CURRICULUM
2023
(Autonomous)
Version 1.0

B. TECH
ELECTRONICS AND COMMUNICATION ENGINEERING

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

Mar Ivanios Vidyanagar, Nalanchira, Thiruvananthapuram – 695 015

June 2024

CURRICULUM and SYLLABI

FOR

B. TECH DEGREE PROGRAMME

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTERS III & IV

2023 SCHEME

(AUTONOMOUS)

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE, Autonomous Institution Affiliated to APJ Abdul Kalam Technological University)

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MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B. TECH DEGREE PROGRAMME

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM
and
SYLLABI for SEMESTERS III &IV

Items	Board of Studies (BoS)	Academic Council (AC)
Date of Approval	11.07.2023	09.08.2023
	04-04-2024	19.06.2024

Sd/-

Head of Department
Chairman, Board of Studies

Sd/-

Principal
Chairman, Academic Council

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

Vision and Mission of the Institution

Vision:

To be an Institution moulding globally competent professionals as epitomes of Noble Values.

Mission:

To transform the Youth as technically competent, ethically sound and socially committed professionals, by providing a vibrant learning ambience for the welfare of humanity.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision and Mission of the Department

Vision:

To be a Centre of Excellence in Electronics and Communication Engineering Education and Research for the service of humanity.

Mission:

To provide quality Engineering Education and to carry out Research in the field of Electronics and Communication Engineering addressing the challenges faced by the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: The graduates of the Programme will have a successful career as Professionals in Industry or as Entrepreneurs, encompassing a broad spectrum of areas related to Electronics and Communication Engineering.

PEO2: They will be able to adapt to the changing needs of Industry and Academia through continuous learning and professional upgrading.

PEO3: They will exhibit social responsibility in their pursuit of technical excellence.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will have the ability to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Design Electronic Circuits and Systems for Communication, Monitoring and Control Applications.

PSO2: Demonstrate the knowledge, in Electronics, Signal processing, Embedded Systems and Communication Engineering, required for providing technical solutions to real world problems

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.TECH. PROGRAMME IN ELECTRONICS AND COMMUNICATION ENGINEERING

For the students admitted from 2023-24

SCHEDULING OF COURSES

i) Knowledge Segments and Credits

Every course of BTech Programme is placed in one of the nine categories as listed in table below. No semester shall have more than six lecture-based courses and two laboratory courses, and/or drawing/seminar/project courses in the curriculum.

Sl. No.	Category	Category Code	Total credits
1	Humanities and Social Sciences including Management Courses	HSC	9
2	Basic Science Courses	BSC	26
3	Engineering Science Courses	ESC	21
4	Programme Core Courses	PCC	72
5	Programme Elective Courses	PEC	18
6	Institute Elective Courses	IEC	6
7	Project Work, Seminar, Comprehensive Course Viva Voce and Internship	PWS	15
8	Mandatory Student Activities (P/F)	MSA	3
	Total Mandatory Credits		**170**
	Value Added Courses (Optional) – Honours/Minor	VAC	15

ii) Semester-wise Credit Distribution

Semester	***I***	***II***	***III***	***IV***	***V***	***VI***	***VII***	***VIII***	***Total***
Credits for Courses	***19***	***22***	***23***	***21***	***22***	***22***	***24***	***14***	***167***
Credits for Activities	*3*								***3***
Total Credits									***170***
Value Added Courses (Optional) – Honours / Minor									***15***
Total Credits									***185***

SEMESTER I						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL10A	Linear Algebra and Calculus	3-1-0-0	4	4
B	BSC	23PYL10A	Engineering Physics	3-1-0-0	4	4
D	ESC	23ESB10D	Problem Solving and Programming in C	2-1-2-0	5	4
E	ESC	23ESL10J	Basics of Electrical Engineering A	2-0-0-0	4	2
		23ESL10L	Basics of Electronics Engineering	2-0-0-0		2
G	ESC	23ESL1NA	Environmental Science	2-0-0-0	2	1*
S	BSC	23PYP10A	Engineering Physics Lab	0-0-2-0	2	1
T	ESC	23ESP10B	Electrical and Electronics Workshop	0-0-2-0	2	1
TOTAL					**23**	**19**

**Not to be considered for Grade/GPA/CGPA. Pass or Fail Only*

SEMESTER II						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL10B	Vector Calculus, Differential Equations and Transforms	3-1-0-0	4	4
B	BSC	23CYL10A	Engineering Chemistry	3-1-0-0	4	4
C	ESC	23ESB10A	Engineering Graphics	2-0-2-0	4	3
D	ESC	23ESB10G	Python Programming	2-0-2-0	4	3
E	PCC	23ECL10A	Network Theory	3-1-0-0	4	4
G	HSC	23HSJ1NB	Professional Communication	2-0-0-2	4	1*
S	BSC	23CYP10A	Engineering Chemistry Lab	0-0-2-0	2	1
T	ESC	23ESB10P	Manufacturing and Construction Practices B	1-0-2-0	3	2
TOTAL					**29**	**22**

**Not to be considered for Grade/GPA/CGPA. Pass or Fail Only*

SEMESTER III						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL20A	Partial Differential Equation and Complex Analysis	3-1-0-0	4	4
B	PCC	23ECL20A	Analog Circuits	3-1-0-0	4	4
C	PCC	23ECL20B	Solid State Devices	3-1-0-0	4	4
D	PCC	23ECJ20C	Logic Circuit Design	2-1-0-1	4	4
E	ESC	23ESL00A	Design Engineering	2-0-0-0	2	2
G	HSC	23HSL2NA	Professional Ethics	2-0-0-0	2	1*
S	PCC	23ECP20A	Analog Circuits Lab	0-0-3-0	3	2
T	PCC	23ECP20B	Logic Circuit Design Lab	0-0-3-0	3	2
M	VAC		Minor Course	3-0-0-0/ 2-1-0-0	3	3
TOTAL					**26/29**	**23/26**

**Not to be considered for Grade/GPA/CGPA. Pass or Fail Only*

SEMESTER IV						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL20C	Probability, Random Processes and Numerical Methods	3-1-0-0	4	4
B	PCC	23ECL20D	Linear Integrated Circuits	3-1-0-0	4	4
C	PCC	23ECL20E	Signals and Systems	3-1-0-0	4	4
D	PCC	23ECJ20F	Microcontroller based system design	3-0-2-1	6	5
E	HSC	23HSL2NB	Universal Human Values-II	2-1-0-0	3	1*
G	ESC	23ESL2NC	Industrial Safety Engineering	2-1-0-0	3	1*
S	PCC	23ECP20C	Linear Integrated Circuits Lab	0-0-3-0	3	2
M/H	VAC		Minor/Honours Course	3-0-0-0/ 2-1-0-0	3	3
TOTAL					**27/30/33**	**21/24/27**

**Not to be considered for Grade/GPA/CGPA. Pass or Fail Only*

SEMESTER V						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	PCC	23ECL30A	Analog and Digital Communication	3-1-0-0	4	4
B	PCC	23ECL30B	Digital Signal Processing	3-1-0-0	4	4
C	PCC	23ECL30C	Electromagnetic Field Theory	3-1-0-0	4	4
D	PEC	23ECL31X	Program Elective I	3-0-0-0/ 2-1-0-0/	3	3
E	HSC	23HSL00A	Management for Engineers	3-0-0-0	3	3
S	PCC	23ECP30A	Communication Lab	0-0-3-0	3	2
T	PCC	23ECP30B	Digital Signal Processing Lab	0-0-3-0	3	2
M/H	VAC		Minor/Honours Course	3-0-0-0/ 2-1-0-0	3	3
TOTAL					**24/27/30**	**22/25/28**

SEMESTER VI						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	PCC	23ECL30D	Control Systems	3-1-0-0	4	4
B	PCC	23ECJ30E	VLSI Circuit Design	3-1-2-0	6	5
D	PEC	23ECL32X	Program Elective II	3-0-0-0/ 2-1-0-0	3	3
E	IEC	23IEL31X	Institute Elective I	3-0-0-0	3	3
F	HSC	23HSL30A	Business Economics and Accountancy	3-0-0-0	3	3
T	PWS	23ECS38A	Seminar	0-0-4-0	4	2
U	PWS	23ECJ38B	Mini Project	0-0-3-0	3	2
M/H	VAC		Minor/Honours Course	3-0-0-0/ 2-1-0-0	3	3
TOTAL					**26/29/32**	**22/25/ 28**

SEMESTER VII						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	PCC	23ECL40A	Information Theory and Coding	3-1-0-0	4	4
B	PCC	23ECL40B	Wireless Communication	3-0-0-0	3	3
C	PCC	23ECL40C	Computer Networks	3-0-0-0	3	3
D	PEC	23ECL43X	Program Elective III	3-0-0-0 2-1-0-0	3	3
E	IEC	23IEL42X	Institute Elective II	3-0-0-0 2-1-0-0	3	3
T	PWS	23ECV48A	Comprehensive Course Viva	0-0-2-0	2	1
U	PWS	23ECJ48A	Project	0-0-10-0	10	5
		23ECI48A	Internship*			
S	PCC	23ECP40A	Advanced Communication Lab	0-0-3-0	3	2
M/H	VAC		Minor/Honours Course	0-1-0-6/ 3-1-0-0	3	3
TOTAL					**31/34/37**	**24/27/30**

** Students can opt for Internship either in S7 or S8. However, in S7, the internship can be permitted only if there are no pending Programme/Course requirements in the semester, that need to be completed in College in the offline mode, such as laboratory sessions.*

SEMESTER VIII						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	PEC	23ECL44X	Program Elective IV	3-0-0-0/ 2-1-0-0	3	3
B	PEC	23ECL45X	Program Elective V	3-0-0-0/ 2-1-0-0	3	3
C	PEC	23ECL46X	Program Elective VI	3-0-0-0/ 2-1-0-0	3	3
U	PWS	23ECJ48B	Project	0-0-10-0	10	5
		23ECI48B	Internship*			
M/H	VAC		Minor/Honours Course	0-0-0-6	6	3
TOTAL					**25/31**	**14/17**

