RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education
(Effective from the Academic Year 2026 – 2027)

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

III & IV SEMESTER B.E.

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 18 UG programs and 13 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A+' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 70% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency Systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained All India Rank 182 in "Scimago Institutions Rankings" for the year 2024.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 75th rank among 1463 top Engineering Institutions & 21st Rank for School of Architecture in India among 115 Architecture Institutions, for the year 2024.

About the department:

The Department of Electronics & Telecommunication Engineering (ETE) at Ramaiah Institute of Technology (MSRIT), Bengaluru, has a rich legacy of excellence in engineering education, research, innovation and professional development. Established in 1996 as the Department of Telecommunication Engineering, it was renamed Electronics & Telecommunication Engineering in 2019 by Visvesvaraya Technological University (VTU), reflecting its expanding academic and technological scope.

The department offers the B.E. programme in Electronics & Telecommunication Engineering, M.Tech in IoT & Sensor Systems, M.Sc. (Engineering) by Research and Ph.D. programmes through its VTU-recognized Research Centre established in 2012. The M.Tech programme, introduced in 2025, focuses on emerging areas such as Internet of Things, sensor systems, embedded systems, wireless communication, cloud computing, edge intelligence and intelligent connected applications.

Equipped with state-of-the-art laboratories, advanced equipment and contemporary learning resources, the department provides an environment that promotes experiential learning, innovation and professional excellence. The faculty members possess strong academic, research and industry expertise, contributing actively to teaching, research and consultancy.

Research and innovation are integral to the department's academic ecosystem. Faculty members and research scholars pursue research in areas including Digital Signal Processing, Wireless Communication, Embedded Systems, Internet of Things, Wireless Sensor Networks, RF and Microwave Engineering, Antenna Design, Control Systems, VLSI and intelligent communication systems. The department undertakes externally funded and industry-supported projects, providing students with opportunities to participate in cutting-edge research and develop solutions to real-world challenges.
The department has established academic and industry collaborations with organisations such as Ansys, JV Micronics, Rohde & Schwarz, Nokia, Intel, Samsung and Stellantis, and academic institutions including Bradley University and IIT Madras. These collaborations support internships, industry-oriented learning, sponsored projects, consultancy and research.

A key research initiative is the **Centre of Excellence – Centre for Antennas and Radio Frequency Systems (CARFS)**, which promotes advanced research, innovation, training and consultancy in antenna and RF technologies.

The department also emphasizes holistic student development through technical workshops, conferences, internships, project competitions, industry interactions and professional activities through **IEEE and IETE**. With its strong academic foundation, research culture and industry connect, the department continues to nurture technically competent, innovative and socially responsible engineers prepared for the evolving fields of electronics, communication, IoT and intelligent connected systems.

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 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 provide an ambience for the students to excel in studies, research and innovation, focusing on meeting global socio-economic needs from a Telecommunication Engineering perspective

MISSION OF THE DEPARTMENT

- Providing high quality technical education to create world class Telecommunication engineers.
- Creating an ambience for skill development, research and entrepreneurial activities to meet socio-economic needs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Graduates will excel in professional careers in Industry, Academia and Research to meet Socio-Economic needs.

PEO2: Graduates will analyze problems specific to Electronics and Telecommunication Engineering and multidisciplinary domains providing technically feasible solutions.

PE03: Graduates will exhibit professional communication skills, teamwork, leadership qualities, ethical behavior and lifelong learning.

Knowledge and Attitude Profile (WK):

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to

evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively 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. **(WK1 to WK4)**

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. **(WK5)**

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. **(WK8).**

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. **(WK2 and WK6)**

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. **(WK1, WK5, and WK7).**

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

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. **(WK8)**

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Identify, analyze, formulate, design and demonstrate applications relevant to Electronics and Telecommunication engineering using electronic devices.

PSO2: Use current technology and modern tools to address solutions for Electronics and Telecommunication products by taking into account safety, healthy environmental requirements.

PSO3: Apply project management tools to solve Electronics and Telecommunication systems byexhibiting teamwork and lifelong learning

Semester wise Credit Breakdown for B.E Degree Curriculum Batch 2025- 2029

Semester Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	08	08	03	03	--	--	--	--	22
Engineering Sciences (ESC)	08	09	--	--	--	--	--	--	17
Humanities, Social Sciences and Management (HSMC)	02	02	--	--	03	03	--	--	10
Ability Enhancement Course (AEC)	02	01	01	01	01	--	03	--	09
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Courses (PCC)	--	--	11	12	12	06	04	--	45
Integrated Professional Core Course (IPCC)	--	--	04	04	03		04	--	15
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	17
Non Credit Mandatory Courses (NCMC)	--	--	--	--	□	--	--	□	--
Total Credits	20	20	21	20	22	22	19	16	160

B.E. in Electronics and Telecommunication Engineering
Scheme of Teaching – Batch : 2025

III SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week			
					L	T	P	Total	L	T	P	S
1	ET31	Vector Space and Transform Techniques	Mathematics	ASC	2	1	0	3	2	2	0	2
2	ET32	Data Structures Using C	ETE	PCC(IC)	3	0	1	4	3	0	2	3
3	ET33	Analog Circuit Design	ETE	PCC	3	0	0	3	3	0	0	3
4	ET34	Digital Circuit Design	ETE	PCC	3	0	0	3	3	0	0	3
5	ET35	Network Analysis	ETE	PCC	3	0	0	3	3	0	0	3
6	UHV36	Universal Human Value Course	ETE	UHV	2	0	0	2	2	0	0	2
7	ETAEC37	Ability Enhancement Course- III	ETE	AEC	1	0	0	1	1	0	0	1
8	ETL38	Analog Circuit Design Lab	ETE	PCC	0	0	1	1	0	0	2	0
9	ETL39	Digital Circuit Design Lab	ETE	PCC	0	0	1	1	0	0	2	0
				Total	**17**	**1**	**3**	**21**	**17**	**2**	**6**	**17**
10	PE69	Physical Education		NCMC	All students have to register compulsorily for any one of the courses with the concerned							
	YO69	Yoga										

	NS69	NSS			coordinator (Yoga Teacher/ Physical Education Director/ 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.				
11	AM31	Additional Mathematics - I *		NCMC	0	0	0	0	-
12	ETSL2	Skill Lab - II		SDC	0	0	1	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.

Ability Enhancement Course- III	Introduction to Machine Learning – ETAEC37

Nomenclature: ASC: Applied Science Course, **IC:** Integrated Course (Practical Integrated with Theory Course), **PCC:** Professional Core Course, **UHV:** Universal Human Value Course, **AEC:** Ability Enhancement Course, **NCMC:** Non-credit Mandatory Course

Credit Definition:

- **1 credit = 1 hour/week of lecture (L)**
- **1 credit = 2 hours/week of tutorial (T)**
- **1 credit = 2 hours/week of practical(P)**
- **Self-Learning Hours (S)**

PCC & ASC courses are theory courses with or without tutorial sessions.

- Each theory credit corresponds to one contact hour per week, while each tutorial credit corresponds to two contact hours per week.
- The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.
- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.
- The SEE shall be evaluated for 100 marks, which shall be scaled down to 50 marks.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.

PCC (IC) is an Integrated course, combining theory with practical components.

- Each theory credit corresponds to one contact hour per week, while each practical credit corresponds to two contact hours per week.
- The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.
- The CIE for the theory component shall be conducted through two internal tests of 30 marks each. Each test shall consist of three questions, out of which students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks.

- The CIE for the practical component shall be evaluated for 20 marks. Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 15 marks. Another 05 marks from a lab test and viva.
- The SEE shall be evaluated for 100 marks, which shall be scaled down to 50 marks.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.
- However, questions from the practical component of the Integrated course may be included in the SEE question paper.

AEC is a 1-credit course involving 1 contact hour per week. The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.

- The CIE will comprise of two tests of 30 marks each having Part-A with MCQs for 6 marks and Part-B with Descriptive questions. The remaining 20 marks shall be assessed through assignments, surprise tests, quizzes, or other components as decided by the course instructor.
- The SEE will comprise of Part-A with MCQs (10 marks) and Part-B (5x8=40 marks) with descriptive questions.

UHV is a 2-criedit course involving 2 contact hours per week. The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.

- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall

be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.

- The SEE shall be evaluated for 100 marks, which shall be scaled down to 50 marks.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.

PCC Laboratory is a 1-credit lab course involving 2 hours of lab sessions per week and uses both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) for assessment.

- CIE totals 50 marks, with 30 marks for lab sessions (Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 30 marks.). Another 15 marks from a lab test and 05 marks for viva.
- SEE totals 50 marks, comprising 40 marks for procedure write up, experiment conduction & results and 10 marks for viva voce.

The Non Credit Mandatory Course, Physical Education (Sport and Athletics)/Yoga/National Service Scheme (NSS):

- Student shall select any one of the NCMC's namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for four semesters and shall attend the course from the III semester to VI semester to complete all the formalities of the course and earn requisite CIE score. The Pass/Fail shall be reflected in the VI semester grade card.
- The above mentioned NCMC's shall not be considered for vertical progression as well as for the calculation of SGPA/CGPA but completion of the courses shall be mandatory for the award of degree.

- CIE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field work every semester (III to VI) for 100 marks and the total 400 marks scored by the student are scaled down to 100 in the VI semester.
- In case, any student fails to secure the minimum 40% of the prescribed marks, he/she shall be deemed to have secured 'F' grade.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics I: is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. The CIE shall be evaluated for 100 marks. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics I shall have CIE component only and **no SEE component**. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

Skill Lab Course: is a 1-credit Lab course with 2 contact hours per week. 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.

Lateral Entry Students:

AICTE Activity Points Requirement for BE Programs: As per AICTE guidelines (refer Chapter 6 – *AICTE Activity Point Program, Model Internship Guidelines*), in addition to academic requirements,

students must earn a specified number of **Activity Points** to be eligible for the award of the degree. The points to be earned is:

1. **Regular students** admitted to a 4-year degree program must earn **100 Activity Points**.
2. **Lateral entry students** (joining from the second year) must earn **75 Activity Points**.
3. **Students transferred** from other universities directly into the V semester must earn **50 Activity Points** from the date of entry into VTU.

These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, earning Activity Points is mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. If a student completes all the semesters (eight or six) at the end of the program but fails to earn the required Activity Points, the VIII semester Grade Card will be withheld until the requirement is fulfilled. Also, the degree will be awarded only after the Grade Card has been released. The hours spent earning the activity points will not be counted for regular attendance requirements. Students can accumulate these points at any time during their program period, including weekends, holidays, and vacations, starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity by AICTE.

B.E. in Electronics and Telecommunication Engineering
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	ET41	Statistics and Probability for Machine Learning	Mathematics	PCC	2	1	0	3	2	2	0	2
2	ET42	Signal and Systems	ETE	PCC	3	0	0	3	3	0	0	3
3	ET43	Microcontrollers	ETE	PCC	3	0	0	3	3	0	0	3
4	ET44	Engineering Electromagnetics (With Integrated Lab)	ETE	PCC(IC)	3	0	1	4	3	0	2	3
5	ETE45x	Program Elective Course – 1	ETE	PEC	3	0	0	3	3	0	0	3
6	ETAEC46	Ability Enhancement Course - IV	ETE	AEC	1	0	0	1	1	0	0	1
7	ETL47	Signals and Systems Lab	ETE	PCC	0	0	1	1	0	0	2	0
8	ETL48	Microcontroller Lab	ETE	PCC	0	0	1	1	0	0	2	0
9	ETL49	Oops and ML Lab	ETE	PCC	0	0	1	1	0	0	2	0
				Total	**15**	**1**	**4**	**20**	**15**	**2**	**08**	**15**
11	AM41	Additional Mathematics II *****		NCMC	0	0	0	0	-			
12	ETSL3	Skill Lab III		SDC	0	0	1	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.

