordinator: Lakshmi S	

Course Contents

Unit I

Introduction to MEMS: Historical background of Micro Electro Mechanical Systems, Feynman's vision, Nano technology and its applications, multi-disciplinary aspects, basic technologies, application areas, scaling laws in miniaturization, scaling in geometry, electrostatics, electromagnetics, electricity and heat transfer.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117105082

Unit II

Micro and Smart Devices and Systems: Transduction principles in MEMS Sensors: Actuators: different actuation mechanisms - silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conductometric gas sensor, silicon micro-mirror arrays, piezo-electric based inkjet print head, electrostatic comb-driver

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117105082

Unit III

Materials and Micromanufacturing: Semiconducting materials, Silicon, Silicon dioxide, Silicon Nitride, Packaging materials Silicon wafer processing, lithography, thin-film deposition, etching (wet and dry), wafer-bonding, Silicon micromachining: surface, bulk

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117105082

Unit IV

Electrical and Electronics Aspects: Electrostatics, Coupled electro mechanics, stability and Pull-in phenomenon, Practical signal conditioning circuits for microsystems, , RF MEMS. Switches, varactors, tuned filters

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117105082

Unit V

Integration and Packaging of Microelectromechanical Systems: Integration of microelectronics and micro devices at wafer and chip levels, Microelectronic packaging: wire and ball bonding, flipchip, Microsystem packaging examples

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117105082

Text Books:

1. G .K. Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat, V.K.Aatre, "Micro and Smart Systems", Wiley India, First edition, 2010.
2. T R Hsu, "MEMS and Microsystems Design and Manufacturing", Tata McGraw Hill, 2nd Edition, 2008.

Reference Books:

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2. S D Senturia, "Microsystem Design", Springer International Edition, 2001.

Course Outcomes (COs):

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

1. Analyze scaling laws and transduction principles as applied to MEMS. (POs – 1, 2, 11, PSO - 2)
2. Understand Micro Systems and their applications. . (POs – 1, 2, 11)
3. Describe various fabrication techniques specific to MEMS devices. (POs – 2, 3, PSO – 2)
4. Analyze the electrical and electronics aspects of MEMS systems. (POs, 4, 3, PSO – 2)
5. Examine the various packaging methods for MEMS devices. (POs – 2, 3, PSO – 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 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		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE):	100	CO1, CO2, CO3, CO4, CO5

VIII Semester

PROJECT WORK	
Course Code: ECP81	**Credits: 0:0:13**
Prerequisite: --	**Contact Hours: --**

Course Contents

The evaluation of the project will be based on two presentations during the semester, and an external evaluation after the semester. Rubrics have been designed for evaluation and will be used during the first and second reviews.

Course Code	Course Name	No. of Hrs/Week		Duration of Exam (Hrs)	Marks		Total Marks	Credits
		Lecture	Practical/ Field Work		IA	Exam		
ECP81	Project Work	-	-	-	50	50	100	12

Course Outcomes (COs):

1. **Problem Statement & Literature Survey:** Display an ability to undertake a project activity by formulating a technical problem through a detailed literature survey of a chosen domain. (POs – 1, 2, 4, 8, 9, 10, 11 PSOs – 1, 2, 3)
2. **Methodology & Implementation:** Develop a comprehensive methodology that outlines the project scope, software and hardware resources, and timelines. (POs – 1, 2, 3, 4, 5, 8, 9, 10, 11, PSOs – 1, 2, 3)
3. **Modern Tools Usage:** Choose a modern set of tools and technologies most suited for implementing the methodology. (POs – 1, 2, 3, 4, 5, 8, 9, 10, 11, PSOs – 1, 2, 3)
4. **Teamwork & Project Management:** Function efficiently as a team, with predefined roles and responsibilities with proof of regular progress review. (POs – 1, 2, 3, 4, 5, 8, 9, 10, 11, PSOs – 1, 2, 3)
5. **Results & Technical report:** Compilation of results to prove the project activities and detail technical report with adequate discussions. (POs – 1, 2, 3, 4, 5, 8, 9, 10, 11, PSOs – 1, 2, 3)