MINOR BASKETS

Semester	BASKET-I EMBEDDED SYSTEMS AND APPLICATIONS				BASKET-II ARTIFICIAL INTELLIGENCE FOR SIGNAL PROCESSING			
	Course Code	**Course**	**L-T-P-J**	**Credit**	**Course Code**	**Course**	**L-T-P-J**	**Credit**
S3	23ECL2MA	Electronic Circuits	2-1-0-0	3	23ECL2MC	Introduction to Multidimensional Data	2-1-0-0	3
S4	23ECL2MB	Microcontrollers	2-1-0-0	3	23ECL2MD	Machine Learning for data processing	2-1-0-0	3
S5	23ECL3MA	Embedded System Design	3-0-0-0	3	23ECL3MC	Deep Learning	2-1-0-0	3
S6	23ECL3MB	Design for IoT	3-0-0-0	3	23ECL3MD	Computational tools for AI	2-1-0-0	3
S7	23ECJ4MA	Mini Project	0-0-6-0	3	23ECJ4MB	Mini Project	0-0-6-0	3
S8	23ECJ4MA	Mini Project	0-0-6-0	3	23ECJ4MB	Mini Project	0-0-6-0	3

MINOR BASKETS (cont…)

Semester	BASKET III ROBOTICS				BASKET IV BIOMEDICAL ENGINEERING			
	Course Code	Course	L-T-P-J	Credit	Course Code	Course	L-T-P-J	Credit
S3	23ECL2 ME	Fundamentals of Robotics	3-0-0-0	3	23ECL2 MG	Fundamentals of Biomedical E ngineering	3-0-0-0	3
S4	23ECL2 MF	Introduction to Industrial Automation	2-1-0-0	3	23ECL2 MH	Assistive Technologies	3-0-0-0	3
S5	23ECL3 ME	Vision System	3-0-0-0	3	23ECL3 MG	Medical Devices Engineering	3-0-0-0	3
S6	23ECL3 MF	Artificial Intelligence for Robotics	3-0-0-0	3	23ECL3 MH	Bio Signal and Image Processing	3-0-0-0	3
S7	23ECJ4 MC	Mini Project	0-0-6-0	3	23ECJ4 MD	Mini Project	0-0-6-0	3
S8	23ECJ4 MC	Mini Project	0-0-6-0	3	23ECJ4 MD	Mini Project	0-0-6-0	3

HONOURS BASKETS

Semester	GROUP I VLSI AND EMBEDDED SYSTEMS				GROUP II COMMUNICATION				GROUP III SIGNAL PROCESSING			
	Course Code	Course	L-T-P-J	Credit	Course Code	Course	L-T-P-J	Credit	Course Code	Course	L-T-P-J	Credit
S4	23ECL 2HB	Nanoelectronics	3-0-0-0	3	23ECL 2HD	Random Process and Applications	2-1-0-0	3	23ECL 2HF	Wavelet Transform and Applications	2-1-0-0	3
S5	23ECL 3HA	FPGA based System Design	3-0-0-0	3	23ECL 3HC	Detection and Estimation Theory	3-0-0-0	3	23ECL 3HE	DSP System Design	3-0-0-0	3
S6	23ECL 3HB	Electronics Design and Automation	3-0-0-0	3	23ECL 3HD	Design and Analysis of Antennas	3-0-0-0	3	23ECL 3HF	Multirate Signal Processing	2-1-0-0	3
S7	23ECL 4HA	RF MEMS	3-0-0-0	3	23ECL 4HB	MIMO and Multiuser Communication Systems	3-0-0-0	3	23ECL 4HC	Computational tools for Signal Processing	2-1-0-0	3
S8	23ECJ 4HA	Mini Project	0-0-6-0	3	23ECJ 4HB	Mini Project	0-0-6-0	3	23ECJ 4HC	Mini Project	0-0-6-0	3

SEMESTER III

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MAL20A	PARTIAL DIFFERENTIAL EQUATION AND COMPLEX ANALYSIS	BSC	3	1	0	0	4	2023

i. COURSE OVERVIEW

This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomenaand has got application across all branches of engineering. The basic theory of functions of a complex variable, residue integration and conformal transformation are discussed.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO1	Solve partial differential equations.	Apply
CO2	Use appropriate methods to solve one dimensional wave equation and heat equation.	Apply
CO3	Solve problems using analyticity of complex functions	Apply
CO4	Find the image of regions under conformal mapping	Apply
CO5	Find complex integrals using Cauchy's formulas to compute several kinds	Apply

iii. SYLLABUS

Partial differential equations: Formation of partial differential equations, Solutions of a partial differential equations, Linear equations of the first order, Method of separation of variables.

One dimensional wave equation-derivation and solution -One dimensional heat equation, derivation and solution

Complex Differentiation: Analytic functions, Cauchy-Riemann equations, harmonic functions, Conformal mappings- standard mappings, Linear fractional transformation.

Complex integration: Line integrals in the complex plane, Contour integrals, Cauchy integral theorem, Cauchy Integral formula

Taylor's series and Laurent's series, zeros of analytic functions, singularities, Residues, Cauchy Residue theorem, Evaluation of definite integral using residue theorem

iv (a) TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,2016

(b) REFERENCES

1. J. Stewart, Essential Calculus, Cengage, 2nd Edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition 2012

v. COURSE PLAN

Module	Contents	Hours
I	Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration, Linear equations of the first order- Lagrange's linear equation, Non-linear equations of the first order - Charpit's method Boundary value problems, Method of separation ofvariables.	**12**
II	One dimensional wave equation- vibrations of a stretched string, Derivation. Solution of wave equation using method of separation of variables, Fourier series solution of boundary value problems involving wave equation, D'Alembert's solution of the wave equation One dimensional heat equation, derivation. Solution of the heat equation using method of separation of variables, Fourier series solutions of boundary value problems involving heat equation- Laplace's equations - Derivation and solution by method of separation of variables.	**13**

III	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations-harmonic functions, finding harmonic conjugate-Conformal mappings- mappings of w=z^2, w=e^z,w=1/z , $w = sinz$	**12**
IV	Complex integration, Line integrals in the complex plane, Basic properties, first evaluation method, second evaluation method, use of representation of a path-Contour integrals, Cauchy integral theorem (without proof) on simply connected domain, on multiply connected domain (without proof). Cauchy Integral formula (without proof), Cauchy Integral formula for derivatives of an analytic function Taylor's series and Maclaurin series.	**11**
V	Laurent's series (without proof)-zeros of analytic functions, singularities, poles, removable-singularities, essential singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem-Residue integration of real integrals –integrals of rational functions of $cos\theta$ and $sin\theta$, integrals of improper integrals of the form ∫_(-∞)^∞ f(x)dx with no poles on the real axis. (∫_A^B f(x)dx whose integrand become infinite at a point in the interval of integration is excluded from the syllabus)	**12**
	Total Hours	**60**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL20A	ANALOG CIRCUITS	PCC	3	1	0	0	4	2023

i. COURSE OVERVIEW

This course aims to develop the skill of design and analysis of various analog circuits using discrete electronic components and devices.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Design various RC circuits, Clipping, Clamping and biasing circuits.	Apply
CO 2	Analyse Common Source amplifier, Multistage MOSFET amplifier, Cascode amplifier.	Apply
CO 3	Analyse CG and CD configuration of MOSFET	Apply
CO 4	Analyse various Feedback amplifiers and Oscillators	Apply
CO 5	Explain the different types of Power amplifiers and voltage regulators	Understand

iii. SYLLABUS

Wave Shaping circuits- Differentiator, Integrator, First Order High pass and low pass RC circuits, Diode clipping and clamping circuits.

MOSFET-Characteristics, Biasing and Small signal analysis of CS configuration.

Analysis of CS stage with current source load, CS stage with diode-connected load, Source degenerated amplifier. Analysis of CG and CD configuration.

Multistage amplifiers – effect of cascading on gain and bandwidth, cascode amplifier, Feedback amplifiers, Power amplifiers.

Audio frequency and high frequency oscillators and Regulated power supplies.

iv (a) TEXT BOOKS

1. Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013
2. Millman J. and C. Halkias, Integrated Electronics, 2/e, McGraw-Hill, 2010
3. Robert Boylestad and L Nashelsky, Electronic Devices and Circuit Theory, 11/e Pearson, 2015

(b) REFERENCES

1. Neamen D., Electronic Circuits – Analysis and Design, 3/e, TMH, 2007
2. Razavi B., Fundamentals of Microelectronics, Wiley, 2015
3. Rashid M. H., Microelectronic Circuits – Analysis and Design, Cengage Learning, 2/e, 2011
4. David A Bell, "Electronic Devices and Circuits", Oxford University Press, 2008.

v. COURSE PLAN

Module	Contents	Hours
I	Wave shaping circuits: First order RC differentiating and integrating circuits, First order RC low pass and high pass filters. Diode Clipping circuits – Positive, negative and biased clipper. Diode Clamping circuits – Positive, negative and biased clamper.	11
II	MOS device and characteristics, MOSFET biasing: Need, operating point, DC load line, biasing circuits and configurations of MOSFET. MOSFET amplifier - CS amplifier and its frequency response, Small signal analysis of CS amplifier.	11
III	Analysis of CS stage with current source load and CS stage with diode-connected load. Analysis of Source degenerated amplifier. Analysis of CG and CD configuration. Multistage amplifiers using MOSFET – effect of cascading on gain and bandwidth, cascode amplifier.	14
IV	Feedback amplifiers: Properties of positive and negative feedback on gain, frequency response and distortion. Analysis of the four basic feedback topologies. RC Coupled amplifier. Oscillators: Classification, criterion for oscillation, RC phase shift oscillator, Hartley and Crystal	12

	oscillator. (working principle and design equations of the circuits; analysis of RC phase shift oscillator only required)	
V	Power amplifiers: Classification, Transformer coupled class A power amplifier, push pull class B and class AB power amplifiers, complementary-symmetry class B and Class AB power amplifiers, efficiency and distortion (no analysis required) Linear Regulated power supplies: Principle of Linear Regulated power supplies, Shunt voltage regulator, series voltage regulator.	**12**
	Total Hours	**60**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL20B	SOLID STATE DEVICES	PCC	3	1	0	0	4	2023

i. COURSE OVERVIEW

The course offers a comprehensive overview of the physics, principles, and applications of various semiconductor devices. Scaling concepts provide insight into the miniaturization trends and challenges in the semiconductor industry.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Apply the concepts of equilibrium carrier concentration and excess carriers to interpret semiconductor physics.	Apply
CO 2	Summarize the carrier transport mechanisms in semiconductors.	Understand
CO 3	Analyze the operation of diodes and bipolar junction transistors under different biasing conditions.	Apply
CO 4	Describe the principle of operation and characteristics of MOS devices.	Understand
CO 5	Discuss scaling and short-channel effects in MOSFETs.	Understand

iii. SYLLABUS

Semiconductor classifications, Fermi Dirac distribution, Equilibrium concentration of electrons and holes, Excess carriers in semiconductors, Concept of Quasi Fermi levels.