Ability Enhancement Course- IV	Introduction to OOPs - ETAEC46

Program Elective Course – 1	Systems Modelling and Control ETE451	Digital Switching Systems and Telecommunication Standards ETE452	Introduction to Quantum Computing ETE453

Nomenclature: IC: Integrated Course (Practical Integrated with Theory Course), **PCC:** Professional Core Course, **PEC:** Professional Elective Course, **AEC:** Ability Enhancement Course, **NCMC:** Non-credit Mandatory Course

Credit Definition:

- **1 credit = 1 hour/week of lecture (L)**
- **1 credit = 2 hours/week of tutorial (T)**
- **1 credit = 2 hours/week of practical(P)**
- **Self-Learning Hours (S)**

PCC(IC) is an Integrated course, combining theory with practical components.

- Theory sessions shall be conducted for 3 hours per week, while the practical sessions shall be conducted for 2 hours per week.

- Theory components shall be evaluated through both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).
- The practical component shall be assessed only through CIE (No SEE).
- The CIE shall consist of two internal test of 30 marks each. Each test will have three questions and student shall answer any two full questions. Each question shall have all CO's addressed for that test. An average of two test shall be taken to award 30 marks.
- The CIE for the practical component shall be evaluated for 20 marks. Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 15 marks. Another 05 marks from a lab test and viva.
- The SEE shall be evaluated for 100 marks, which shall be scaled down to 50 marks.
- The SEE examination shall consist of 10 questions with internal choice and student shall answer any five full questions.
- However, questions from the practical component of the Integrated course (IC) can be included in the SEE question paper.

PCC & PEC courses are theory courses with or without tutorial sessions.

- Each theory credit corresponds to one contact hour per week, while each tutorial credit corresponds to two contact hours per week.
- The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.

- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.
- The SEE shall be evaluated for 100 marks, which shall be scaled down to 50 marks.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.

AEC is a 1-credit course involving 1 contact hour per week. The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.

- The CIE will comprise of two tests of 30 marks each having Part-A with MCQs for 6 marks and Part-B with Descriptive questions. The remaining 20 marks shall be assessed through assignments, surprise tests, quizzes, or other components as decided by the course instructor.
- The SEE will comprise of Part-A with MCQs (10 marks) and Part-B (5x8=40 marks) with descriptive questions.

PCC Laboratory is a 1-credit lab course involving 2 hours of lab sessions per week and uses both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) for assessment.

- CIE totals 50 marks, with 30 marks for lab sessions (Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 30 marks.). Another 15 marks from a lab test and 05 marks for viva.

- SEE totals 50 marks, comprising 40 marks for procedure write up, experiment conduction & results and 10 marks for viva voce.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics II: is prescribed for IV Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. The CIE shall be evaluated for 100 marks. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics II shall have CIE component only and **no SEE component**. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

Skill Lab Course: is a 1-credit Lab course with 2 contact hours per week. 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.

Lateral Entry Students:

AICTE Activity Points Requirement for BE Programs: As per AICTE guidelines (refer Chapter 6 – *AICTE Activity Point Program, Model Internship Guidelines*), in addition to academic requirements, students must earn a specified number of **Activity Points** to be eligible for the award of the degree. The points to be earned is:

1. **Regular students** admitted to a 4-year degree program must earn **100 Activity Points**.
2. **Lateral entry students** (joining from the second year) must earn **75 Activity Points**.
3. **Students transferred** from other universities directly into the V semester must earn **50 Activity Points** from the date of entry into VTU.

These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, earning Activity Points is mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. If a student completes all the semesters (eight or six) at the end of the program but fails to earn the required Activity Points, the VIII semester Grade Card will be withheld until the requirement is fulfilled. Also, the degree will be awarded only after the Grade Card has been released. The hours spent earning the activity points will not be counted for regular attendance requirements. Students can accumulate these points at any time during their program period, including weekends, holidays, and vacations, starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity by AICTE.

Note: Internship: All the students shall have to undergo mandatory internship of 6 – 8 weeks during the intervening vacation of the IV & V semesters, intervening vacation of VI & VII semesters, VII semester. A Viva-voce based CIE examination shall be conducted during the VIII semester as per the rubrics defined by the department and the prescribed credits shall be included in VIII semester grade card.

III SEMESTER

VECTOR SPACE AND TRANSFORM TECHNIQUES	
Course Code: 25ET31	**Credits: 2:1:0**
Pre – requisites: Nil	**Contact Hours: 30L+30T+30S**
Course Coordinator: Dr. Vijaya Kumar and Dr. A. Sreevallabha Reddy	

Course Content

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

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), Limitations of Fourier transform.

- 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

Linear Programming I: Introduction to Linear Programming Problem (LPP), Formulation of the problem, Graphical method, General, Canonical and standard forms of LPP, Simplex method, Big-M method, Two-phase simplex method.

- 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

Linear Programming II: Duality in linear programming, Fundamental theorem of Duality, Dual simplex method. Transportation problem, Finding initial basic feasible solution by North-West corner method, Vogel's approximation method, Test for optimality – MODI method, Assignment problem – Hungarian method.

- 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 Books:

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 – 5th edition – 2015.

Course Outcomes (COs):

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, 2, 3 & PSO – 1, 2)**
2. Analyze engineering systems using orthogonal transformations and matrix decompositions. **(PO-1,2, 4, 5 & PSO – 2, 3)**
3. Apply Fourier series to represent and analyze periodic functions **(PO – 1, 2, 3 & PSO – 1, 2)**
4. Use Fourier transforms to solve engineering and mathematical problems **(PO – 1, 2, 5 & PSO – 1, 2)**
5. Apply Z-transforms and discrete Fourier transforms for the analysis of discrete-time systems. **(PO – 1, 2, 3, 5 & PSO – 1, 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	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	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 USING C	
Course Code: ET32	**Credits: 3:0:1**
Pre – requisites: Computing Fundamentals and C programming	**Contact Hours: 45L+30P+45 S**
Course Coordinator: Dr. Arvind Kumar G	

Course Content

Unit I

Linked List and Hashing: Introduction to Structures, Dynamic memory allocation, Introduction to Linked List, Types of linked list, Basic operations (Insert, Delete, Traverse, and Display). Introduction to Hashing, Components of Hashing, How does Hashing work.

- Pedagogy / Course delivery tools: PPT, Chalk and talk
- Links: https://www.programiz.com/dsa/linked-list
- Impartus recording: https://a.impartus.com/ilc/#/course/132060/636

Unit II

Stacks & Queues: Basic stack operations, Stack Applications-Conversion & Evaluation of expressions, Introduction to queues: Basic operations, Different types of queues.

- Pedagogy / Course delivery tools: PPT, Chalk and talk
- Links: https://www.andrew.cmu.edu/course/15- 121/lectures/Stacks%20and
- %20Queues/Stacks%20
- Impartus recording: https://a.impartus.com/ilc/#/course/132060/636

Unit III

Trees: Introduction to trees: Basic tree concepts, Binary tree properties, Conversion of Generat tree to a Binary tree, Binary tree traversal – In Order, Pre Order and Post-Order, Merkle Tree

- Pedagogy / Course delivery tools: PPT, Chalk and talk
- Links: https://data-flair.training/blogs/binary-tree-in- c/#:~:text=In%20

- programming%20terminology%2C%20a%20tree %20tree.
- Impartus recording: https://a.impartus.com/ilc/#/course/132060/636

Unit IV

Graphs: Introduction & Basic concepts, Graph operations, Graph Traversal-Depth first & Breadth first traversal. Graph storage structure: Adjacency matrix & Adjacency list. Shortest path algorithms - Minimum spanning tree, Dijkstra's algorithm.

- Pedagogy / Course delivery tools: PPT, Chalk and talk
  - Links: https://www.cs.yale.edu/homes/aspnes/pinewiki/ C(2f)Graphs.html
  - Impartus recording: https://a.impartus.com/ilc/#/course/132060/636
-

Unit V

Data Structures in Blockchain Technology:

Introduction to Blockchain, Linked List for Blockchain Structure, Merkle Tree for Transaction Storage, Hash Pointers for Data Integrity, Graphs for Network Representation and Queues for Transaction Handling

Pedagogy / Course delivery tools: PPT, Chalk and talk

- Links: https://www.geeksforgeeks.org/blockchain-structure/

List of Experiments:

Session Numbers	***Topics***	***Unit***
1	Program to insert, delete and display a single-linked list by attaching or detaching nodes at the beginning of the list.	**Unit 1**
2	Program to insert, delete and display a double linked list by attaching or detaching nodes at the beginning and at the end of the list.	**Unit 1**
3	Program to insert, delete and display a single-linked list by attaching or detaching nodes at the end of the list	**Unit 1**
4	Program to insert, delete and display a Circular linked list by adding at the end and deleting at the beginning and at the end of the list	**Unit 2**
5	Program to convert a given decimal number to hexadecimal	**Unit 2**

6	Implementation of a stack using a single linked list	**Unit 2**
7	Program to decide whether a switch is routable or not using a stack.	**Unit 3**
8	Program to convert infix to postfix	**Unit 3**
9	Implementation of a Queue using a single linked list Program to implement Maximum /Minimum Priority Queue	**Unit 3**
10	Program to find the height and depth of a binary tree.	**Unit 4**
11	Programs for in-order, pre-order and post-order traversal of trees Program to insert, delete, traverse and search in a binary search tree	**Unit 4**
12	Program to search a database using linear search Program to search a database using binary search	**Unit 4**
13	Program to implement breadth-first traversal and depth-first traversal for a given graph.	**Unit 4**
14	Program to demonstrate a Linked List-based Blockchain Structure	**Unit 5**
15	Program to demonstrate using a Queue data structure to handle Blockchain Transactions.	**Unit 5**

Text Books:

1. Yedidyah Langsam & Moshe J. Augenstein Aaron M. Tanenbaum, "Data Structures using C O Pearson Publication, 2008.
2. Richard Gilberg and Behrouz Forouzan, "Data Structures: A Pseudo code approach with C", 2nd edition, Thomson publishing, 2007.
3. E. Balagurusamy, "Data Structures using C", Tata McGraw Hill, 2017.

Reference Books:

1. Reema Theraja, "Data Structures using C", Oxford publications,2014
2. Daniel Drescher., "Blockchain Basics: A Non-Technical Introduction in 25 Steps" Apress., 2017
3. Sahni Horowitz, "Fundamentals of Data Structures", University Press, Second edition,2008
4. E. Balagurusamy, "Programming in ANSI C", Tata McGraw Hill, 2017.

Web Links and Video Lectures (e-Resources):

1. NPTEL online course "Programming and Data Structures", http://nptel.ac.in/courses/106105085/
2. NPTEL online course "Introduction to programming in C",

https://onlinecourses.nptel.ac.in/noc17_cs43/preview

Course Outcomes (COs):

1. Understand the basic concepts of Data structures (PO-1,PO-2,PO5, PO-11, PSO-1)
2. Understand the fundamental concepts of stacks and queues and apply them for real world applications. (PO-1,,PO-2,PO5, PO-11, PSO-1)
3. Understand the fundamental concepts and Implement various tree traversal techniques (PO1, PO-2, PO-3,PO-5, PO-6, PO-8, PO-9, PO-10, PO-11, PSO-1, PSO-2, PSO-3)
4. Apply graph traversal algorithms for networking operations. (PO1, PO-2, PO-3,P, PO-6, PO-8, PO-9, PO-10, PO-11, PSO-1, PSO-2, PSO-3)
5. Demonstrate the usage of data structures in Blockchain technology (PO1, PO-2, PO-3, PO-6, PO-8, PO-9, PO-10, PO-11PSO-1, PSO-2, PSO-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	CO1, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
Other components		
Lab Evaluation	20	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ANALOG CIRCUIT DESIGN	
Course Code: ET33	**Credits: 3:0:0**
Pre – requisites: Basic Electronics	**Contact Hours: 30L+30T+30S**
Course Coordinator: Dr. Kusuma S M	

Course Content

Unit I

Field – Effect Transistors: Introduction and Characteristics of JFETs, Transfer Characteristics. FET Biasing, JFET Small Signal Model, JFET AC equivalent Circuit, Low Frequency analysis of common source, common drain and common gate amplifier. **MOSFET:** Device Structure and Physical Operation, V-I Characteristics, MOSFET Circuits at DC, Biasing in MOS amplifier Circuits, Small Signal Operation and Models, MOSFET as an amplifier and as a switch, Analysis of common source, common drain and common gate amplifiers

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/108102095
- Impartus recording: http://a.impartus.com/ilc/#/course/107458/533

Unit II

Power Amplifiers: Class A large signal amplifiers, second harmonic distortion, high order harmonics generation, Transformer coupled audio power amplifier, Class B push pull amplifiers.