PROJECT EVALUATION RUBRICS

Criteria	Max Marks	Achievement Levels				CO Mapping
		Inadequate (0 – 33 %)	**Developing (34-66%)**	**Proficient (67-100%)**	**Marks Awarded**	
Problem Statement & Literature Survey	**10**	Very few quality sources pertinent to the chosen technical area articles. The problem statement is not focused on or highly impacted by state of the art.	A sufficient number of quality papers were selected in the domain. The problem statement is focused but does not greatly impact improving the state-of-the-art in the domain.	A sufficient number of quality papers were selected in the domain, with a critical review, The problem statement is feasible and focused and has the potential to create an original breakthrough in the chosen problem domain.		**CO 1**
Methodology & Implementation	**10**	No clear methodology, with unclear justification for to problem statement and low feasibility of implementation.	The methodology is suitable for problem statements but the feasibility of implementation is not realistic.	Clear and efficient design of methodology highly suitable for problem with good probability for success.		**CO 2**
Modern Tool Usage	**10**	Has not applied any modern tools for the design/analysis of the technical block diagrams.	Has applied tools, but without proper working knowledge, and has not obtained satisfactory results.	Has applied tools effectively to design/analyze/debug/optimize complex technical blocks.		**CO 3**
Teamwork & Project Management	**10**	No evidence of distribution of work to team members, or regular meetings to achieve goals in required time frames.	Individuals have contributed separately without proper coordination and evidence for regular meetings and progress updates.	Clear and coordinated effort to implement the methodology through joint efforts evidenced through regular meetings and progress updates.		**CO 4**
Results & Discussion	**10**	Results are sparse and minimal and Poorly written document without proper organization	Results are comprehensive and document contains proper organization and includes figures for explanation but lacks depth in individual sections.	Results are comprehensive and support the hypothesis unequivocally. Document is well written and has been submitted to a conference as a review article.		**CO 5**
				TOTAL MARKS AWARDED		

RESEARCH/ INDUSTRIAL INTERNSHIP	
Course Code: INT82	**Credits: 0:0:5**
Prerequisite: --	**Contact Hours: --**

Course Contents

The evaluation of students will be based on an intermediate presentation, along with written report containing a Certificate from the employer. The rubrics for evaluation of the presentation and the questionnaire for the report will be distributed at the beginning of the internship.

Course Code	Course Name	No. of Hrs/Week		Duration of Exam (Hrs)	Marks		Total Marks	Credits
		Lecture	Practical/ Field Work		IA	Exam		
INT82	Internship	-	-	-	50	50	100	5

Course Outcomes (COs):

1. Analyze the working of complex technical systems/blocks. (POs – 1, 2, 3, 4, PSOs – 1, 2, 3)
2. Apply modern software tools effectively for design and development of complex technical blocks. (POs – 1, 2, 3, 4, 5, PSOs – 2, 3)
3. Appreciate the effectiveness of teamwork in completing complex tasks within deadlines. (POs – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
4. Appreciate the requirements for constant technology upgradation. (POs – 1, 2, 3, 4, 5, 11)
5. Create quality technical report describing all aspects of the internship. (POs – 1, 2, 3, 4, 5, 8, 9, 10)

Criteria	Maximum Marks	Achievement Levels				CO Mapping
		Inadequate (0% – 33 %)	**Developing (34% – 66 %)**	**Proficient (67% – 100 %)**	**Marks Awarded**	
Methodology	**10**	No working knowledge of the domain.	Working knowledge of the domain, with some knowledge of internal details.	Detailed understanding of the system, along with underlying mechanisms.		**CO 1**
Modern Software Tools	**10**	Has not applied any modern tools for the design/analysis of the technical block diagrams.	Has applied tools, but without proper working knowledge, and has not obtained satisfactory results.	Has applied tools effectively to design/analyze/debug/optimize complex technical blocks.		**CO 2**
Teamwork	**10**	Does not understand the importance of teamwork in a practical setting.	Has utilized/partaken in team efforts to a limited extent.	Has effectively participated as a member in a team, due to which significant results have been obtained.		**CO 3**
Lifelong Learning	**10**	No understanding of the requirements for lifelong learning in the engineering profession.	Can present examples of the impact of lifelong learning in the engineering industry.	Can present examples of the impact of lifelong learning, along with the requirement of skills upgradation in the modern engineering profession.		**CO 4**
Report Writing	**10**	Not professionally written, content not covering all items of course outcome.	Professional report writing, with some of the course outcomes addressed as part of the report.	Professionally prepared report, addressing to full extant all the items listed as part of the required outcomes of the internship.		**CO 5**
				TOTAL MARKS AWARDED		