Carrier transport mechanisms in semiconductors - drift and diffusion current density, Einstein relation, Continuity, and steady-state diffusion equations.

PN junction diode –Graphical representation of carrier concentration, potential,electric field, and charge density. Derivation of contact potential, Equilibrium depletionwidth, Energy band diagrams, Derivation of ideal diode current.
Bipolar junction transistor - Current components, Base width modulation. Metal Semiconductor Contacts-basic concepts.

Metal Oxide Silicon System - Working of ideal MOS capacitor, Derivation of threshold voltage, Real MOS capacitor. MOSFET- structure, operation, and characteristics, drain current equation.

MOSFET scaling - Short channel effects. Introduction to Multi-gate FETs (MuGFETs).

iv (a) TEXT BOOKS

1. Ben Streetman and Sanjay Banerjee, Solid State Electronic Devices, Pearson Education, 7th Edn., 2014.
2. Sung Mo Kang, CMOS Digital Integrated Circuits: Analysis and Design, McGraw-Hill, Third Ed., 2016
3. Donald A. Neamen, Semiconductor Physics and Devices - Basic Principles, McGraw Hill, 4th Edn., 2021.

(b) REFERENCES

1. Pierret, Semiconductor Devices Fundamentals, Pearson, 2006
2. S.M. Sze, Physics of Semiconductor Devices, John Wiley & Sons, 3rd Edn., 2008.
3. Achuthan, K N Bhat, Fundamentals of Semiconductor Devices, 1e, McGraw Hill,2015
4. Jan M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005

v. COURSE PLAN

Module	Contents	Hours
I	**Semiconductor classification** - Elemental and compound, Intrinsic and extrinsic, Energy band diagrams, Direct and indirect bandgap semiconductors. Fermi Dirac distribution, Fermi level, Equilibrium concentration of electrons and holes, Derivation of mass action law. **Excess carriers in semiconductors**– Generation and transient decay of excess carriers, Concept of Quasi Fermi levels.	**14**
II	**Carrier transport mechanisms in semiconductors** – Derivation of drift current density, Concept of mobility, Variation of mobility with temperature and doping, High field effect, Hall Effect. Derivation of diffusion current density, Einstein relation. Continuity and steady-state diffusion equations, Diffusion length.	**13**
III	**PN junction diode** - Working, Distribution of carrier concentration, potential, electric field, and charge density	**13**

	(Graphical representation). Derivation of contact potential, Equilibrium depletion width, Energy band diagrams, Minority carrier distribution of forward biased PN junction, Derivation of ideal diode current (Ideal diode equation). **Bipolar junction transistor** - Modes of operation, Current components, Performance parameters, Base widthmodulation. **Metal Semiconductor contacts** - Ohmic and Schottky Contacts (no analysis required).	
IV	**Metal Oxide Silicon System** -Working and energy band diagrams of ideal MOS capacitor at equilibrium, accumulation, depletion, inversion, and strong inversion, Derivation of threshold voltage. Energy band diagram of real MOS capacitor and concept of flat band voltage. **Metal Oxide Semiconductor Field Effect Transistor (MOSFET)** - Structure and working, Drain characteristics and transfer characteristics. Derivation of drain current equation (Square law model).	**11**
V	**MOSFET scaling** – need for scaling, constant voltage scaling and constant field scaling. **Short channel effects** - DIBL and threshold voltage variations, Velocity Saturation, Hot carrier effects, Impact ionisation, Punch through. Subthreshold conduction, Channel length modulation. Introduction to Multi-gate FETs (MuGFETs).	**9**
	Total Hours	**60**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECJ20C	LOGIC CIRCUIT DESIGN	PCC	2	1	0	1	4	2023

i. COURSE OVERVIEW

The course aims at providing an idea about the digital circuits and the design of different functions effectively using basic building blocks.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Use the knowledge of number systems in operations relevant to logic circuits	Apply
CO 2	Design combinational circuits and sequential circuits	Apply
CO 3	Develop Verilog codes for logic circuits	Apply
CO 4	Design finite state machines.	Apply
CO 5	Explain different types of logic families and programmable logic circuits.	Understand

iii. SYLLABUS

Number Systems and Codes

Binary and hexadecimal number systems and arithmetic operations, binary codes, Signed number representation Fixed and floating point numbers.

Boolean postulates and logic gates – Boolean expressions, rules of Boolean algebra, SOP/ POS forms, Minimization of Boolean expressions.

Combinational logic circuits: adders/subtractors, code converters, comparators, multiplexers, demultiplexers, decoders, and encoders

Introduction to Verilog modelling techniques.

Sequential logic circuits - Latches and flip-flops, Characteristic Tables/ Equation, Excitation Table, Timing diagrams.

Application of Flip-flops – Counters – Registers, Shift registers, Design of synchronous counters.

Implementing sequential logic circuits using flip-flops in Verilog.

Finite state machines – Design of random sequence generators, Analysis, Mealy type and Moore – type Sequential circuits, conversion, analysis.

TTL, ECL, CMOS - Electrical characteristics of logic gates – TTL inverter - circuit description and operation; CMOS inverter – circuit, description, and operation; NAND in

TTL and CMOS, NAND and NOR in CMOS.

Programmable logic circuits: read-only memory, programmable read-only memory (ROM/PROM), programmable logic devices (PLD), programmable logic arrays (PLA), and field programmable gate arrays (FPGA)

iv (a) TEXT BOOKS

1. Morris Mano, Digital Design, Prentice Hall of India,6 /e, 2013.
2. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2007.
3. Samir Palnikar,Verilog HDL: A Guide to Digital Design and Synthesis, Sunsoft Press, 2003.

(b) REFERENCES

1. Ronald J Tocci, Digital Systems, Pearson Education, 11/e,2010.
2. Anand Kumar, Fundamentals of Digital Circuits, 4/e, 2016.
3. Wakerly J.F., Digital Design: Principles and Practices, Pearson India,4/e, 2008
4. Thomas L Floyd, Digital Fundamentals, Pearson Education, 11/e, 2018.

v. COURSE PLAN

Module	Contents	Hours
I	**Number Systems and Codes:** Number representations and conversions between bases - Binary and hexadecimal number systems, binary codes, Representation and arithmetic operation of unsigned/signed numbers; Fixed- and floating-point numbers. **Logic Gates, Boolean postulates and laws** Logic Gates and Functions, De-Morgan's Theorems, Principle of Duality, Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS), Canonical forms, Karnaugh maps, Minimization of Boolean expressions.	14
II	**Combinational logic circuits**: adders/subtractors, code converters, comparators, multiplexers, demultiplexers, decoders, and encoders **Introduction to Verilog Modelling techniques** Basics of verilog -- basic language elements: identifiers, data objects, scalar datatypes, operators. Modelling in verilog, Implementation of gates/ combinational logic circuits with simple verilog codes.	8

III	**Sequential logic circuits** - Latches and flip-flops, S-R, JK and Master-Slave JK, D and T flip-flops, Characteristic Tables/ Equation, Excitation Table, Timing diagrams. **Application of Flip-flops** – Counters – Asynchronous/ Synchronous counters, Ring/ Johnson Counters, Registers, Shift registers, Design of synchronous counters. Implementing sequential logic circuits using flip-flops in Verilog.	14
IV	**Finite state machines** - State behaviour of synchronous sequential circuits – State diagrams, state tables, Design of random sequence generators, State tables reduction and design, Mealy-type and Moore-type sequential circuits, Conversion, Analysis.	14
V	**Logic Families -** types and comparison, Electrical characteristics of logic gates, TTL inverter - circuit description and operation; CMOS inverter – circuit, description and operation; Structure and operations of TTL and CMOS gates; NAND in TTL and CMOS, NAND and NOR in CMOS. **Programmable logic circuits**: Programmable logic devices (PLD), programmable logic arrays (PLA), and field programmable gate arrays (FPGA)	10
	Total Hours	**60**

It is mandatory that a course project shall be undertaken by a student for this subject. Evaluations will be performed on the project and upon successful completion a brief report must be submitted by the student.

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignment and Course Project	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESL00A	DESIGN ENGINEERING	ESC	2	0	0	0	2	2023

i. COURSE OVERVIEW

Goal of this course is to expose the students to the fundamental principles of design engineering. Students are required to utilize design thinking as a crucial and pertinent approach to learning, reflecting its significance and relevance in contemporary contexts. The course also focuses on familiarizing the students with the concepts of innovative idea generation and presentation along with its market viability and business model.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Demonstrate the ability to effectively apply the principles of the design process in solving real-world engineering challenges.	Apply
CO 2	Analyse user needs and frame well-defined problem statements	Analyse
CO 3	Create innovative ideas to solve real-world problems by applying the principles of Design Thinking	Create
CO 4	Explain the concepts of Modular design, Ergonomics and Aesthetics to address design challenges	Understand
CO 5	Create a pitch deck and deliver a presentation that effectively communicates an innovative idea.	Create

iii. SYLLABUS

Defining a Design Process-: Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Empathize: Understanding User Needs, Define- Framing the Problem. Translating empathy findings into actionable problem statements.

Ideate: Brainstorming, Steps in Brain Storming: Divergent-Convergent Thinking and Questioning. Prototype: Inexpensive prototypes to quickly explore and iterate on ideas.

Test: Gathering feedback from real users through interactions.

Design Engineering Concepts: Modular Design and Life Cycle Design Approaches. Bio-mimicry, Aesthetics and Ergonomics in Design. Design for Production, Use, and Sustainability.