Feedback Amplifiers: Concept of feedback, transfer gain with feedback, General characteristics of negative feedback amplifiers, Input and Output impedance.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/108102095
- Impartus recording: http://a.impartus.com/ilc/#/course/107458/533

Unit III

Introduction to Operational Amplifiers and Characteristics: Introduction to Operational Amplifiers and Characteristics: Introduction, Block diagram, characteristics and equivalent circuits of an ideal op-amp. The Practical op-amp Introduction, input offset voltage, offset current, thermal drift, common mode rejection ratio, slew rate and its Effect, PSRR and gain – bandwidth product, Summing amplifier, Integrators and differentiators, Instrumentation amplifier, Log/ Antilog amplifier,

Triangular/rectangular wave generator, phase-shift, oscillators. Relevant Problems

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://www.youtube.com/playlist?list=PLuv3GM6-gsE3npYPJJDn
- EF3pdiHZT6Kj3
- Impartus recording: http://a.impartus.com/ilc/#/course/107458/533

Unit IV

Comparators and Converters: Comparator, Zero Crossing Detector, Monostable and Astable Multivibrator, Schmitt Trigger, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifiers, Voltage-to-current converter, Current-to-voltage converter. Relevant Problems.

Active Filters: First & Second order high pass & low pass Butterworth filters, higher order filters Band pass filters, Band reject filters & all pass filters.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://www.youtube.com/playlist?list=PLuv3GM6- gsE3npYPJJDn
- EF3pdiHZT6Kj3
- Impartus recording: http://a.impartus.com/ilc/#/course/107458/533

Unit V

A/D & D/Converters: Basics, R–2R D/A Converter, successive approximation ADC, dual slope ADC, Timer: Internal architecture of 555 timer, Mono stable, Astable multivibrators, and applications, PLL, regulator, Fixed and Adjustable Voltage Regulators.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: http://www.youtube.com/playlist?list=PLbRMhDVUMngcoKrA
- 4sH-zvbNVSE6IpEio
- Impartus recording: http://a.impartus.com/ilc/#/course/107458/533

Text Books:

1. Robert L. Boylestad and Louis Nashelsky, “Electronics devices and Circuit theory”, Pearson, 11th Edition, July 2015.
2. A S. Sedra, K. C. Smith, “Microelectronic Circuits”, Oxford University Press, 8th edition Nov 2019.
3. Ramakant A Gayakwad, “Op-Amps and Linear Integrated Circuits”, Pearson, 4th edition, May 2015.

Reference Books:

1. I. J. Nagrath, “Electronics: Analog and Digital”, PHI, 2013
2. David A. Bell, “Operational Amplifiers and Linear ICs” Oxford University Press, 3rd Edition July 2021.
3. Choudhury Roy D and Shail B. Jain, “Linear Integrated Circuits”, Wiley Eastern, Oct 2018.

Web Links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=2I_8YNVgbEw&t=43s
- https://www.youtube.com/watch?v=7Nqj2XstBkw
- https://www.youtube.com/watch?v=Ok-1kMqUnPk&list=PLO4mxQzfcml_56XSGcA8ULOv7qEtZd0Hy&index=27, https://www.youtube.com/watch?v=8GLpBE5n5Cw&list=PLc7Gz02Znph-c2-ssFpRrzYwbzplXfXUT&index=88,
- https://www.youtube.com/watch?v=WzdmaSUCQGM&list=PLyYrySVqmyVPz vVlPW-TTzHhNWg1J_0LU&index=42
- https://www.youtube.com/watch?v=Bw6ahZ8znNU
- http://www.youtube.com/playlist?list=PLbRMhDVUMngcoKrA4sH-zvbNVSE6IpEio
- http://www.youtube.com/playlist?list=PLbRMhDVUMngcoKrA4sH-zvbNVSE6IpEio
- https://www.youtube.com/watch?v=ljlDriLo_7U&list=PLc7Gz02Znph-c2-ssFpRrzYwbzplXfXUT&index=81

Course Outcomes (COs):

1. Recall structures of JFET, MOSFETs, and functional block diagrams Linear IC’s, PLL and IC Regulators. (PO-1, PO-2, PO-11) (PSO-1, PSO-3)
2. Understand the operational principles, characteristics and models of JFET, MOSFET, Linear IC’s, PLL and IC Regulators. (PO-1, PO-2, PO-3, PO-11) (PSO-1, PSO-3)
3. Apply the fundamental circuit concepts and use the device models to analyse the various amplifier circuits using BJT, JFET and MOSFETs. (PO-1, PO-2, PO-3, PO-6, PO-11) (PSO-1, PSO-2, PSO-3)
4. Analyse the performance of various circuits using Linear IC’s PLL and IC Regulators. (PO-1, PO-2, PO-3, PO-6, PO-11) (PSO-1, PSO-2, PSO-3)
5. Acquire competency to design analog circuits present in complicated electronic systems. (PO-1, PO-2, PO-3, PO-6, PO-11) (PSO-1, PSO-2, PSO-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 will be taken for 30 marks.		
Other components		
Surprise Test	10	CO1, CO2, CO3, CO4, CO5
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

DIGITAL CIRCUIT DESIGN	
Course Code: ET34	**Credits: 3:0:0**
Pre – requisites: Basic Electronics	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Ramya H R	

Course Content

Unit I

Principle of combinational logic: Introduction to combinational logic, Canonical forms, Karnaugh maps, Map entered variables, Code Converters.
Design and Analysis of Combinational logic: Digital Multiplexers, Demultiplexers Encoders, Decoders, Parallel adders, Carry Look Ahead Adder, Binary comparators.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/ 117106011
- Impartus recording: https://a.impartus.com/ilc/#/course/81459/295

Unit II

Sequential Circuits: Flip-flops, Pulse-Triggered and Edge Triggered Flip-Flops, Master-Slave JK Flip- Flop, Characteristic Equations, Registers, Counters - Binary Ripple Counters, Synchronous Binary counters, Counters based on Shift Registers, Mealy and Moore sequential networks.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/ 117106011
- Impartus recording: https://a.impartus.com/ilc/#/course/81459/295

Unit III

Digital Design with Verilog HDL: Emergence of HDLs-Typical design flow- of HDLs-Design Methodologies, Modules and ports.

Data flow modeling and Gate Level modeling: Gate Types-Gate Delays-Delay Examples-Continuous Assignment-Delays-Expressions, Operators, Operands-Operator Types-Examples. Modeling of adder, subtractor, multiplier, comparator using full adder.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/ 117106011
- Impartus recording: https://a.impartus.com/ilc/#/course/81459/295

Unit IV

Behavioural modeling: Structured Procedures-Procedural assignments- Timing controls-conditional statement- Multi way Branching-Loops-Sequential and parallel blocks, Generate Blocks-Examples. Behavioural modeling of flip-flops and counters.Tasks and Functions,

Logic Synthesis with Verilog HDL: Logic Synthesis-Verilog HDL Synthesis-Interpretation of Verilog Constructs-Synthesis Design flow-examples-verification of the gate level netlist,

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/ 117106011
- Impartus recording: https://a.impartus.com/ilc/#/course/81459/295

Unit V

Memories and PLDs: ROM, RAM, Simple PLDs, PROM, PLA, PAL, FPGA Architecture, Composition of Memory.

Introduction to Machine Learning for Digital Circuits.Case study: Synthesize Boolean Functions into Logic Circuits using Machine Learning. Example 2: ML-Based Circuit Selection for Specific Design Constraints.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/ 117106011
- Impartus recording: https://a.impartus.com/ilc/#/course/81459/295

Text Books:

1. John M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2009.
2. Donald D Givone, “Digital Principles and Design”, Tata McGraw Hill Edition, 2007.
3. Samir Palnitkar, “VERILOG HDL-A Guide to digital design and synthesis”, 2nd edition, Pearson education.2003.
4. Wayne Wolf, “FPGA based system design”, Pearson Education, 2005.

Reference Books:

1. R D Sudhaker Samuel, "Logic Design – A simplified approach", Sanguine Technical Publishers, 2011
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital logic with VERILOG design", TMH, 2013

Course Outcomes (COs):

1. Ability to design and implement combinational logic circuits. (PO-1, PO-2, PO-3, PO-7, PO-8,PO-9,PO-11, PSO-1, PSO-2,PSO-3)
2. Ability to design and implement a sequential circuit (PO-1, PO-2, PO-3, PO-7, PO-8,PO-9,PO-11, PSO-1, PSO-2,PSO-3)
3. Ability to understand the basics of Verilog HDL to design digital circuits(PO-1, PO-2, PO-3, PO-7, PO-8,PO-9,PO-11, PSO-1, PSO-2,PSO-3)
4. Ability to apply Verilog HDL to design and evaluate combinational and sequential circuits using different abstraction levels. (PO-1, PO-2, PO-3, PO-7, PO-8,Po-9,PO-11, PSO-1, PSO-2,PSO-3)
5. Design and synthesize digital circuits on an FPGA processor using EDA tools. Understand Case studies of Digital circuit design using machine learning (PO-1, PO-2, PO-3, PO-7, PO-8,PO-9,PO-11, PSO-1, PSO-2,PSO-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	CO1, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
Other components		
Mini Project	10	CO1, CO2, CO3, CO4, CO5
Surprise Test	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

NETWORK ANALYSIS	
Course Code: ET35	**Credits: 3:0:0**
Pre – requisites: Fundamentals of Electronics and Communication Engineering	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Viswanath Talasila	

Course Content

Unit I

Basic Concepts

Practical and Ideal sources, Voltage and Current Division, Source transformations, Dependent Sources, Mesh and Nodal analysis (for circuits with purely resistive elements and with impedance elements), Concepts of Super Node and Super Mesh, Industry case study on sensor loading using Analog Devices Circuit Note

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Unit II

Circuit Analysis Techniques

Superposition theorem, Circuit design using superposition theorem, Thevenin's theorem, Using the Thevenin's theorem in the absence of an independent source, Maximum power transfer theorem, Industry case study of a SAR ADC input being driven by a signal source modeled using a Thevenin equivalent (using Texas Instruments TechNotes)

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Unit III

Transient Behaviour, Initial conditions of linear electric circuits

Recalling first and second order ordinary differential equations and solutions, Analysis of networks (RL, RC and RLC combinations), solving circuits with initial conditions, Analysis of switching circuits, Passive differentiators and integrators using passive elements, Edge detection using a differentiator circuit, Industry Case study on RC DeBounce and EMI filtering circuits (Texas Instruments DeBounce Product Overview)

- Pedagogy / Course delivery tools: Blackboard teaching

- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Unit IV

Laplace Transforms for Electric Circuit Analysis

Introduction to Laplace Transforms, Basic theorems used for circuit analysis, Circuit representations in the Laplace domain, Representation of complex waveforms using Laplace transforms, Circuit analysis when the source has a complex waveform

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/2

Unit V

Modelling electric circuits using Transfer Functions

Waveform synthesis using Laplace Transform techniques, Introduction to Transfer Functions, Transfer function models of electric circuits, Circuit synthesis with transfer functions