Product Viability and Business Model- Value Proposition, Market Opportunity, Cost-Revenue Relationship, Technology and Implementation, Competitive Analysis, Traction and Milestones.

iv (a) TEXT BOOKS

1. Yousef Haik, Sangarappillai Sivaloganathan, Tamer M. Shahin, Engineering Design Process, Third Edition, Cengage Learning, January 2017.
2. Michael Lewrick, Patrick Link, Larry Leifer, Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems, Wiley Publications, June 2018
3. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods, Wiley Publications, April 2020
4. A Osterwalder, Value Proposition Design: How to Create Products and Services Customers Want, Wiley Publications, October 2014

(b) REFERENCES

1. Dr. Amitkumar Goudar, The Secrets of Design Thinking Mindset: More Tools And Techniques To Enhance Your Design Thinking Skill, Clever Fox Publishing, October 2023
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving, Penguin Random House India Private Limited, 2020
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business; Revised, Updated edition, March 2019
4. Don Norman , The Design of Everyday Things, Basic Books; 2 edition November 2013
5. Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

v. COURSE PLAN

Module	Contents	Hours
I	Design Process: - Defining a Design Process-: Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design. Practical Exercise: Need Identification Case studies. How to define a Problem Statement. Present an idea using the stages of the Design Process.	6
II	Design Thinking Approach: -Introduction to Design Thinking. Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Empathize: Understanding User Needs, Gathering meaningful insights from users. Define: Framing the Problem. Translating empathy findings into actionable problem statements. Utilizing tools such as problem statements, point-of-view statements, and user personas. Practical Exercise: Analyse user needs and frame well-defined problem statements	6
III	Ideate: Brainstorming, Steps in Brain Storming: Divergent-Convergent Thinking and Questioning. Prototype: Low-Fidelity Prototyping: Building rough, inexpensive prototypes using materials like paper, cardboard, or digital wireframes to quickly explore and iterate on ideas. Test: Gathering feedback from real users through interviews, surveys, or usability tests to evaluate prototypes and refine designs. Practical Exercise: Design Thinking in a Team Environment. Create innovative ideas to solve real-world problems by applying the principles of Design Thinking	6
IV	Design Engineering Concepts: Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry, Aesthetics and Ergonomics in Design. Design for Production, Use, and Sustainability. Design Communication: Communicating Designs Graphically, Communicating Designs Orally and in Writing. Practical Exercise: Apply the concepts of Modular design, Ergonomics and Aesthetics to address design challenges	6
V	Product Viability and Business Model: Customer Segments, Value Proposition, Market Opportunity, Cost- Revenue Relationship,	6

	Technology and Implementation, Competitive Analysis, Traction and Milestones. Practical Exercise: Create a Pitch deck and make a presentation of the idea generated along with its business model.	
	Total Hours	**30**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Evaluation – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignment	:	15 marks
Assessment through Test	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Evaluation (Design Presentation)	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 01
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EVALUATION (60 Marks)

The end semester evaluation for Design and Engineering will consist of a group presentation, with a maximum group size of 5 students. Students will be required to apply the fundamentals of design thinking learned during the course to identify and address a problem statement. The problem statement shall be selected from the pool of problems provided by various Government departments and industries listed in initiatives such as Smart India Hackathon or Young Innovators Programme or their own solution to a potential regional real-world problem.

Mark Distribution for Design Presentation (60 Marks):

Understanding of User Needs and Problem Statement: 10 marks

Demonstrating a clear understanding of user needs and articulating a well-defined problem statement.

Creativity and Innovation in Solution Design: 10 marks

Presenting innovative and creative solutions that address the identified problem statement effectively.

Product Market Fit: 10 Marks

Evaluating the market potential and ensuring alignment between the proposed solution and market demands.

Clarity and Effectiveness of Presentation: 10 marks

Delivering a clear and engaging presentation that effectively communicates the proposed solution and its benefits.

Competitive Analysis: 10 Marks

Conducting a thorough analysis of competitors and market dynamics to inform strategic decision-making.

Individual and Teamwork: 10 Marks

Assessing individual contributions to the presentation as well as the effectiveness of teamwork and collaboration within the group.

This evaluation format provides students with an opportunity to apply their knowledge and skills in design thinking to real-world problems, while also evaluating their ability to work effectively in teams and deliver compelling presentations.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23HSL2NA	PROFESSIONAL ETHICS	HSC	2	0	0	0	1	2023

i. COURSE OVERVIEW

The objective of this course is to create an awareness on engineering ethics and human values. The course also aims to instill moral and social values, loyalty and also to learn to appreciate the rights of others

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Identify different skills required in personal life.	Understand
CO 2	Apply well-defined techniques to cope with emotion and stress.	Apply
CO 3	Solve moral and ethical problems in professional life.	Apply
CO 4	Explain the core values that shape the ethical behaviour of a professional.	Understand
CO 5	Solve moral and ethical problems through explorations and assessment by established experiments.	Apply
CO6	Apply the knowledge of human values and social values to contemporary ethical values and global issues	Apply

iii. SYLLABUS

Meaning and significance of life skills. Life skills identified by WHO: Self- awareness,Empathy, Decision making, problem solving, interpersonal relationship, coping with stress, coping with emotion. Self-awareness: Definition, need for self-awareness; Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback Stress Management: Stress, reasons and effects, stress diaries, the four A's of stress management, techniques, approaches: action- oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude training

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques

Life skills for Professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, motivation, personality development, IQ, EQ and SQ Responsibilities and Rights.– Collegiality and loyalty- Managing conflict-Respect for authority- Collective bargaining- Confidentiality-Role of confidentiality in moral integrity- conflicts of interest-occupational crime-professional rights-employee right-IPR discrimination

Engineering Ethics & Professionalism- Senses of Engineering Ethics - Variety of moral issues-Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory-Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action- Self-Interest-Customs and Religion-uses of ethical theories

Engineering as social Experimentation- Engineering as Experimentation-Engineers as responsible Experimenters- Codes of Ethics- Plagiarism-A balanced outlook on law- Challenger case study-Bhopal gas tragedy

Global Ethical Issues- Multinational Corporations- Environmental Ethics-Business Ethics-Computer Ethics- Role in Technological Development-Engineers as Managers-Consulting Engineers- Engineers as Expert witnesses and Advisors-Moral leadership

iv (a) TEXT BOOKS

1. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, 1st Edition, 2016.
2. Life Skills for Engineers, Complied by ICT Academy of Kerala, McGraw Hill Education (India) Private Ltd., 2016
3. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012
4. R S Naagarazan, A textbook on professional ethics and human values, New age international (P) limited, New Delhi,2006.

(b) REFERENCES

1. Barun K.Mitra, Personality Development & Soft Skills, Oxford Publishers, 3rd impression, 2017.
2. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2014.
3. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
4. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics
5. Concepts and cases, Wadsworth Thompson Learning, United states,2005.

v. COURSE PLAN

Module	Contents	Hours
I	Overview of Life Skills: Meaning and significance of life skills Life skills identified by WHO: Self- awareness, Empathy, Decision making, problem solving, interpersonal relationship, coping with stress, coping with emotion. Self-awareness: Definition, need for self-awareness; Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback. Stress Management: Stress, reasons and effects, stress diaries, the four A's of stress management, techniques, Approaches: action- oriented, emotion- oriented, acceptance- oriented, resilience, Gratitude Training, Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques	5
II	Life skills for Professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, motivation, personality development, IQ, EQ, and SQ Collegiality and loyalty, Managing conflict, Respect for authority Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest-Occupational crime, Professional rights, Employee right, IPR, Discrimination	5
III	Senses of Engineering Ethics, Variety of moral issues, Types of Inquiry- Professionalism, Models of professional roles, Theories about right action-Self-Interest-Customs and Religion, Uses of Ethical Theories	6
IV	Engineering as Experimentation, Engineers as responsible Experimenters-Codes of Ethics, Plagiarism, A balanced outlook on law-Case study)	8
V	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics-Role in Technological Development, Moral leadership- Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	6
	Total Hours	30

vi. ASSESSMENT PATTERN

Continuous Assessment : Group Project – 50: 50

Continuous Assessment		
Attendance	:	5 marks
Case Study	:	30 marks
CAT	:	15 marks
(Test to be conducted for 30 marks and need to be converted to 15 Marks)		
Total Continuous Assessment	:	**50 marks**
Group Project with Presentation and Report	:	**50 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 01
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECP20A	ANALOG CIRCUITS LAB	PCC	0	0	3	0	2	2023

i. COURSE OVERVIEW

The course aims to help the students gain practical skills in designing analog circuits using discrete electronic components and to analyze the transient and frequency response. The course also helps the students acquire expertise in using simulation tools for analyzing analog circuits.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Demonstrate the functioning of analog circuits using discrete components, and analyze the transient and frequency responses.	Analyze
CO 2	Use EDA tools effectively for analyzing the transient and frequency response of analog circuits.	Apply

iii. SYLLABUS

Design of analog circuits using discrete components: Study of RC circuits – High pass and low pass filters, RC integrating and differentiating circuits, design of clipping and clamping circuits, RC coupled amplifier, Audio and Radiofrequency oscillators, and Transistor series voltage regulator.

Simulation of analog circuits using EDA tool

High Pass filters and Low Pass filters, RC integrating and differentiating circuits, Clipping and clamping circuits, Cascade amplifier, MOSFET amplifier, Cascode amplifier, Feedback amplifiers, and Power amplifiers.

iv. REFERENCES

1. Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013
2. Neamen D., Electronic Circuits – Analysis and Design, 3/e, TMH, 2007

v. COURSE PLAN

Expt	Contents	Hours
	Part A **Design of analog circuits using discrete components**	
I	**Study of RC circuits** a) Obtain the frequency response of RC high Pass and low pass filters, and determine the cut-off frequency for each case. b) Study the effect of RC time constants and inputs, on the transient response of RC differentiator and Integrator	**6**
II	**Design of wave shaping circuits:** Observe the transient response and transfer characteristics of clipping and clamping circuits	**6**
III	**RC-coupled common emitter amplifier** a) Study the effect of bypass capacitor on the gain and frequency response of RC coupled amplifier b) Study the effect of load resistance on the gain	**3**
IV	**AF and RF oscillators** a) Analysis of RC phase shift Oscillator b) Analysis of the Hartley oscillator	**6**
V	**Transistor series voltage regulator:** Design a transistor series voltage regulator and plot the load and line regulation characteristics	**3**
	Part B **Simulation of analog circuits using the EDA tool**	
I	Study of EDA tool, different types of analysis a) Simulate the frequency response of RC high-pass and low-pass filter circuits b) Transient analysis of RC differentiator and Integrator circuits	**3**
II	Simulate the transient response and transfer characteristics of clipping and clamping circuits.	**3**
III	Transient and AC analysis of Cascade amplifier	**3**
IV	Transient and AC analysis of common source MOSFET amplifier	**3**
V	AC analysis of Cascode amplifier	**3**
VI	Analysis of current-series feedback amplifier	**3**

VII	Analysis of Class B and Class AB power amplifiers	**3**
	Total Hours	**45**

vii. ASSESSMENT PATTERN

Continuous Assessment : Final Assessment – 60 : 40

Continuous Assessment		
Attendance	:	5 marks
Continuous Assessment in Lab (Lab work + Evaluation)	:	55 marks
Total Continuous Assessment	:	**60 marks**
Final Assessment	:	**40 marks**
TOTAL	:	**100 marks**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECP20B	LOGIC CIRCUIT DESIGN LAB	PCC	0	0	3	0	2	2023

i. COURSE OVERVIEW

The course aims to help the students gain practical skills in using digital ICs for designing and building logic circuits. The course also helps the students acquire skills to simulate the output of digital circuits using hardware description language like Verilog, and to implement the digital designs on FPGA board.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO1	Demonstrate the functioning of various combinational and sequential circuits using ICs	Apply
CO2	Apply an industry-compatible hardware description language to simulate logic circuits	Apply
CO3	Implement logic circuits on FPGA boards	Apply

iii. SYLLABUS

Logic Circuit Design using digital ICs: Realization of SOP and POS expressions using logic gates, Design and implementation of half adders and full adders, BCD adder using IC7483, Realization of the combinational circuits using multiplexer and demultiplexer ICs, Design of asynchronous and synchronous counters.

Verilog simulation and Synthesis of digital circuits on FPGA board: Realization of logic gates, adders, multiplexers and demultiplexers, flipflops, counters, ring, and Johnson counters, and BCD to seven-segment decoder.

iv. REFERENCES

1. Thomas L Floyd, Digital Fundamentals, Pearson Education, 11/e, 2018.
2. Morris Mano, Digital Design, Prentice Hall of India,6/e, 2013.
3. Blaine C. Readler, Verilog by Example: A Concise Introduction for FPGA Design. United States, Full Arc Press, 2011.
4. Samir Palnikar, Verilog HDL: A Guide to Digital Design and Synthesis, Sunsoft Press, 2/e, 2003.

v. COURSE PLAN

Expt	Contents	Hours
	Part A **Logic Circuit Design using digital ICs**	
I	Realization of SOP and POS expressions using logic gates	**4**
II	Design of half adder and full adder using logic gates	**3**
III	BCD adder using IC 7483	**3**
IV	Realization of combinational circuits using Multiplexer and Demultiplexer ICs	**3**
V	Design of 3-bit asynchronous counters (up, down, and Mod-N)	**4**
VI	Design of Mod-N synchronous counters using digital ICs	**4**
	Part B **Verilog simulation and Synthesis of logic circuits on FPGA board**	
I	Familiarization with the FPGA Board Realization of Logic Gates in Verilog and its implementation on the FPGA board.	**4**
II	Adders in Verilog: Develop Verilog modules for half adders and full adders, and implement them on the FPGA board	**3**
III	Multiplexer and Demultiplexer: Develop Verilog modules for multiplexer and demultiplexer, and implement them on the FPGA board	**4**
IV	Simulation and Synthesis of Flipflops: Develop Verilog modules for SR, JK, and D flipflops and implement them on the FPGA board	**3**
V	Simulation and Synthesis of counters (a) Develop Verilog modules for the simulation of a 4-bit up, down, and Mod-N counters (b) Implement the counters on the FPGA board	**4**
VI	Simulation and Synthesis of Ring and Johnson counters: Develop a Verilog module for the simulation of 4-bit ring counter and Johnson counter and implement them on the FPGA board	**3**

VII	BCD to seven-segment decoder in FPGA	**3**
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : Final Assessment – 60 : 40

Continuous Assessment		
Attendance	:	5 marks
Continuous Assessment in Lab (Lab work + Evaluation)	:	55 marks
Total Continuous Assessment	:	**60 marks**
Final Assessment	:	**40 marks**
TOTAL	:	**100 marks**

SEMESTER IV

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MAL20C	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	BSC	3	1	0	0	4	2023

i. COURSE OVERVIEW

This course introduces students to the modern theory of probability and statistics, covering important models of random variables and analysis of random processes using appropriate time and frequency domain tools. A brief course in numerical methods familiarizes students with some basic numerical techniques for finding roots ofequations, evaluating definite integrals solving systems of linear equations and solvingordinary differential equations which are especially useful when analytical solutions arehard to find.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO1	Identify the different discrete random experiments and find the probabilities of their occurrence	Apply
CO2	Identify the different continuous random experiments and find the probabilities of their occurrence	Apply
CO3	Examine random processes using autocorrelation, power spectrum and Poisson process model as appropriate.	Apply
CO4	Find roots of equations, definite integrals and interpolating polynomial on given numerical data using standard numerical techniques	Apply
CO5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations.	Apply

iii. SYLLABUS

Discrete random variables and their probability distributions, Binomial distribution, Poisson distribution, Discrete bivariate distributions, Expectation -multiple random variables.

Continuous random variables and their probability distributions - Uniform, exponential and normal distributions, Continuous bivariate distributions, Expectation-multiple random variables, i.i.d random variables and Central limit theorem.
Random processes and its classification, wide sense stationary (WSS) processes, power

spectral density of WSS processes, Poisson process.

Roots of equations- Newton-Raphson, regula falsi methods. Interpolation-finite differences, Newton's forward and backward formula, Newton's divided difference method, Lagrange's method. Numerical integration.

Solution of linear systems - Gauss-Siedal and Jacobi iteration methods. Curve fitting-method of least squares, Solution of ordinary differential equations-Euler and Classical Runge-Kutta method of second and fourth order, Adams- Moulton predictor-correction method

iv (a) TEXT BOOKS

1. Jay L. Devore, Probability and Statistics for Engineering and the Sciences,8th edition, Cengage, 2012
2. Oliver C. Ibe, Fundamentals of Applied Probability and Random Processes,Elsevier, 2005
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10 th Edition, JohnWiley & Sons, 2016.

(b) REFERENCES

1. Hossein Pishro-Nik, Introduction to Probability, Statistics and Random Processes, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. V.Sundarapandian, Probability, Statistics and Queueing theory, PHI Learning, 2009
3. Gubner, Probability and Random Processes for Electricaland Computer Engineers,Cambridge University Press,2006.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36Edition, 2010.

v. COURSE PLAN

Module	Contents	Hours
I	Discrete random variables and probability distributions, expected value, mean and variance (discrete) Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	12

II	Continuous random variables and probability distributions, expected value, mean and variance (continuous) Uniform, exponential and normal distributions, mean and variance of these distributions Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem. Friction: Introduction Sliding Friction- Coulomb's Laws of Friction- Wedge Friction- Analysis of Single Bodies- Analysis of Connected Bodies (With Numerical Examples)	**12**
III	Random process -definition and classification, mean, autocorrelation. WSS processes its autocorrelation function and properties. Power spectral density Poisson process, inter-distribution of arrival time. combination of independent Poisson processes(merging) and subdivision (splitting) of Poisson processes	**12**
IV	Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences- Numerical Integration- Trapezoidal rule and Simpson's 1/3rd rule with proof. (derivation of other methods/ formulae not required in this module)	**12**
V	Solution of linear systems -Gauss-Siedal method, Jacobi iteration method Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares. Linear Correlation- Basic ideas of Multiple regression. Solution of ODE-Euler, Modified Euler and Classical Runge - Kutta methods of second and fourth order ,Adams-Moulton predictor-corrector methods	**12**
	Total Hours	**60**

vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL20D	LINEAR INTEGRATED CIRCUITS	PCC	3	1	0	0	4	2023

i. COURSE OVERVIEW

Goal of this course is to develop the skill to design circuits using operational amplifiers and other linear ICs for various applications.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO1	Explain the Op Amp fundamentals and differential amplifier configurations	Understand
CO2	Design operational amplifier circuits for various applications	Apply
CO3	Design Oscillators and active filters using op amps	Apply
CO4	Explain the working and applications of timer, VCO and PLL ICs	Understand
CO5	Describe the working of Voltage regulator IC's and Data converters	Understand

iii. SYLLABUS

Operational amplifiers (Op Amps):741 Op Amp, Block diagram, Ideal op-amp parameters, typical parameter values for 741, Equivalent circuit, Open loop configurations, .

Differential amplifier: DC and AC Analysis, CMRR, input and output resistance, Concept of current mirror.

Op-amp with negative feedback: Virtual ground Concept, analysis of practical inverting and non-inverting amplifiers for closed loop gain, Input Resistance and Output Resistance

Op-amp applications: Summer, Voltage Follower, Integrator, Differentiator, Precision rectifiers, Comparators, Schmitt Trigger, Log and antilog amplifiers.

Op-amp Oscillators and Multivibrators: Phase Shift and Wien-bridge Oscillators, Triangular waveform generators, Astable and monostable multivibrators.

Active filters: Comparison with passive filters, Concept of Low Pass, High pass, Band Pass and Band Reject filters, First and second order low pass and High pass active filters,

Frequency response.

Timer and VCO: Timer IC 555- Functional diagram, Astable and monostable operations. Voltage Controlled Oscillator,

Phase Locked Loop – Basic building blocks, Operation, Lock and capture range, PLL IC 565, Applications of PLL.

Voltage Regulators: Fixed and Adjustable voltage regulators, IC 723, Current boosting, Current limiting, Short circuit and Fold-back protection.

Digital to Analog converters-Weighted resistor type and R-2R Ladder type.