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Text Books:

1. William H. Hayt, Jack Kemmerly, J Phillips and Steven M. Durbin, "Engineering Circuit Analysis", 10th Edition, McGraw Hill Education, 2024
2. Fundamental of Electric Circuits, Charles Alexander and M Sadiku, 7th Edition, McGraw Hill Education (India) , 2022

Reference Books:

1. "Network Analysis", ME Van Valkenburg, PHI/Pearson, 3rd Edition, 2015
2. "Circuits", Bruce Carlson, Thomson Learning, 2002

Web Links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ee14/preview

Course Outcomes (COs):

1. Develop the ability to represent and solve electric circuits using concepts from linear matrix algebra (PO-1, PO-2, PO-3, PO-4, PO-6, PSO-1, PSO-2)
2. Use differential equations to model and analyse linear electric circuits. (PO-1,

PO-2, PO-3, PO-4, PO-6, PO-12, PSO-1, PSO-2, PSO-3)

3. Compute transient and steady state behaviour of linear circuits with initial conditions (PO-1, PO-2, PO-3, PO-4, PO-6, PSO-1, PSO-2)
4. Use circuit theorems and transform techniques to simplify the analysis and design of linear circuits (PO-1, PO-2, PO-3, PO-4, PO-6, PO-12, PSO-1, PSO-2, PSO-3)
5. Model linear electric circuits in the frequency domain using Laplace transform techniques (PO-1, PO-2, PO-3, PO-4, PO-6, PO-12, PSO-1, PSO-2, PSO-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	CO1, CO2, CO3, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
Other components		
Assignment	10	CO1, CO2
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

UNIVERSAL HUMAN VALUE COURSE	
Course Code: UHV36	**Credits: 2:0:0**
Pre – requisites: Nil	**Contact Hours: 30L + 30S**
Course Coordinator: Mrs. Nisha S L	

Course Content

Unit I

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

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? - its 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, Power point 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!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha
- Understanding the Body as an instrument of 'I' (I being the doer, seer andenjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail

- Programs to ensure Sanyam and Swasthya

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/polls for self-exploration
- Links: Harmonyin 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

1. Understanding Harmony in the family – the basic unit of human interaction
2. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti;
3. Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
4. Understanding the meaning of Vishwas; Difference between intention and competence
5. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship
6. Understanding the harmony in the society (society being an extension of family):
7. Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals
8. 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/polls for self-exploration
- Links: Harmony in Family- Trust https://youtu.be/F2KVW4WNnS8 Links: Harmony in family- Respecthttps://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

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, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/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

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- 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.

- Case studies of typical holistic technologies, management models and production systems
- 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

Suggested Learning Resources:

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

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. Reprinted 2008.
2. **PL Dhar, RR Gaur**, 1990, Science and Humanism, Commonwealth 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_4L2fCNX4Agw282PN86pcZZT3 Osr?usp=sharing
4. **Presentation slides:**
   https://drive.google.com/drive/folders/1rMUKh1s0HPRBlpp_b1mpS-duNRcwS6YH?usp=sharing

Course Outcomes (COs):

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

1. Apprehend the need of Value Education over Human aspirations (PO-6)
2. Assimilate Harmony over the physical needs and to overcome the self- needs for a prosperous life. (PO-6)
3. Recognize the need of Harmony in the Family and Society for a better World. (PO-6)
4. Explain the need of mutual understanding for Holistic Harmony in all the Levels of Human Existence. (PO-6)
5. Explain the Holistic understanding of Harmony and Professional Ethics at Individual Level and Society. (PO-6, PO-8)

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		
Assignment Quiz/Presentation Model / mini project / Any other	20 (10 + 10)	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ABILITY ENHANCEMENT COURSE – III INTRODUCTION TO MACHINE LEARNING	
Subject Code: ETAEC37	**Credits: 1:0:0**
Pre requisites: Nil	**Contact Hours: 14L**
Course Coordinator: Dr. Kavita Patil	

Course Contents

UNIT-I

Data Preparation and Feature Engineering: Types of data: structured and unstructured data, Data collection methods, Data preprocessing, Handling missing values, Noise and outliers, Feature scaling and normalization, Feature extraction and feature selection, Dimensionality reduction – basic idea.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.swayam2.ac.in/imb26_mg46/preview

Unit-II

Instance-Based Learning - Case-Based Reasoning(CBR): Instance-based & lazy learning, CBR concept, CBR cycle, Similarity measures, case representation, applications of CBR.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.swayam2.ac.in/imb26_mg46/preview

Unit-III

Tree-Based Learning Algorithms: Ensemble learning, Bagging and Boosting techniques, AdaBoost and Gradient Boosting algorithms, advantages and limitations of ensemble tree-based models.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.swayam2.ac.in/imb26_mg46/preview

Unit-IV

Model Evaluation and Validation: Training and testing of machine learning models, Train–test split, Cross-validation. Performance evaluation metrics: accuracy, precision, recall,F1-score.Confusion matrix .

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.swayam2.ac.in/imb26_mg46/preview

Unit-V

Applications and Case Studies in Machine Learning: Machine learning applications in finance and image recognition, and End-to-end machine learning workflow.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.swayam2.ac.in/imb26_mg46/preview

Text Books:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", Second Edition, O'Reilly Media, 2019.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Second Edition, Springer, 2016.

Reference Books:

1. Tom M. Mitchell- Machine Learning- McGraw Hill Education, International Edition.
2. Richard O. Duda, Peter E. Hart, David G. Stork, *"Pattern Classification"*, Second Edition, Wiley-Interscience, 2001.

Course Outcomes

1. Understand different types of data and apply appropriate data preparation and feature engineering techniques for machine learning tasks. (PO1, PO2, PO4, PSO1 & 3) .
2. Explain the concept of instance-based and lazy learning and apply Case-Based Reasoning techniques to solve simple problem scenarios. (PO1, PO2, PO3, PSO1 & 3) .
3. Understand ensemble tree-based learning techniques such as Bagging and Boosting and analyze their advantages and limitations. (PO1, PO2, PO4, PSO1 & 3) .
4. Evaluate machine learning models using appropriate validation techniques and performance metrics. (PO2, PO3, PO4, PO5, PSO1 & 3).
5. Apply machine learning techniques to selected application domains and understand the end-to-end machine learning workflow. (PO3, PO6, PO11, PSO1 & 3).

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO 1, 2 & 3
Internal Test-II	30	CO 3, 4 & 5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignment	10	CO 1, 2 & 3
Quiz	10	CO 4 & 5
Semester-End Examination:	50	CO 1, 2, 3, 4 & 5

ANALOG CIRCUIT DESIGN LAB	
Course Code: ETL38	**Credits: 0:0:1**
Pre – requisites: Fundamentals of Electronics and communication Engineering – 25PSCEC24	**Contact Hours: 30P**
Course Coordinator: Dr. Kusuma S M	

Course Content

List of Experiments:

Hardware /simulation experiments

1. Design and testing of Complementary Symmetry Class B push pull amplifier
2. Design and testing of Colpitts oscillator/ Simulation
3. Design and testing of Crystal oscillator
4. Design and testing of Schmitt trigger using Opamp IC741
5. Design and testing of Emitter follower
6. Design and Testing of RC coupled Amplifier using EMOSFET.
7. Design and testing of Analog Low pass filter using OpampIC741.
8. Design and testing of Analog High pass filter using OpampIC741 /Simulation.
9. Design and testing of Astable multivibrator using timer IC555.
10. Design and testing of Mono stable multivibrator using timer IC555/ Simulation.
11. Design and testing of regulators.
12. Design and testing of PLL.
13. Design and testing of ADC and DAC
14. Design and testing of Instrumentation amplifiers.
15. AI simulation of OPAmp circuits

Text Books:

1. Jacob Millman and Christos C. Halkias, "Integrated Electronics", Tata-McGraw Hill, 2017.
2. D. Roy Choudhury and Shail B Jain, "Linear Integrated Circuits", 5th edition reprint, New Age International, 2017.

Reference Books:

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit theory", Pearson Education, 11th Edition, 2017.

Web Links and Video Lecture (e-Resources):

- https://www.vlab.co.in/broad-area-electronics-and-communications

Course Outcomes (COs):

1. Design and evaluate Analog signal wave shaping circuits. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10, PO-11, PSO-1, PSO-2, PSO-3)
2. Design and evaluate different types of amplifiers and oscillators. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10, PO-1, PSO-1, PSO-2, PSO-3)
3. Design and evaluate Linear and nonlinear Op Amp based applications. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10, PO-1, PSO-1, PSO-2, PSO-3)
4. Design and evaluate Timing control and conversion circuits (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10, PO-11, PSO-1, PSO-2, PSO-3)
5. Design and evaluate rectification and regulation circuits. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10, PO-11, PSO-1, PSO-2, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory observation/records after the conduction of every experiment	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

DIGITAL CIRCUIT DESIGN LAB	
Course Code: ETL39	**Credits: 0:0:1**
Pre – requisites: Basic Electronics	**Contact Hours: 30P**
Course Coordinator: Dr. Ramya H R	

Course Content

Note:

I. Student should design the logic circuit using **gates** and wiring the circuit using **trainer kit** to verify the design.
II. Student should write the Verilog module to simulate and synthesize the logic circuit using FPGA **XC3S400 IC** hardware with **Xilinx 14.7i** software.

List of Experiments:

1. Realization of 4-bit parallel Adder/Subtractor using 7483 IC.
2. Realization of code converters using basic and universal gates.
3. Design and realization of arithmetic circuits using MUX (74153 IC).
4. Design and realization of arithmetic circuits using DE MUX (74139 IC)
5. Design of Encoder and Priority Encoder using IC 74147.
6. Design of Decoder using IC 7447.
7. Realization of Flip-Flops: (i) JK Master slave (ii) T type and (iii) D type using NAND gates and using IC 7476.
8. Realization of 3-bit MOD–N Asynchronous counters using IC 7476.
9. Realization of MOD–N Asynchronous counters using IC 74192.
10. Realization of 3-bit MOD-N Synchronous counters using 7476.
11. Realization of shift operations, Ring /Johnson counters using 7495 IC.
12. Interfacing of Stepper motor to control the direction.
13. Interfacing of DC-motor to control the speed of the motor.
14. Generation of square, ramp & triangular waveforms using DAC.
15. FSM-Based Sequence Detector Using Verilog.

Note:

1. Experiment numbers 1 to 11 are carried out using digital trainer Kit
2. All experiments will be Simulated using Verilog codes and implemented on Verilog kits.

Text Books:

1. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2009.
2. Donald D Givone, "Digital Principles and Design ", Tata McGraw Hill Edition, 2007.
3. Samir Palnitkar, "VERILOG HDL-A Guide to digital design and synthesis", 2nd

edition, Pearson education, 2003.
4. Wayne Wolf, "FPGA based system design", Reprint 2005, Pearson Education, 2005

Reference Books:

1. R D Sudhaker Samuel, "Logic Design – A simplified approach", Sanguine Technical Publishers, 2011
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital logic with VERILOG design", TMH, 2013

Web Links And Video Lectures (e-Resources):

- https://dld-iitb.vlabs.ac.in
- https://de-iitr.vlabs.ac.in
- https://de-iitg.vlabs.ac.in
- http://vlabs.iitkgp.ac.in

Course Outcomes (COs):

1. Ability to design and evaluate combinational logic circuits with minimum gates. (PO1, 2, 3, 5,8,9, 10, 11) (PSO1, 2, 3)
2. Ability to design and evaluate sequential networks with a minimum number of gates. (PO1, 2, 3,5,8,9,10,11) (PSO 1, 2, 3)
3. Ability to design and evaluate simple or complex logical circuits using Verilog HDL. (PO1, 2, 3, 5,8,9, 10, 11) (PSO1, 2, 3)
4. Ability to design & evaluate memory blocks with minimum number of gates using FPGA architecture. (PO1, 2, 3, 5, 8, 9,10, 11) (PSO 1, 2, 3).
5. Design and synthesize digital circuit on FPGA processor using EDA tools. (PO1, 2, 3, 5, 8, 9, 10, 11) (PSO1, 2, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory observation/records after the conduction of every experiment	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

PHYSICAL EDUCATION	
Course Code: PE69	**Credits: NCMC**
Pre – requisites: Nil	
Course Coordinator: Dr. Kiran Kumar H K	

Course Content

Course Learning Objectives:

1. To introduce students to the importance of physical fitness for success in any career.
2. To instill in them concepts of team spirit and team building
3. To develop positive thinking, goal setting and decision-making abilities under duress.
4. To harness values and skills like leadership, communication and sacrifice.
5. To inculcate in students, the ability to handle success and failures with equanimity.