Analog to Digital Converters-Flash type and Successive approximation type.

iv (a) TEXT BOOKS

1. Roy D. C. and S. B. Jain, Linear Integrated Circuits, 5/e, New Age International, 2018

(b) REFERENCES

1. Salivahanan S. and V. S. K. Bhaaskaran, Linear Integrated Circuits, 3/e, Tata McGrawHill, 2018
2. Gayakwad R. A., Op-Amps and Linear Integrated Circuits, 4/e, Prentice Hall, 2010
3. R.F. Coughlin & Fredrick Driscoll, Operational Amplifiers & Linear Integrated Circuits, 6/e, PHI, 2001
4. David A. Bell, Operational Amplifiers & Linear ICs, 3/e, Oxford University Press, 2011

v. COURSE PLAN

Module	Contents	Hours
I	**Operational amplifiers (Op Amps)**: The 741 Op Amp, Block diagram, Ideal op-amp parameters, typical parameter values for 741, Equivalent circuit, Open loop configurations, Voltage transfer curve, Frequency response curve. **Differential Amplifiers**: Differential amplifier using BJT, DC Analysis of DIBO differential amplifier, AC analysis- differential and common mode gains, CMRR, input and output resistance. **Concept of current mirror**: two-transistor current mirror, Wilson and Widlar current mirrors.	12

II	**Op-amp with negative feedback:** Virtual ground Concept; analysis of practical inverting and non-inverting amplifiers for closed loop gain, Input Resistance and Output Resistance. **Op-amp applications:** Summer, Voltage Follower-loading effects, Differential and Instrumentation Amplifiers, Voltage to current and Current to voltage converters, Integrator, Differentiator, Precision rectifiers, Comparators, Schmitt Triggers, Log and antilog amplifiers.	12
III	**Op-amp Oscillators and Multivibrators**: Phase Shift and Wien-bridge Oscillators, Triangular waveform generator, Astable and monostable multivibrators. **Active filters**: Comparison with passive filters, Concept of Low Pass, High pass, Band Pass and Band Reject filters. First and second order low pass and High pass active filters, Frequency response.	12
IV	**Timer and VCO:** Timer IC 555- Functional diagram, Astable and monostable operations. Basic concepts of Voltage Controlled Oscillator. **Phase Locked Loop** – Basic building blocks, Operation, Lock and capture range, PLL IC 565, Applications of PLL.	12
V	**Voltage Regulators:** Fixed and Adjustable voltage regulators, IC 723 – Low voltage and high voltage configurations, Current boosting, Current limiting, Short circuit and Fold-back protection. **Data Converters:** Digital to Analog converters, Weighted resistor type and R-2R Ladder type. Analog to Digital Converters: Flash type and Successive approximation type.	12
	Total Hours	**60**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL20E	SIGNALS AND SYSTEMS	PCC	3	1	0	0	4	2023

i. COURSE OVERVIEW

This course aims to lay the foundational aspects of signals and systems in both continuous time and discrete time, in preparation for more advanced subjects in digital signal processing, image processing, communication theory and control systems.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Apply the properties and operations of signals to classify them.	Apply
CO 2	Apply the properties of systems to classify them.	Apply
CO 3	Apply various transform techniques for representing a signal in frequency domain	Apply
CO 4	Analyze the response of systems using time domain and frequency domain techniques	Apply
CO 5	Apply sampling theorem to discretize continuous time signals	Apply

iii. SYLLABUS

Elementary signals, Continuous time and Discrete time signals – classification and properties

Continuous time and discrete time systems – properties, classifications, LTI Systems, convolution sum, convolution integral.

Frequency domain representation Continuous time signals and systems – laplace transform, Continuous time Fourier transform, System analysis -Transfer function, Stability, Causality, Frequency response

Sampling - Theorem, aliasing, reconstruction of signals

Frequency domain representation Discrete time signals and systems – Z transform, Inverse Z transform, Discrete time Fourier transform, System analysis -Transfer function, Stability, Causality, Frequency response

iv (a) TEXT BOOKS

1. Alan V. Oppenheim and Alan Willsky, Signals and Systems, PHI, 2/e, 2018
2. Simon Haykin, Signals & Systems, John Wiley, 2/e, 2003

(b) REFERENCES

1. Anand Kumar, Signals and Systems, PHI, 3/e, 2013.
2. Mahmood Nahvi, Signals and System, Mc Graw Hill (India), 2015.
3. P Ramesh Babu, R Anandanatarajan, Signals and System, 4th Ed, 2014
4. Rodger E. Ziemer, Signals & Systems - Continuous and Discrete, Pearson, 4/e,2013

v. COURSE PLAN

Module	Contents	Hours
I	Elementary Signals, Classification and representation of continuous time and discrete time signals – even & odd, periodic & aperiodic, energy & power, symmetric & asymmetric, causal & non-causal and memory & memoryless Signal operations – Folding, Shifting, Scaling and combinations.	10
II	Continuous time and discrete time systems – Properties and Classification – linearity, time-invariance and causality Representation of Continuous time and discrete time systems Continuous time LTI systems and convolution integral. Discrete time LTI systems and convolution sum. Impulse response - Stability and causality of LTI systems. Correlation between signals, Orthogonality of signals.	14
III	Frequency domain representation of continuous time signals and Systems. Review of Laplace Transform, ROC of Transfer function, Properties of ROC, Stability and causality conditions. Continuous time Fourier transform and its properties. Convergence and Gibbs phenomenon Relation between Fourier and Laplace transforms. Analysis of LTI systems using Laplace and Fourier transforms. Concept of transfer function, Frequency response, Magnitude and phase response.	12
IV	Sampling of continuous time signals, Sampling theorem for lowpass signals, aliasing, reconstruction of signals Frequency domain representation of discrete time signals.	12

	Z transform, ROC, Inverse transform, properties, Unilateral Z transform.	
V	Discrete time Fourier transform (DTFT) and its properties. Analysis of discrete time LTI systems using DTFT. Magnitude and phase response. Relation between DTFT and Z-Transform, Analysis of discrete time LTI systems using Z transform, Transfer function. Stability and causality using Z transform.	12
	Total Hours	**60**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECJ20F	MICROCONTROLLER BASED SYSTEM DESIGN	PCC	3	0	2	1	5	2023

i. COURSE OVERVIEW

The course is intended at providing both theoretical and practical knowledge of Microcontrollers that would enable students to design systems for a variety of applications. The main focus is on 8051 microcontroller and interfaces. An introduction to ARM is also provided. In addition, an exposure to advanced controllers, related industry relevant hardware and software platforms are included.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Explain the architecture of 8051 microcontroller and ARM processor	Understand
CO 2	Write assembly/C programs for 8051/ARM	Apply
CO 3	Design interfaces for 8051	Apply
CO 4	Design microcontroller-based systems for different applications	Apply
CO 5	Use hardware and software tools for the development of microcontroller-based systems	Apply

iii. SYLLABUS

General Computer Architecture- Functional units of a computer, Von Neumann and Harvard computer architectures, CISC and RISC architectures. Computer general Architectures, Processor operation; Intel **8051 Architecture**-Architecture Block diagram of 8051, Internal RAM organisation, Program Status Word (PSW), Addressing Modes

8051 Programming- 8051 Signals/Pin configuration, Familiarisation of IDE, Instruction Set, Programing in Assembly/C

8051 Interfacing–Serial Data Communication, Interfacing of LCD display, switches/keyboard, Stepper Motor, DAC and ADC

ARM Processor Architecture- ARM core dataflow model, registers, current program status register, Pipeline, pipeline hazards, Exceptions, Interrupts and Vector Table, Core extensions. **Introduction to ARM programming**- Instruction set, Assembly/C programming

Advanced controllers- Microcontroller modules/boards, Interrupt and timer controllers, Communication interfaces

iv. (a) TEXT BOOKS

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson Education, Second edition, 2011.
2. Steve Furber, ARM System-on-Chip Architecture, Second Edition,

   PEARSON, 2016.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay

   The 8051 Microcontroller: A Systems ApproachPearson, 2012.
4. Stallings W., Computer Organisation and Architecture, 10/e, Pearson Education, 2018.

(b) REFERENCES

1. David A. Patterson, John L. Hennessy, Computer organization and design: The Hardware/Software interface, Morgan Kaufmann Publishers,5/e, 2014.
2. ARM System Developers Guide, Andrew N Sloss, Dominic Symes and Chris Wright, Elsevier, 1st Edition, 2008
3. Matt Richardson, Shawn Wallace, Wolfram Donat, Getting Started with Rasberry Pi:Getting to know the Inexpensive ARM-Powered Linux Computer, 4/e, Mumbai Shroff Publishers. 2021

v. COURSE PLAN

Module	Contents	Hours
I	Functional units of a computer, Von Neumann and Harvard computer architectures, CISC and RISC architectures. Processor operation-instruction cycle. Intel 8051 microcontroller family, features. Architecture Block diagram of 8051. Internal RAM organisation, Program Status Word (PSW), Addressing Modes. 8051 Signals/Pin configuration, Familiarisation of IDE, Instruction Set, Programming in Assembly/C	8
	Laboratory Experiments: IDE, Assembly Instructions/ Registers/Ports/Memory, Addition/Subtraction of 16 bit data, Sorting (Ascending/Descending) of data, Code conversion – Hex to Decimal/ASCII to Decimal and vice versa.	8

II	8051 Timers/Counters; 8051 interrupts; Serial Data Communication; Interfacing of LCD display, switches/keyboard, Stepper Motor, DAC and ADC	12
	Laboratory Experiments: Display interface, Digital sensors/switch/keyboard interface, Analog Sensors, ADC Interface	16
III	ARM Processor Fundamentals-ARM core dataflow model, registers, current program status register, Pipeline, pipeline hazards, Exceptions, Interrupts and Vector Table, Core extensions.	9
IV	Introduction to the ARM Instruction set- Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, Conditional Execution. ALP programming.	10
	Laboratory Experiments:: Stepper motor and DC motor interface	4
V	Advanced controllers/boards/modules/interfaces for different applications – STM32, LPC 2148, Interrupt controllers, RTC, USB, UART, I2C, SPI, SSP controllers, watch dog timers and othersystem control units.	6
	Laboratory Experiments:: Familiarisation of Advanced Controllers boards/ modules/interfaces	2
	Total Hours	**75**

Sl No.	**Laboratory Program/Experiment**	**No of hours**
1	IDE, Assembly Instructions/Registers/Ports/Memory	2
2	Addition/Subtraction of 16 bit data	2
3	Sorting (Ascending/Descending) of data	2
4	Code conversion – Hex to Decimal/ASCII to Decimal and vice versa.	2
5	Display interface	4
6	Digital sensors/switch/keyboard interface	4
7	Analog Sensors, ADC Interface	4
8	DAC Interface, Waveform Generation	4
9	Stepper motor and DC motor interface	4
10	Familiarisation of advanced controllers, hardware/software platforms and modules	2
	Total	**30**

Sl No.	Micro-project Activity*	Hours
1	Problem identification, beneficiary, solutions	2
2	System level functional representation of the solution	1
3	Scaled down version for implementation of proof of concept	1
4	Hardware design	2
5	Software design	2
6	Hardware/software implementation	4
7	Testing and modifications	3
	Total	**15**

* More hours are to be utilised outside the above schedule for completion of the macro-project.

The project hour is to be allotted along with the lab hour for managing the lab and project work in an effective manner.

vi. ASSESSMENT PATTERN

Continuous Assessment : End semester Examination – 60 : 40

Continuous Assessment		
Attendance	:	5 marks
Project Work	:	15 marks
Assessment through Tests	:	20 marks
Assessment of Lab Work	:	10 marks
Lab Exam	:	10 marks
Total Continuous Assessment	:	**60 marks**
End Semester Examination	:	**40 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

No. of tests: 02
Maximum Marks: 30
Test Duration: 1 ½ hours
Topics: 2 ½ modules (approx.)

viii. END SEMESTER EXAMINATION

Maximum Marks: 40
Exam Duration: 2 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23HSL2NB	UNIVERSAL HUMAN VALUES-II	HSC	2	1	0	0	1	2023

i. COURSE OVERVIEW

The objectives of the course are:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS'
2. To facilitate the development of a holistic perspective among students towards life and profession leading towards a value-based living
3. To help the students to have ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with nature

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Understand themselves and their surroundings (family, society, nature)	Understand
CO 2	Show more commitment towards what they have learnt about Human values, Human relationship and Human society	Understand
CO 3	Apply Sustainable Solutions to Real Life problems based on the learning gained through Universal Human Values	Apply

iii. SYLLABUS

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education Purpose and motivation for the course, recapitulation from Universal Human Values-I

Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

(Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking)

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' - happiness and physical facility Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health. (Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease) Understanding Harmony in the Family and Society- Harmony in Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

(Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives)

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence,

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all pervasive space Holistic perception of harmony at all levels of existence.

(Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.)

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 Sum up.

(Include practice Exercise and Case studies will be taken up in Practice (tutorial) Sessions. Eg. To discuss the conduct as an engineer or scientist etc.)

iv (a) TEXT BOOKS

1. Gaur P.R, Asthana R, Bagaria G.P, Human Values and Professional Ethics (2ndrevised Edition) Excel Books, New Delhi, 2019
2. Tripathi A. N, Human Values, New Age Intl. Publishers, New Delhi, 2004.

(b) REFERENCES

1. Gaur R.R, Sangal R, Bagaria G P 'A Foundation Course in Human Values and Professional Ethics (Teacher Manual), Excel Books, 1stEdition 2013.
2. Parichaya E K, Nagaraj A,Jeevan Vidya, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Mohandas K Gandhi, 'The story of my Experiments with Truth' Fingerprint,2009
4. Cecile Andrews 'Slow is Beautiful',New Society Publishers,2006.
5. Kumarappa J C Economy of Permanence, Sarva Seva Sangh Prakashan, 2017.

v. COURSE PLAN

Module	Contents	Hours
I	Understanding Value Education Self-Exploration as the process for Value Education Sharing about oneself, Understanding Happiness and Prosperity-the Basic Human Aspirations Right, Understanding, Relationship, Physical Facility Exploring Human Consciousness Happiness and Prosperity- Current Scenario Method to Fulfil the Basic Human Aspirations Exploring Natural Acceptance	9
II	Understanding Human Being as the Co-existence of the Self and Body, Distinguishing between the needs of the Self and the Body Exploring the difference of needs of the Self and the Body, The Body as an Instrument of the Self Understanding Harmony in the Self Exploring Sources of Imagination in the Self Harmony of the Self with the Body Programme to ensure Self Regulation and Health Exploring Harmony of Self with the Body	9
III	Harmony in the Family-the Basic unit of Human Interaction Values in the Human-to-Human Relationship, 'Trust' –the foundation Value in Relationship Exploring the feeling of Trust	

	'Respect'- as the Right Evaluation Exploring the feeling of Respect Understanding Harmony in the Society Vision for the Universal Human Orden, Exploring Systems to fulfil Human Goal	**9**
IV	Understanding Harmony in the Nature, Interconnectedness, self regulation and Mutual Fulfilment among the four orders of Nature Exploring the four orders of Nature, Realizing Existence as Co-Existence at all Levels, The Holistic Perception of Harmony in Existence Exploring Co-Existence in Existence	**9**
V	Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct Exploring Ethical Human Conduct, ABasis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Exploring Humanistic Models in Education, Holistic Technologies, Production Systems and Management-Models- Typical Case Studies, Strategies for Transition towards Value –based Life and Profession Exploring Steps of Transition towards Universal Human Order	**9**
	Total Hours	**45**

vi ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Continuous Assessment Test (1 No)	:	10 marks
Assignment/Project/Case study etc	:	20 marks
Self-Assessment	:	5 marks
Peer Assessment (Peer Assessment can be done on group-wise basis by dividing the class into suitable groups.)	:	5 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

Assessment Pattern can be modified (if needed), subject to the approval of the Committees Concerned

vii) END SEMESTER EXAMINATION

The End semester examination will be conducted by the faculty. The examination will be for three hours and 60 marks.

viii) MODE OF CONDUCT OF COURSE

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions. In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. Depending on the nature of topics, worksheets, home assignment and/or activity are included.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESL2NC	INDUSTRIAL SAFETY ENGINEERING	ESC	2	1	0	0	1	2023

i. COURSE OVERVIEW

Goal of this course is to expose the students to the concepts of safety engineering and identify possible safety requirements. It introduces students to the various safety equipment and precautions. After this course, students will be able to recognize similar safety problems in real-world situations and respond accordingly

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Explain the theories of accident causation and preventive measures of industrial accidents.	Understand
CO 2	Explain personal protective equipment, its selection, safety performance & indicators and importance of housekeeping	Understand
CO 3	Explain the various hazards and associated safety measures in construction industries.	Understand
CO 4	Explain various hazards associated with different machines and mechanical.	Understand
CO 5	Explain different hazard identification tools in different industries with the knowledge of different types of chemical hazards	Understand

iii. SYLLABUS

Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management.

Personal protection in the work environment, Types of PPEs, Personal protective equipment respiratory and non-respiratory equipment. Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Typical industrial models and methodology.

Introduction to construction industry and safety issues in construction Safety in various

construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative

Trauma Disorders. Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding, Material Handling equipment-operation & maintenance. . Hearing Conservation Program in Production industries.

Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - Hazard and Operability study (HAZOP)) –Hazardous properties of chemicals, Material Safety Data Sheets

iv (a) TEXT BOOKS

1. R.K Jain, Industrial Safety, Health and Environment management systems, Khanna Publications, 2000.
2. Paul S V, Safety management System and Documentation training Programme handbook, CBS Publication, 2000.
3. Krishnan, N.V. Safety management in Industry. Jaico Publishing House, New Delhi, 1997.

(b) REFERENCES

1. Guidelines for Process Hazards Analysis (PHA, HAZOP), Hazards Identification, and Risk Analysis, CRC Press 2018.
2. Safety Management System And Documentation Training Programme Handbook, CBS Publishers & Distributors, 2019
3. Hazards and Safety in Process Industries - Case Studies, CRC Press, 2021

v. COURSE PLAN

Module	Contents	Hours
I	Need for safety- Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation - Safety, organization- objectives, types, functions, Role of management - supervisors, workers, unions, government and voluntary agencies in safety. Safety policy- Safety Officer-responsibilities, authority. Safety committee need, types, advantages.	9
II	Personal protection in the work environment -Types of PPEs, Personal protective equipment-respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance - Frequency rate, severity rate, incidence rate, activity rate. Housekeeping- Responsibility of management and	9

	employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits.	
III	Introduction to construction - industry and safety issues in construction. Safety in various construction operations – Excavation and filling – Underwater works – Under-pinning & Shoring – Ladders & Scaffolds. Tunneling – Blasting , Demolition – Confined space –Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.	9
IV	Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements- wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.	9
V	Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis. Hazard and Operability study (HAZOP)) – methodology, criticality analysis, corrective action and follow-up. Control of Chemical Hazards- Hazardous properties of chemicals, Material Safety Data Sheets	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 100 : 0

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
Final Examination (Summative)	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. NO END SEMESTER EXAMINATION

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECP20C	LINEAR INTEGRATED CIRCUITS LAB	PCC	0	0	3	0	2	2023

i. COURSE OVERVIEW

This course aims to familiarize students with the Analog Integrated Circuits and Design and implementation of application circuits using basic Analog Integrated Circuits.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Implement various linear circuits using op amp.	Apply
CO 2	Implement various nonlinear circuits using analog ICs	Apply
CO 3	Simulate the analog integrated circuits using simulation tool	Apply

iii. SYLLABUS

Fundamentals of operational amplifiers and basic circuits

Application circuits of 555 Timer/565 PLL

Simulation experiments

iv. REFERENCES

1. Roy D. C. and S. B. Jain, Linear Integrated Circuits, 5/e, New Age International, 2018.
2. M. H. Rashid, Introduction to Pspice Using Orcad for Circuits and Electronics, 3/e, Prentice Hall, 2003

v. COURSE PLAN

Expt	Contents
I	1. Familiarization of Operational amplifiers - Measurement of Op-Amp parameters 2. Inverting and Non inverting amplifier (frequency response) 3. Adder, Integrator and Comparator. 4. Difference Amplifier and Instrumentation amplifier. 5. Schmitt trigger circuit using Op–Amps. 6. Astable and Monostable multivibrator using Op-Amps. 7. Wien bridge oscillator using Op-Amp. 8. RC Phase shift Oscillator.
II	1. Astable and Monostable multivibrator using Timer IC NE555. 2. Study of PLL IC: free running frequency lock range capture range 3. D/A Converters - R-2R ladder circuit.
III	Simulation experiments. 1. Astable and Monostable multivibrator using Op-Amps. 2. RC Phase shift Oscillator. 3. Precision rectifiers using Op-Amp. 4. D/A Converters- R2R ladder circuit.

vi. ASSESSMENT PATTERN

Continuous Assessment : Final Assessment – 60 : 40

Continuous Assessment		
Attendance	:	5 marks
Continuous Assessment in Lab (Lab work + Evaluation)	:	55 marks
Total Continuous Assessment	:	**60 marks**
Final Assessment	:	**40 marks**
TOTAL	:	**100 marks**

MINOR: BASKET I

EMBEDDED SYSTEMS AND APPLICATIONS

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2MA	ELECTRONIC CIRCUITS	VAC	2	1	0	0	3	2023

i. COURSE OVERVIEW

This course aims to develop the skill of design and analysis of various analog circuits using discrete electronic components and ICs.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Design simple circuits using diodes, resistors, and capacitors.	Apply
CO 2	Design amplifier and oscillator circuits.	Apply
CO 3	Explain the working of MOSFETS, Power supplies, D/A and A/D converters	Understand
CO 4	Explain circuits using operational amplifiers and 555 IC.	Understand

iii. SYLLABUS

Wave shaping circuits: Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Clipping circuits - Positive, negative, and biased clipper. Clamping circuits - Positive, negative, and biased clamper.