Selection Process: A Student shall select any one of the following Sports based on his/her interest and the facility available. The details **of Sports Facilities available (both indoor and outdoor) at institute campus** are as below:

Outdoor Games		**Indoor Games**		**Athletics**	
Games	**No. of Students**	**Games**	**No. of Students**	**Events**	**No. of Students**
Volleyball	12 x 4 = 48	**Badminton**	30	**Sprint** - 100mt, 200mt, 400mt	60
Basketball	12 x 4 = 48	**Table Tennis**	30	**Middle distance running** – 800mt, 1,500mt	
Kabaddi	12 x 4 = 48	**Chess**	30	**Long distance running** – 5,000mt, 10,000mt	
Kho Kho	12 x 4 = 48	**Weight Training [Gym]**	35	**Jumping Events** –Long Jump Triple Jump High Jump	30
Throw ball	12 x 4 = 48			**Throwing Events** Shot Put Discuss Javelin	30
Football	16 x 4 = 64	**Note: Students should bring their own sports attires**			

Hockey	16 x 4 = 64	
Cricket	16 x 4 = 64	

Contact Sessions: A student shall abide by the following during the sessions scheduled in the semester.

Session 1

Fundamentals of Physical Education, value addition to personality through fitness education, discipline and team building activities, Orientation towards particular sports and skill training

Session 2

Formation of teams based on student's orientation and preference. Team practice and skill enhancement.

Session 3

Conduction of matches in all sporting events registered by Students. Evaluation of each student shall be based on their performance either in team or individual. The student representing the Institute at University/State/National/International Level will be awarded additional marks during evaluation.

Course Outcomes (CO's):

1. Develop interest and skill in playing particular sports.
2. Understand the process of organizing sporting events.
3. Appreciate the role of fitness for a better lifestyle.
4. Derive lessons from sports activities for effective planning and discipline in Life.
5. Analyze situations and optimize end results.

Course Assessment & Evaluation:

1. A committee consisting of Sports Director and Coaches of respective Sports will be formed to observe and evaluate the students for CIE in each semester.
2. Students shall follow the schedules, rules and regulations as prescribed by the Committee.
3. Students shall mandatorily have 85% attendance to be eligible for evaluation.
4. All the Sessions and evaluation process will be common for all semesters of the academic year.
5. The final result will be reflected on the grade card of 8th Semester.
6. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE.

YOGA	
Course Code: YO69	**Credits: NCMC**
Pre – requisites: Nil	
Course Coordinator: Dr. Hari Chandra B P & Dr. Parimala P	

Course Content

Course Learning Objectives:

1. To introduce to the students, the fundamental theoretical aspects of yoga.
2. To inculcate in students a habit of practicing yoga.
3. To be able to demonstrate basic yoga asanas.
4. To be able to practice fundamental breathing practices and mudras.
5. To understand the relevance of yoga and research in modern times.

Introduction: Definition of yoga, benefits, astangas of yoga, Relevance of yoga and yoga-research in modern times.

Asanas: Kriyathmakachalanas, Suryanamaskar, Superbrain yoga, Vrikshasana, Trikonasana, Veerabhadrasana, Paschimotasana, Purvothanasana, Bharadwajasana, Amruthasana, Parivruttha Trikonasana, Parsvakonasana, Ustrasana, Padmasana, Jaaanushirshasana, Navasana, Ardhachakrasana, Ardhakatichakrasana, Jataraparivarthanasana, Sethubandasana, Sarvangasana, Mathyasana, Dhanurasana, Shirshasana.

Pranayamas: Anuloma-Viloma, Suryanuloma, Chandranuloma, Brahmari, Suryanbedhana, Chandrabedhana, Sheetali, Seethkari, Sadantha, bastrika.

Mudras: Chinmudra-Jnanamudra, Praana mudra, panchaprana mudras, panchabhoota mudras, Pruthvi mudra, Shoonya mudra, Surya mudra, Jalodharanashaka mudra, Kundalini mudra, shoonyavaayu mudra, shakti mudra, sandhi mudra, vajra mudra and garuda mudra.

Course Outcomes (CO's):

At the end of the course, a student will

1. Understand the fundamental and theoretical aspects of yoga.
2. Develop a habit of practicing yoga.
3. Demonstrate basic yoga asanas.
4. Demonstrate fundamental breathing practices.
5. Understand the relevance of yoga and its research in modern times.

Reference Books:

1. Light on yoga, B K S Iyengar, Publisher -Thorsons, UK, 2006

2. Light on pranayama, B K S Iyengar, Publisher - Element; First Edition
3. The Essential Yoga Mudras for Healing, Dr. Aasoori K. Rangaraja Iyengar, Saranga Publishing; First Edition 2021

Pedagogy:

Chalk and talk, demonstration, videos, ppt.

Contact Sessions:

There would be one introduction class, and five contact classes in each semester.
The candidates shall practice yoga on a daily basis, or in the worst case on alternate days at their place of residence and maintain a short diary in the format provided by yoga teacher. The same shall be brought to the classes.

Online reference sources:

- Yoga for beginners part 1: https://www.youtube.com/watch?v=VwPeThpwfWI
- Yoga for beginners part 2: https://www.youtube.com/watch?v=s_pnJTcOp8A
- Suryanamaskar: https://www.youtube.com/watch?v=nUdlucNd6go&t=133s
- Yoga for anxiety and stress: https://www.youtube.com/watch?v=hJbRpHZr_d0
- Common yoga protocol: https://www.youtube.com/watch?v=Av5ib_XRKT4
- Relevance of yoga in modern times: www.youtube.com/watch?v=HUzBCts7BTo

Course Assessment & Evaluation:

1. A committee consisting of Yoga Instructors will be formed to observe and evaluate the students for CIE in each semester.
2. Students shall follow the schedules, rules, and regulations as prescribed by the Committee.
3. Students shall mandatorily have 85% attendance to be eligible for evaluation.
4. All the Sessions and evaluation processes will be common for all semesters of the academic year.
5. The final result will be reflected on the grade card of 8th Semester.
6. The final marks shall be calculated after scaling down CIE to 50 marks & combining it with 50 marks for SEE.

Scheme of SEE

Practical Demonstration	30 marks
Write-up	10 marks
Viva	10 marks
Total	**50 marks**

NATIONAL SERVICE SCHEME	
Course Code: NS69	**Credits: NCMC**
Pre – requisites: Nil	
Course Coordinator: Dr. Puttabore Gowda & Dr. Siddaraju C	

Course Content

Course Learning Objectives:

1. To introduce students to the importance of national service
2. To harness values and skills like leadership, teamwork and sacrifice.
3. To serve society through educational services and health
4. To work towards rural and local development through technological services
5. To inculcate in students, the ability to handle socially relevant projects.

Students shall involve in activities related to national and regional technical and non-technical services, as listed below.

- Serving society by bringing awareness on education and cleanliness.
- Blood donation camps
- Developing technologies for rural masses.
- Conduction and participation in camps for a social cause.
- Educating towards health and well-being of individuals/society.
- Cultural and educational programs for society.
- Contributing towards the improvement of civil services and bringing certain shortcomings to the notice of higher authorities for suitable remedial actions.
- Contribution towards traffic management and other public services.
- Clean up and development of water sources around public places.
- Services during a disaster or other needy situations.
- Camps for the rejuvenation of lakes and water bodies.
- Serving nature and agriculture.
- Awareness programs on health and food adulteration.
- Presenting papers/talks in various fora on the above topics.
- Developing technologies for rural masses beyond academic requirements.
- Plantation programs.
- Conducting programs for self-sustainability, and human and national development.
- Contribution towards orphans and challenged individuals through well-recognized organizations.

- Carrying out designated activities in villages.
- Development and implementation of strategies for solid waste, E-waste etc.
- Education towards pollution control and traffic management.
- Production of documentaries and short films/videos for motivating people on any of the above causes.

Course Outcomes (CO's):

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

1. Understand the importance of national service.
2. Gain skills like leadership and teamwork.
3. Volunteer towards educational services and health.
4. Contribute to rural and local development through technical services.
5. Comprehend socially relevant projects

Contact Sessions:

The students shall attend the review and contact sessions as scheduled by the course coordinator.

Course Assessment & Evaluation:

1. The candidates shall maintain a record of activities in a Diary, and get them endorsed during the contact sessions at least 3 times in a semester.
2. A detailed project report should be submitted during the last fortnight of the semester
3. Evaluation will be done during each semester based on the nature of the contribution.
4. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE

ADDITIONAL MATHEMATICS – I (For Lateral Entry Diploma Students)	
Course Code: AM31	**Credits: 0:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. Shashi Prabha Gogate S	

Course Content

Unit I

Differential Calculus: Successive differentiation, nth derivatives of some standard functions, Leibnitz theorem, Polar curves. Angle between the radius vector and the tangent, angle between curves, length of the perpendicular from pole to the tangent, pedal equations. Taylor's and Maclaurin's expansions.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit II

Integral Calculus: Introduction, Reduction formula, Reduction formula for $\int Sin^n x dx$, $\int Cos^n x dx$ and $\int Sin^n x Cos^m x dx$. Evaluation of double and triple integrals.

- Pedagogy / Course delivery tools: Chalk and talk
- Links https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit III

Vector Algebra: Scalar and vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple product-simple problems. Vector functions of a single variable. Derivative of a vector function, geometrical interpretation. Velocity and acceleration.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit IV

Vector Differentiation: Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector field, irrotational vector. Laplace's operator. Vector identities connected with gradient, divergence and curl.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit V

First Order Differential Equations: Solution of first order and first degree differential equations, variable separable methods, homogeneous equations, linear and Bernoulli's equations, exact differential equations.

- Pedagogy / Course delivery tools: Chalk and talk, Power Point Presentation
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/59742/295

Text Books:

1. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. **Erwin Kreyszig** – Advanced Engineering Mathematics – Wiley Publication, 10th Edition, 2015.

Reference Books:

1. **H. K. Dass** – Higher Engineering Mathematics – S Chand Publications, 1998.
2. **B. V. Ramana** – Engineering Mathematics – Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

Course Outcomes (COs):

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

1. Solve problems related to nth derivative to some standard functions, polar curves and power series expansions. (PO-1,2)
2. Apply the concept of reduction formula to determine the length, area, volume of revolution of an arc of the curve. (PO-1,2)
3. Solve the problems related to velocity and acceleration. (PO-1,2)
4. Apply vector differentiation to identify solenoidal and irrotational vectors. (PO-1,2)
5. Apply the concept of various methods to solve first order first degree differential equations. (PO-1,2)

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

SKILL LAB COURSE II	
Course Code: ETSL2	**Credits:0:0:1**
Pre – requisites: Nil	**Contact Hours:**
Course Coordinator:	

Skill Lab Course: is a 1-credit Lab course with 2 contact hours per week. 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 Semester

NUMERICAL METHODS, STATISTICS AND PROBABILITY	
Course Code: ET41	**Credits: 2:1:0**
Pre – requisites: Nil	**Contact Hours: 30L+30T+30S**
Course Coordinator: Dr. Vijaya Kumar and Dr. A. Sreevallabha Reddy	

Course Content

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
- 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
- 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/111/105/111105035/
    - https://nptel.ac.in/courses/111/107/111107119
- 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

Reference Books:

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 (COs):

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 – 1,2, 3, 4 & PSO – 1, 2)
2. Model uncertainty using continuous and joint probability distributions. (PO-1, 2, 4 & PSO – 1, 2)
3. Apply stochastic processes and Markov chains to model and analyze random systems. (PO – 1, 2, 3 & PSO – 1, 2)
4. Apply sampling theory and statistical hypothesis testing for data-driven decision making (PO – 1,2, 4 & PSO – 1, 2)
5. Apply vector calculus and optimization techniques to solve engineering and data analysis problems. (PO – 1, 2, 3, 5 & PSO – 1, 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	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	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%)

SIGNALS AND SYSTEMS	
Course Code: ET42	**Credits: 3:0:0**
Pre – requisites: Knowledge of Mathematics	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Ramya H R	

Course Content

Unit I

Introduction: Definitions of a signal and a system, classification of signals, basic operations on signals, elementary signals, and systems viewed as interconnections of operations, properties of systems.

- Pedagogy / Course delivery tools: Chalk and talk
- Links:https://www.youtube.com/playlist?list=PLq-Gm0yRYwTjwxaqapPsS
- AHzs4_nkQLVr
- Impartus Recording: http://a.impartus.com/ilc/#/course/96153/452

Unit II

Time-domain representation for LTI systems: Convolution, impulse response representation, Convolution Sum and Convolution Integral. Properties of LTI systems in terms of its impulse response representation. Differential and difference equation representations.

- Pedagogy / Course delivery tools: Chalk and talk
- Links:https://www.youtube.com/playlist?list=PLqGm0yRYwTjwxaqapPsSAH zs4_nkQLVr
- Impartus Recording: http://a.impartus.com/ilc/#/course/96153/452

Unit III

Fourier representation for signals: Fourier representation of signals, Discrete and continuous time Fourier representation of periodic and non-periodic signals and its properties with relevant problems.

- Pedagogy / Course delivery tools: Chalk and talk
- Links:https://www.youtube.com/playlist?list=PLqGm0yRYwTjwxaqapPsSAH zs4_nkQLVr
- Impartus Recording: http://a.impartus.com/ilc/#/course/96153/452

Unit IV

Applications of Fourier representations: Introduction, Frequency response of LTI systems, Fourier transform analysis of LTI systems.

- Pedagogy / Course delivery tools: Chalk and talk
- Links:https://www.youtube.com/playlist?list=PLqGm0yRYwTjwxaqapPsSAHzs4_nkQLVr
- Impartus Recording: http://a.impartus.com/ilc/#/course/96153/452

Unit V

Z-Transforms: Introduction, Z- transform, properties of ROC, properties of Z-transforms, inverse Z- transforms. Z-Transform analysis of LTI systems.

- Pedagogy / Course delivery tools: Chalk and talk
- Links:https://www.youtube.com/playlist?list=PLqGm0yRYwTjwxaqapPsSAHzs4_nkQLVr
- Impartus Recording: http://a.impartus.com/ilc/#/course/96153/452

Text Books:

1. Simon Haykins and Barry Van Veen, "Signals and Systems", John Wiley & Sons, January 2021.

Reference Books:

1. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems", Pearson Education Asia/PHI, 2nd edition, 1997. Indian reprint 2010.
2. Ganesh Rao and Satish Tunga, "Signals and Systems", Cengage India Private Limited, 2017

Course Outcomes (COs):

1. Recall the classifications of signals, properties of systems, and definitions of various transforms. (PO-1, PO-11, PSO-1, PSO-3)
2. Understand the basic operations on signals, convolution in LTI systems, and properties of various transforms. (PO-1, PO-2, PO-3, PO-5, PO-11, PSO-1, PSO-2, PSO-3)
3. Apply the properties of Fourier representations and Z transforms to obtain frequency domain representations of signals from time-domain and vice-versa. (PO-1, PO-2, PO-3, PO-5, PO-11, PSO-1, PSO-2, PSO-3)
4. Analyse the LTI system to determine system properties, using time-domain and transform-domain techniques. (PO-1, PO-2, PO-3, PO-5, PO-11, PSO-1, PSO-2, PSO-3)
5. Evaluate the LTI system response by solving differential and difference equations, using the time-domain and transform-domain techniques. (PO-1, PO-2, PO-3, PO-5, PO-11, PSO-1, PSO-2, PSO-3)

Web Links and Video Lectures (e-Resources):

1. https://www.tutorialspoint.com/signals_and_systems/index.asp
2. https://www.youtube.com/watch?v=s8rsR_TStaA
3. http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals- and.html
4. https://freevideolectures.com/course/3540/signals-and-systems-i

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 will be taken for 30 marks.		
Other components		
Assignment	10	CO1, CO2, CO3, CO4, CO5
Quiz	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

MICROCONTROLLERS	
Course Code: ET43	**Credits: 3:0:0**
Pre – requisites: Computing fundamentals and C Programming	**Contact Hours: 45L+45S**
Course Coordinator: Dr. S G ShivaPrasad Yadav	

Course Content

Unit I

Introduction to Microcontroller: Small Microcontroller, Anatomy of a Typical Small Microcontroller, Memory, Software, where does MSP430 fit, The Outside and inside View—Pin-Out, Functional Block Diagram, Central Processing Unit, Memory-Mapped Input and Output, Clock Generator, Exceptions: Interrupts and Resets, Development Environment, Assembly Language., Access to the Microcontroller for Programming and Debugging.

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc20_ee98/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59760/295

Unit II

Architecture of the MSP430 Processor: Central Processing Unit., Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Examples, Reflections on the CPU and Instruction Set, Resets**.**

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc20_ee98/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59760/295

Unit III

Digital I/Os, Interrupts and LP Modes: Parallel ports, Interrupts on Inputs, Application: examples of hex keypad, multiplexed display, LCD and DC motor interfaces. Interrupts and ISRs, ISRS in Assembly and C, Issues Associated with Interrupts, Low Power Modes of operation.

Development Environment: Introduction, Aspects of C for Embedded Systems, Access for debugging, MSP430- starter kit

- Pedagogy / Course delivery tools: Blackboard teaching

- Links: https://onlinecourses.nptel.ac.in/noc20_ee98/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59760/295

Unit IV

Clock System & Timers: Clock modules; Crystal oscillators, VLO and DCO, Clock module control, Oscillator Faults, FLL+.

Timers: Watchdog timer, Basic Timer1, RTC, Timer_A; Timer block, Capture and compare channels, Interrupts, Example application –Generation of a precise frequency and a simple PWM

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc20_ee98/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59760/295

Unit V

Mixed Signal Systems and Communication Interfaces: General and practical issues with ADCs, Architecture and Basic operations of - The ADC10 Successive-Approximation, Basic introduction to DAC12, Serial Peripheral Interface, SPI with USCI, Software UART using Timer_A, Inter-integrated Circuit Bus (I^2C), examples using I^2C.

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc20_ee98/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59760/295

Text Books:

1. John H. Davies, "MSP430 Microcontroller Basics"**,** Newnes, Elsevier, 2010.
2. Cris Nagy, "Embedded Systems Design using the TI MSP430 Series", Newnes, Elsevier, 2003.

Reference Books:

1. https://www.hep.princeton.edu//~marlow/rrs/Guides/Workbench.pdf

Web Links and Video Lectures (e-Resources):

1. www.msp430.com
2. https://nptel.ac.in/courses/117104072

Course Outcomes (COs):

1. Ability to understand the basics of Microcontroller (PO-1, PO-2, PO-11, PSO-1, PSO-3)

2. Implement and evaluate basic assembly/ C programs in MSP 430 (PO-1, PO-2, PO-3,PO-11, PSO-1, PSO-3)
3. Implement applications using interrupt and low power modes (PO-1, PO-2, PO-3, PO-5, PO-7, PO-11, PSO-1, PSO-2, PSO-3)
4. Understand and analyze the usage of timers and implement timing based applications (PO-1, PO-2, PO-3, PO-5, PO-6, PO-11, PSO-1, PSO-2, PSO-3)
5. Implement applications using serial peripheral interfaces (PO-1, PO-2, PO-3, PO-5, PO-6, PO-11, PSO-1, PSO-2, PSO-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 will be taken for 30 marks.		
Other components		
Mini Project	10	CO1, CO2, CO3, CO4, CO5
Surprise Test	10	CO1, CO2, CO3, CO4,CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ENGINEERING ELECTROMAGNETICS	
Course Code: ET44	**Credits: 3:0:1**
Pre – requisites: Transform Techniques and Linear Programming	**Contact Hours: 45L+ 30P+45S**
Course Coordinator: Mrs. Nisha S L	

Course Content

Unit I

Coluomb's Law and Electric Field Intensity: Experimental law of Coulomb, Electric field intensity, Field of a line charge and Sheet charge.

Electric flux density and Gauss's Law: Applications of Gauss's Law, divergence, Maxwell's First equation (Electrostatics), Vector Operator Dell and divergence theorem.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/108104087
- Impartus Recording: http://a.impartus.com/ilc/#/course/81460/295

Unit II

Energy and Potential: Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of point charge, Energy density in the electrostatic field.

Conductors, Dielectrics and Capacitance: Current and current density, Continuity of current, Metallic conductors, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics, Capacitance and examples.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/108104087
- Impartus Recording: http://a.impartus.com/ilc/#/course/81460/295

Unit III

Poisson's And Laplace's Equations: Derivation of Poisson's and Laplace's Equations, Examples of the solution of Laplace's equation.

The Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic Potentials.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/108104087
- Impartus Recording: http://a.impartus.com/ilc/#/course/81460/295

Unit IV

Magnetic Forces: Force on a moving charge, differential current elements, Force between differential current elements, Magnetic boundary conditions

Time-varying fields and Maxwell's equations: Faraday's law, displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, the retarded potential.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/108104087
- Impartus Recording: http://a.impartus.com/ilc/#/course/81460/295

Unit V

Uniform Plane Wave: Wave propagation in free space, Wave propagation in dielectrics, Poynting's theorem and wave power, Propagation in good conductors: Skin Effect.

Transmission lines: Introduction, transmission line equation and solution, Reflection and transmission coefficients, SWR, line impedance, and line admittance, Smith chart.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/108104087
- Impartus Recording: http://a.impartus.com/ilc/#/course/81460/295

Text Books:

1. W.H. Hayt, J.A. Buck and M. Jaleel Akhtar, "Engineering Electromagnetics", 8thEdition, McGraw-Hill, 2015.
2. Mathew N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6thEdition, Oxford University Press, 2015.

Reference Books:

1. John Krauss and Daniel A Fleisch, "Electromagnetics with applications", Mc GrawHill, reprint 2014.
2. N. Narayana Rao, "Fundamentals of Electromagnetics for Engineering", Pearson,reprint 2012.

Web Links and Video Lectures (e-Resources):

- http://videolectures.net/mit6013f05_electromagnetics_applications/

Course Outcomes (COs):

1. State several laws and principles of electric, magnetic, and electromagnetic fields (PO-1, PO-11, PSO-1, PSO-3)
2. Solve problems by applying the concepts of electric, magnetic, electromagnetic fields and to use smith Chart. (PO-1, PO-2, PO-3, PO-5, PO-6, PO-8, PO-9, PO-10, PO-11,PSO-1, PSO-2, PSO-3)
3. Analyse theoretical and practical meaning of different expressions related to electric and magnetic fields. (PO-1, PO-2, PO-3, PO-5, PO-6, PO-8, PO-9, PO-9, PO-10, PO-11, PSO-1, PSO-2, PSO-3)
4. Analyse the importance of Electrostatic, Magnetic boundary condition, Time-varying fields, and Maxwell's equations. (PO-1, PO-2, PO-3, PO-5, PO-6, PO-7, PO-8, PO-10, PO-11, PSO-1, PSO-2, PSO-3)
5. Evaluate wave equation for Uniform Plane Waves in good conductor, dielectric, transmission lines, and power associated with EM waves using Poynting theorem. ((PO-1, PO-2, PO-3, PO-5, PO-6, PO-7, PO-8, PO-9, PO-10, PO-11, PSO-1, PSO-2, PSO-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 will be taken for 30 marks.		
Other components		
Assignment	10	CO1, CO2, CO3, CO4, CO5
Surprise Test	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

SYSTEMS MODELLING AND CONTROL	
Course Code: ETE451	**Credits: 3:0:0**
Pre–requisites: Network Analysis	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Vijaya Madhavi C M	

Course Content

Unit I

Transfer Function Approach to Modelling of Systems and Control Systems: Transfer Function Models of physical systems from various domains, Types of Control Systems, Notion of stability

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Unit II

State Space Modelling of Physical Systems (Stability and Controllability): Transition from differential equations to state space models, Modeling systems from different application domains (electrical, mechanical, ecological etc), Basic notions of stability, Modeling the Predator Prey equations from Ecology

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Unit III

Analysis of State Space Systems:

Linearization of nonlinear state space systems, Controllability, observability

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Unit IV

Performance Specifications of Control Systems: Standard test signals, First and second order systems, Time response specifications, Steady state errors, Design of a basic feedback control system

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Unit V

Pole Placement (controller design): Theory of elementary pole placement, Full State/output feedback, Design of controllers for pole placement.

- Pedagogy / Course delivery tools: Blackboard teaching
- Links: https://onlinecourses.nptel.ac.in/noc21_ee14/preview
- Impartus Recording: https://a.impartus.com/ilc/#/course/59763/295

Text Books:

1. K Ogata, "Modern Control Engineering", PHI, 4th Edition, 2002
2. Normal S Nice, "Control Systems Engineering", Wiley India Edition, 9th Edition, 2018

Reference Books:

1. Farid and Kuo, "Automatic Control Systems", John Wiley and Sons, 9th Edition, 2014.
2. I J Nagrath, M Gopal, "Control Systems Engineering", New Age International Publishers, 8th Edition, 2025
3. Hassan K Khalil, "Nonlinear Systems", Prentice Hall, 3rd Edition, 2002.
4. Tariq Samad et. al., "Impact of Control Technology", IEEE – Control Systems Society Report, February 2011

Web Links and Video Lectures (e-Resources):

- NPTEL material on Control Engineering by Dr. Ramkrishna Pasumarthy and Dr.ViswanathTalasila, https://onlinecourses.nptel.ac.in/noc17_ee12/preview
- MIT OpenCourse in Feedback Control Systems, http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-30-feedback-control- systems-fall-2010/
- MIT Open Course in Systems and Control, http://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls- spring-2013/
- https://elearn.nptel.ac.in/shop/nptel/control-engineering-2/

Course Outcomes (COs):

CO1: Acquire knowledge of modelling physical systems using transfer function approach and analysing system stability across various application domains (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PSO-1, PSO-2, PSO-3)

CO2: Acquire knowledge of modelling physical systems using state space approach and analysing system stability across various application domains (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PSO-1, PSO-2, PSO-3)

CO3: Analyse nonlinear state space systems and evaluate systems controllability and observability (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PSO-1, PSO-2, PSO-3)

CO4: Design first- and Second-order control system using standard test signals and analyse their time domain and steady-state responses (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PSO-1, PSO-2, PSO-3)

CO5: Use of controllability and observability principles to design controllers using pole placement method to satisfy desired specifications in diverse application domains. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PSO-1, PSO-2, PSO-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 will be taken for 30 marks.		
Other components		
Assignment/Surprise test	10	CO1, CO2, CO3, CO4,CO5
Lab based Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

DIGITAL SWITCHING SYSTEMS	
Course Code: ETE452	**Credits: 3:0:0**
Pre–requisites: Introduction to Electronics	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Parimala P	

Course Content

UNIT-I

INTRODUCTION: Developments of Telecommunications, Network structure, Digital transmission, FDM, TDM, PDH and SDH, Message switching, Circuit switching, Functions of switching systems, Basics of crossbar systems, Electronic switching. Signaling methods, Telephone network organization, Numbering, charging

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://www.youtube.com/watch?v=anKyTnpti-o&t=8s

Unit-II

TELECOMMUNICATIONS TRAFFIC:

Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, Lost call systems, Queuing Systems. Network Traffic load and parameters, Grade of service and blocking probability, Incoming Traffic and Service Time analysis, Blocking Models and Loss Estimates, Delay systems.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://www.youtube.com/watch?v=mLoLouF026g

Unit-III

SPACE DIVISION SWITCHING: Introduction, Single stage networks, Gradings, Link Systems, GOS of Linked systems

TIME DIVISION SWITCHING: Introduction, space and time switching, Time switching networks, Synchronization

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://www.youtube.com/watch?v=UNZdld1MF04

Unit-IV

FUNDAMENTALS OF DIGITAL SWITCHING SYSTEMS: Purpose of analysis, Basic central office linkages, Outside plant venous inside plant, Switching system hierarchy, Evolution of digital switching systems, Building blocks of a digital switching system, Hardware architecture Basic call processing, Switching system software.

Data communication Architecture, ISO-OSI Reference Model, Link to Link Layers, Satellite based data networks and switching, LAN, Metropolitan Area network, Fiber optic networks, and Data network standards. Routing & Switching concept.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk

Links:https://www.youtube.com/watch?v=9_LvrgKEnCM&list=PL5XJ1nD6ql-qL8tKE3B2iOIDzQ9-YL1Tp

Unit-V

MAINTENANCE OF DIGITAL SWITCHING SYSTEM: Introduction, Scope, Software maintenance, Interface of a typical digital switching system central office, System outage and its impact on digital switching system reliability, Impact of software patches on digital switching system maintainability, **Optical Switching:** OTDM, Synchronization, Header Processing, SONET/SDH core Network

Mobile switching: The cellular concept, analog and digital network elements, Hand-off

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://www.youtube.com/watch?v=1JZG9x_VOwA

TEXT BOOKS:

1. J E Flood: Telecommunication and Switching, Traffic and Networks, Pearson Education 2020
2. Syed R. AH, Digital Switching Systems, TMH Ed 2020.

REFERENCE BOOKS:

1. P Gnanasivam 'Telecommunication switching and networks' PHI learning Pvt ltd ,2021
2. John C Bellamy: Digital Telephony Wiley India 3rd Ed, 2021
3. Thyagarajan Vishwanathan, Telecommunication Switching PHI learning Pvt ltd, 2021
4. Stephen W Gibson, m"Cellular Mobile Radio Telephones, Prentice Hall of India, 2022

Web Links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=9Rc_XrgN9kA
2. https://www.youtube.com/watch?v=1JZG9x_VOwA

Course Outcomes:

1. Apply fundamental concepts of Telecommunication networks and switching techniques
2. Analyze telecommunication traffic models, congestion parameters, and queuing systems.
3. Design and evaluate space-division and time-division switching networks.
4. Analyze hardware architecture, software control, and layered data communication models in digital switching systems.
5. Assess reliability, software maintenance, and advanced switching paradigms in optical and mobile networks.

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO 1, 2 & 3
Internal Test-II	30	CO 3, 4 & 5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignment	10	CO 1, 2 & 3
Quiz/MCQ	10	CO 4 & 5
Semester-End Examination:	50	CO 1, 2, 3, 4 & 5

INTRODUCTION TO QUANTUM COMPUTING	
Course Code: ETE453	**Credits: 3:0:0**
Pre–requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Kusuma	

Course Content

Unit I

Introduction to Quantum Computing: Quantum Bits, Bloch Sphere Representation of a Qubit, Multiple Qubits. **C**lassical vs quantum computing, Bit vs Qubit, Superposition and Entanglement, Quantum Measurement and Collapse of State, Introduction to Bra-Ket Notation (Dirac Notation).

Linear Algebra Revisits: Complex Numbers Versus Real Numbers, Vectors, Scalar Multiplication, Vector Addition, and Bases.

- Pedagogy /Course delivery Tools-Chalk and talk, Power point presentation, Videos
- Link- https://nptel.ac.in/courses/106106232

Unit II

Quantum Gates: X, Z, Y, H (Hadamard), S, T, Multi-qubit gates: CNOT, Toffoli, Quantum Circuits and their simulation, Gate representation using matrices, **Quantum Circuits:** Design and Simulation of Quantum Circuits. **Quantum Measurement Theory**, Noise and error correction, Distinguishing Quantum states & Measures

- Pedagogy /Course delivery tools-Chalk and talk, Power point presentation, Videos
- Link- https://nptel.ac.in/courses/106106232

Unit III

Quantum Algorithms: Deutsch's Algorithm, Grover's Algorithm, Shor's Algorithm, Concept of Quantum Speed-up, Grover's Algorithm.

- Pedagogy /Course delivery tools-Chalk and talk, Power point presentation, Videos
- Link- https://nptel.ac.in/courses/106106232

Unit IV

Quantum Communication: Introduction to Quantum Teleportation, Quantum Entanglement in Communication, Bell States, Classical vs Quantum Channels

- Pedagogy /Course delivery tools-Chalk and talk, Power point presentation, Videos
- Link- https://nptel.ac.in/courses/106106232

Unit V

Quantum Cryptography: quantum for security, No-cloning theorem, Quantum Key Distribution (QKD) – BB84 Protocol, Security advantages of QKD

- Pedagogy /Course delivery tools-Chalk and talk, Power point presentation, Videos
- Link- https://nptel.ac.in/courses/106106232

Suggested Learning Resources:

Text Books:

1. Nielsen, M. A., & Chuang, I. L. (2010). *Quantum computation and quantum information* (10th anniversary ed.). Cambridge University Press. ISBN: 9781107002173.
2. Bernhardt, C. (2019). *Quantum computing for everyone* (1st ed.). MIT Press. ISBN: 9780262039253

Reference Books:

1. Van Assche, G. (2006). *Quantum cryptography and secret-key distillation*. Cambridge University Press. ISBN: 9780521855825
2. Hidary, J. D. (2021). *Quantum computing: An applied approach* (2nd ed.). Springer. https://doi.org/10.1007/978-3-030-39224-2
3. Lidar, D. A., & Brun, T. A. (Eds.). (2013). *Quantum error correction*. Cambridge University Press. ISBN: 9780521896118

Course Outcomes (COS):

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

1. **Describe** the fundamental concepts of quantum computing.
2. **Discuss** quantum communication principles
3. **Apply** linear algebra techniques including complex numbers, vector operations, and basis transformations to model quantum states and gates.
4. **Illustrate** the operation of quantum algorithms like Deutsch's, Grover's, and Shor's, and **evaluate** their quantum speed-up advantages compared to classical algorithms.
5. **Analyze** quantum cryptographic schemes for their security implications.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2,CO3
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Simulations and the Report for the same	20	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in other component		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

ABILITY ENHANCEMENT COURSE – IV Introduction to OOPS	
Course Code: ETAEC46	**Credits: 1:0:0**
Pre – requisites: Fundamentals of Computing	**Contact Hours: 14L**
Course Coordinator: Dr. Arvind Kumar G	

Course Content

UNIT-I

Introduction: Why OOP's, Features of OOP's, recursive functions, user-defined types, function overloading, inline functions.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc25_cs34/preview

Unit-II

Classes & Objects: Classes, Scope resolution operator, passing objects as arguments, returning objects, and object assignment.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc25_cs34/preview

Unit-III

Constructors and Destructors: Introduction to Constructors and Destructors, friend functions, Parameterised constructors,

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc25_cs34/preview

Unit-IV

Inheritance and Polymorphism: Types of Inheritance: Single, Multiple, Multilevel, and Hierarchical, Operator overloading using friend functions such as +, - , pre-increment, post-increment

.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc25_cs34/preview

UNIT-V

Introduction to ML Using OOP: How OOP is Used in ML (Encapsulation, Inheritance in ML models), Creating a Simple ML Model Class for Training and

Prediction.

- Pedagogy / Course delivery tools: PPT, Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc25_cs34/preview

Text book:

1. Steven F. Lott, Dusty Phillips, "**Python Object-Oriented Programming**", Build Robust and Maintainable Object-Oriented Python Applications and Libraries, 4th Edition,2021.
2. **Python Object-Oriented Programming"** – *Steven F. Lott*.

Reference books:

1. John V Guttag, Introduction to computation and Programming using Python, Revised and expanded edition, MIT Pres, 2013.
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, - Introduction to Programming in Python: An interdisciplinary Approach, Pearson India Education Services Pvt. Ld. 2016.

Course Outcomes (COs):

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

1. Understand the fundamental concepts of Object-Oriented Programming (OOP). (PO-1 to 5) (PSO-1,2)
2 Apply the principles of classes and objects. (PO-1 to 5) (PSO-1,2)
3. Demonstrate the working of constructors and destructors. (PO-1 to 5) (PSO-1,2)
4. Implement inheritance and polymorphism techniques. (PO-1 to 5) (PSO-1,2)
5. Explore the application of OOP in Machine Learning (ML). (PO-1 to 5) (PSO-1,2)

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
The average of the two internal tests will be taken for 30 marks.		
Other components		
Mini project	20	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

SIGNALS AND SYSTEMS LAB	
Course Code: ETL47	**Credits: 0:0:1**
Pre – requisites: Knowledge of Mathematics and Programming	**Contact Hours: 30P**
Course Coordinator: Dr. Ramya H R	

Course Content

List of Experiments Conducted Using MATLAB

1. Basic Operation on matrices.
2. Generation on various signals and sequences
3. Operations, finding the even and odd parts on signals and sequences.
4. Impulse response of a given system.
5. Linear convolution of two given sequences.
6. Circular convolution of two given sequences.
7. Autocorrelation of a given sequence and verification of its properties.
8. Cross correlation of given sequences and verification of its properties.
9. Solving a difference equation.
10. Verification of linearity and time invariance properties of a given continuous system .
11. Verification of linearity and time invariance properties of a given discrete system
12. Verification of linearity and time invariance properties of a given discrete system.
13. Computation of unit sample, unit step and sinusoidal response of the given LTI system and verifying its properties.
14. Locating the zeros and poles and plotting the pole zero maps in s-plane and z-plane for the given transfer function.
15. Solve a difference equation using Z-transform technique.

TEXTBOOKS:

1. Simon Haykins and Barry Van Veen, “Signals and Systems”, John Wiley & Sons, January 2021.

REFERENCE BOOKS:

1. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, “Signals and Systems”, Pearson Education Asia/PHI, 2nd edition, 1997. Indian reprint 2010.
2. Ganesh Rao and Satish Tunga, “Signals and Systems”, Cengage India Private Limited, 2017
3. H.P Hsu, R. Ranjan, Signals and Systems, Scham’s Outlines, TMH, 2009
4. B.P Lathi, Linear systems and signals, Oxford University Press, 2010

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.nitt.edu/home/academics/departments/ece/facilitiesnservices/labs/signal_processing_lab/
2. http://ece.cet.ac.in/digital-signal-processing-lab/

Course Outcomes (COs):

1. Understand the signal processing concepts, Operations on signals, and verify different properties of signals and systems. (PO1, 2, 3, 5, 8, 11, PSO1, 2, 3)
2. Analyze the impulse and step response of LTI systems and compute total response of an LTI system for the given differential and difference equation (PO1, 2,3,5,8,11, PSO1,2,3)
3. Ability to compute Fourier Series of periodic and Non Periodic signals and verify its properties. (PO1,2,3,5,8,11, PSO1,2,3)
4. Ability to compute Fourier Transform of periodic and non-periodic signals and verify its properties. (PO1,2,3,5,8,11, PSO1,2,3)
5. Ability to compute signals using Z Transforms techniques. (PO1,2,3,5,8,11, PSO1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory observation/records after the conduction of every experiment	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

MICROCONTROLLERS LAB	
Course Code: ETL48	**Credits: 0:0:1**
Pre – requisites: Computing fundamentals and C Programming	**Contact Hours: 30P**
Course Coordinator: Dr. S G Shiva Prasad Yadav	

Course Content

List of Experiments:

1. Simple data handling programs in ALP -- Addition and subtraction
2. Multiplication and division
3. Block move and Block exchange
4. Code conversion (Binary to ASCII…)
5. Finding largest and smallest
6. Ascending order and descending order
7. Square and cube of 8 bit and 16-bit data.
8. Interfacing on board LED
9. LED using Timer
10. LCD Interfacing
11. Stepper motor Interface
12. ADC Interfacing
13. DAC Interfacing using Sine Wave and Triangular wave
14. DAC Interfacing using symmetric and asymmetric Square wave
15. Interfacing experiments with MSP430 Launch Pad

Text Books:

1. John H. Davies, "MSP430 Microcontroller Basics"**,** Newnes, Elsevier, 2008.
2. Cris Nagy, "Embedded Systems Design using the TI MSP430 Series", Newness, Elsevier, 2003.

Web Links and Video Lectures (e-Resources):

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-c-and-arm-cortex-microcontrollers/
2. https://nptel.ac.in/courses/117104072

Course Outcomes (COs):

1. Ability to understand the concepts of microcontroller and assembly language programming, interrupts, low power modes, Timers and communication interface (PO-1, PO-2, PO-3, PO-5, PO-7, PO-8, PO-9, PO-11, PSO-1, PSO-2, PSO-3)
2. Understand the development environment of MSP430 processor for the assembly programs, Low power modes, Timers and communication interface (PO-1, PO-2, PO-3, PO-5, PO-7, PO-8, PO-9, PO-11, PSO-1, PSO-2, PSO-3)
3. Implement and evaluate the assembly programs (PO-1, PO-2, PO-3, PO-5, PO-7, PO-8, PO-9, PO-11, PSO-1, PSO-2, PSO-3)
4. Implement and evaluate C programs for interrupts, Low power modes and Timers (PO-1, PO-2, PO-3, PO-5, PO-7, PO-8, PO-9, PO-11, PSO-1, PSO-2, PSO-3)
5. Implement and evaluate C programs for communication interface PO-1, PO-2, PO-3, PO-5, PO-7, PO-8, PO-9, PO-11, PSO-1, PSO-2, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory observation/records after the conduction of every experiment	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

Introduction to OOPS & Machine Learning LAB	
Course Code: ETL49	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 30P**
Course Coordinator: Dr. Arvind Kumar G	

Course Content

List of Experiments to be Conducted using Python Idle Shell or Jupiter Note Book

Lab	Topics
1.	Python program to demonstrate Operators and Built-in Functions.
2.	Python program to create a list, tuple, string, dictionary and set.
3.	Program related to the creation of a class and the modification of attributes and methods in a class
4.	Python Program Illustrating Recursion.
5.	Python Program Illustrating the concept of Inheritance.
6.	Python Program Illustrating Operator Overloading.
7.	Python Program Illustrating Polymorphism (Method Overriding)
8.	Program that illustrates the overriding of methods of the parent class by the methods of the child class
9.	Demonstration of Importing Multiple Classes from a User-Defined Module in Python
10.	Preparation of the Dataset and Calculation of the Correlation Coefficient
11.	Spliting DataSet into TrainSet, TestSet and validation for the linear regression model
12.	Build a Simple Linear Regression Model using Python
13.	Implement Logistic Regression Model on Train DataSet in Python
14.	To perform Exploratory Data Analysis on a given dataset in order to understand its structure, distribution, patterns, relationships, and anomalies using statistical and visualization techniques.
15.	CASE STUDIES: Build a Simple Credit Card Fraud Detection Model Using Logistic Regression in Python. Build a Simple Linear Regression Model to Predict the Weight of Students Based on Height in Python. Build a Logistic Regression Model for the Wine Quality Dataset

Prescribed Text Books

1. Wesley J. Chun, Core Python Programming, 2nd Edition, Pearson Education.
2. Reema Thareja, Python Programming Using Problem Solving Approach, Oxford University Press.
3. Mark Lutz, Learning Python, 5th Edition, O'Reilly Media.
4. Sebastian Raschka & Vahid Mirjalili, Python Machine Learning, 3rd Edition, Packt Publishing.

Reference Books

1. Luciano Ramalho, Fluent Python, 2nd Edition, O'Reilly Media.
2. Jake VanderPlas, Python Data Science Handbook, O'Reilly Media.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, O'Reilly Media.
4. Al Sweigart, Automate the Boring Stuff with Python, 2nd Edition, No Starch Press.

Course Outcomes

1. **CO1:** Apply fundamental Python syntax, operators, built-in functions, and data structures to solve basic computational problems. (PO1,2,3,5)
2. **CO2:** Design and implement object-oriented programs using classes, inheritance, polymorphism, operator overloading, and modules in Python.(PO1,2,3,4,5,9)
3. **CO3:** Analyze datasets by performing data preparation, correlation analysis, and exploratory data analysis using appropriate Python libraries.(PO1,2,3,4,5,10)
4. **CO4:** Develop and evaluate basic machine learning models such as linear regression and logistic regression using Python.(PO1,2,3,4,5,10,11)
5. **CO5:** Apply Python programming and machine learning techniques to solve real-world problems through case studies.(PO1,2,3,4,5,6,7,8,9,10,11)

Assessment Tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory observation/records after the conduction of every experiment	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

ADDITIONAL MATHEMATICS – II (For Lateral Entry Diploma Students)	
Course Code: AM41	**Credits:0:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. Veena B N	

Course Content

Unit I

Differential Calculus- I: Partial differentiation, Euler's theorem, total differential coefficient, differentiation of composite and implicit functions.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

Unit II

Differential Calculus- II: Jacobian and Properties. Taylor's theorem for function of two variables, maxima and minima for functions of two variables.

- Pedagogy / Course delivery tools: Chalk and talk
- Links https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030
- https://a.impartus.com/ilc/#/course/59742/295

Unit III

Vector Integration: Line integrals, surface integrals and volume integrals. Green's theorem, Stokes' and Gauss divergence theorem (without proof) and problems, orthogonal curvilinear coordinates.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134/
- Impartus recording: https://a.impartus.com/ilc/#/course/619570/1030

Unit IV

Higher Order Differential Equations: Higher order linear differential equations, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452
- https://a.impartus.com/ilc/#/course/59742/295

Unit V

Probability: Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability- illustrative examples. Bayes theorem – examples.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/107/111107119/
- Impartus recording: https://a.impartus.com/ilc/#/course/283623/703

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. Erwin Kreyszig – Advanced Engineering Mathematics – Wiley Publication, 10th Edition, 2015.

Reference Books:

1. H. K. Dass – Higher Engineering Mathematics – S Chand Publications, 1998
2. B V. Ramana – Engineering Mathematics – Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

Course Outcomes (COs):

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

1. To carryout differentiation of function of several variables. (PO-1,2)
2. Solve the problems related to Jacobians, the extreme values of a function and Taylors series. (PO-1,2)
3. Exhibit the interdependence of line, surface and volume integrals using integral theorems. (PO-1,2)
4. Find the solution of second and higher order ODEs with constant and variable coefficients. (PO-1,2)
5. Solve the problems on conditional probability and Baye's theorem. (PO-1,2)

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

SKILL LAB COURSE III	
Course Code: ETSL3	**Credits:0:0:1**
Pre – requisites: Nil	**Contact Hours:**
Course Coordinator:	

Skill Lab Course: is a 1-credit Lab course with 2 contact hours per week. 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.