Amplifiers: RC coupled amplifier – design and working, voltage gain and frequency response.

Feedback in amplifiers - Effect of negative feedback on amplifiers.

Oscillators: Classification, criterion for oscillation, Wien bridge oscillator, Hartley, and Crystal oscillator. (design equations and working of the circuits; analysis not required).

MOSFET- Structure, Enhancement and Depletion types, principle of operation and characteristics. MOSFET Amplifier- Circuit diagram, design and working of common source MOSFET amplifier.

Operational amplifiers: Characteristics of op-amps (gain, bandwidth, slew rate, CMRR, offset voltage, offset current), comparison of ideal and practical op-amp (IC741), Applications of op-amps- adder/summing amplifier, integrator, differentiator, Comparator.

Regulated power supplies: 3 pin regulators-78XX

Integrated circuits: D/A and A/D convertors – important specifications, R-2R ladder type D/A convertors. Flash A/D convertors.

Circuit diagram and working of Timer IC555, astable and monostable multivibrators using 555

iv (a) TEXT BOOKS

1. Boylestad and L Nashelsky, Electronic Devices and Circuit Theory, Pearson, 11/e, 2008.
2. Salivahanan S. and V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 3/e, ` 2008.

(b) REFERENCES

1. David A Bell, Electronic Devices and Circuits, Oxford University Press, 2008.
2. Neamen D., Electronic Circuits, Analysis and Design, 3/e, TMH, 2007.
3. Millman J. and C. Halkias, Integrated Electronics, 2/e, McGraw-Hill, 2011.
4. Ramakant A Gayakwad, Op-Amps and Linear Integrated Circuits, 4/e,PHI, 2000.
5. K.Gopakumar, Design and Analysis of Electronic Circuits, Phasor Books, Kollam, 2013

iv.COURSE PLAN

Module	Contents	Hours
I	Wave shaping circuits: Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Clipping circuits - Positive, negative, and biased clipper. Clamping circuits - Positive, negative, and biased clamper.	9
II	Amplifiers: RC coupled amplifier – design and working, voltage gain and frequency response. Feedback in amplifiers - Effect of negative feedback on amplifiers.	10

	Oscillators: Classification, criterion for oscillation, Wien bridge oscillator, Hartley, and Crystal oscillator. (design equations and working of the circuits; analysis not required).	
III	MOSFET- Structure, Enhancement and Depletion types, principle of operation and characteristics. MOSFET Amplifier- Circuit diagram, design and working of common source MOSFET amplifier.	8
IV	Operational amplifiers: Characteristics of op-amps (gain, bandwidth, slew rate, CMRR, offset voltage, offset current), comparison of ideal and practical op-amp (IC741), Applications of op-amps- adder/summing amplifier, integrator, differentiator, Comparator. Regulated power supplies: 3 pin regulators-78XX	9
V	Integrated circuits: D/A and A/D convertors – important specifications, R-2R ladder type D/A convertors. Flash A/D convertors. Circuit diagram and working of Timer IC555, astable and monostable multivibrators using 555	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2MB	MICROCONTROLLERS	VAC	2	1	0	0	3	2023

i. COURSE OVERVIEW .

This course aims to impart an overview of a microcontroller-based system design and interfacing techniques

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO1	Explain the building blocks of microcomputer / microcontroller system.	Apply
CO2	Apply the knowledge of addressing modes and instructions to develop assembly language programs for 8051 microcontrollers.	Apply
CO3	Interface the various peripheral devices to the 8051-microcontroller using assembly language programming.	Apply
CO4	Develop microcontroller-based applications using Open-Source Embedded Development boards.	Apply
CO5	Explain the architecture of 8051, ATmega-2560 microcontrollers.	Understand

iii. SYLLABUS

Computer Arithmetic and Processor Basics: Functional units of a computer, Von-Neumann and Harvard computer architectures, Processor Architecture – Generalinternal architecture, Address bus, Data bus, control bus. Register set – status register, accumulator, program counter, stack pointer, general purpose registers. Processor operation – instruction cycle, instruction fetch, instruction decode, instruction execute.

8051 Architecture: Block diagram of 8051, Pin configuration, Registers, Internal Memory, Timers, Port Structures, Interrupts, Addressing Modes, Instruction set (brief study of 8051 instruction set).

Programming and Interfacing of 8051: Simple assembly language programs- addition, subtraction, multiplication, and division. Interfacing of LCD display, Keyboard,Stepper Motor, DAC, and ADC - with 8051 and its programming.

Open-SourceEmbeddedDevelopmentBoards-
IntroductiontoATmega2560microcontroller- block diagram and pin description,

Introduction to Arduino Mega 2560 board, Simple applications- Solar tracker, 4- digit 7 segment LED display, Tilt sensor, Home security alarm system, Digital Thermometer, IoT applications.

ARM Based System:

Introduction - ARM family, ARM 7 register architecture. ARM programmer's model. Introduction to Raspberry pi 4 board, Applications- Portable Bluetooth speaker, remote controlled car, Photo Booth, IoT weather station, Home automation centre, Portal Digital eBook Library.

iv (a) TEXT BOOKS

1. Subrata Ghoshal, Computer Architecture and Organization: From 8085toCore 2Duo and beyond, Pearson, 2011.
2. M.A.Mazidi,J.G.MazidiandR.D.McKinlay,"The8051Microcontrollerand Embedded Systems: Using Assembly and C",Pearson Education, Second edition, 2011.
3. Steve Furber, ARM System -on-chip Architecture,PearsonEducation,2001.

(b) REFERENCES

1. Stallings W., Computer Organisation and Architecture,5/e, Pearson Education, 2019.
2. https://www.microchip.com/wwwproducts/en/ATmega2560
3. www.arduino.cc
4. www.raspberrypi.org

v. COURSE PLAN

Module	Contents	Hours
I	**Computer Arithmetic and Processor Basics:** Functional units of a computer, Von Neumann and Harvard computer architectures, Processor Architecture – General internal architecture, Address bus, Data bus, control bus. Register set – status register, accumulator, program counter, stack pointer, general purpose registers. Processor operation – instruction cycle, instruction fetch, instruction decode, instruction execute.	9

II	**8051 Architecture:** Block diagram of 8051, Pin configuration, Registers, Internal Memory, Timers, Port Structures, Interrupts, Addressing Modes, Instruction set (brief study of 8051 instruction set).	**9**
III	**Programming and Interfacing of 8051:** Simple assembly language programs- addition, subtraction, multiplication, and division. Interfacing of LCD display, Keyboard, Stepper Motor, DAC, and ADC -with 8051 and its programming.	**9**
IV	**Open-Source Embedded Development Boards**: Introduction to ATmega 2560 microcontroller - block diagram and pin description, Introduction to Arduino Mega 2560 board, Simple applications- Solar tracker, 4- digit 7 segment LED display, Tilt sensor, Home security alarm system, Digital Thermometer, IoT applications.	**9**
V	**ARM Based System:** Introduction - ARM family, ARM 7 register architecture. ARM programmer's model. Introduction to Raspberry pi 4 board, Applications- Portable Bluetooth speaker, remote controlled car, Photo Booth, IoT weather station, Home automation centre, Portal Digital eBook Library.	**9**
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

MINOR: BASKET II

ARTIFICIAL INTELLIGENCE FOR SIGNAL PROCESSING

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2MC	INTRODUCTION TO MULTIDIMENSIONAL DATA	VAC	2	1	0	0	3	2023

i. COURSE OVERVIEW

This course aims to give an introduction of 1D, 2D and 3D signals and data and its processing in time and frequency domains.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Apply time domain and frequency domain analysis of signals	Apply
CO 2	Apply data visualization techniques	Apply
CO 3	Discuss the basic concepts of speech production and speech analysis	Understand
CO 4	Apply the basic image processing concepts to analyse a 2D discrete signal in time and frequency domain	Apply
CO 5	Describe 3D signals and models for video processing	Understand

iii. SYLLABUS

Introduction to basics of signals, classification, time and frequency domain analysis.

Introduction to data analysis, classification, fundamentals of big data analysis.

Introduction to speech signal processing, production, time and frequency domain analysis.

Fundamentals of image processing, representation, basic steps in image processing.

Fundamentals of video processing, 3D motion models, motion estimation

iv (a) TEXT BOOKS

1. Rabiner and Schafer, Digital Processing of Speech Signals, Prentice Hall, 1978.
2. Minelli M., Chambers M., Dhiraj A., Big Data, Big Analytics: Emerging BusinessIntelligence and Analytic Trends for today's Businesses, Wiley CIO, 2013.
3. Gonzalez Rafel C, Digital Image Processing, Pearson Education, 2009
4. M. Tekalp ,"Digital video Processing", Prentice Hall International
5. A Anand Kumar, "Digital Signal Processing", PHI learning, 2e, 2015.

(b) REFERENCES

1. Nelson Morgan and Ben Gold, Speech and Audio Signal Processing: Processing and Perception Speech and Music, July 1999, John Wiley & Sons, ISBN: 0471351547
2. Douglas O'Shaughnessy, Speech Communications: Human & Machine, IEEEPress, Hardcover 2/e, 1999; ISBN: 0780334493.
3. S Jayaraman, S Esakkirajan, T Veerakumar, Digital image processing, Tata McGraw Hill, 2015
4. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication ",1st edition , PHI

v. COURSE PLAN

Module	Contents	Hours
I	**Introduction to signals:** Elementary signals, classification and representation of signals, time domain and frequency domain analysis (using DFT).	8
II	**Introduction to data:** Data and Relations, Data Visualization, Correlation, Regression, eigenvalues and eigen vectors, Forecasting, Classification and Clustering. Big data Technology: Fundamentals of Big Data, Types. Introduction to data visualization tools.	10

III	**Speech Processing (1D):** Acoustic theory of speech production. Speech Analysis: Speech signal, Short-Time Speech Analysis, Time domain and Frequency domain analysis.	9
IV	**Digital Image Fundamentals (2D):** Image representation, basic relationship between pixels. Image enhancement – spatial and spectral domains. Introduction to image degradation and restoration. Image segmentation. Image morphology.	10
V	**Video Processing (3D):** Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models: 3D motion models, Geometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow	8
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2MD	MACHINE LEARNING FOR DATA PROCESSING	VAC	2	1	0	0	3	2023

i. COURSE OVERVIEW

This course aims to give a detailed study of different machine learning algorithms and the mathematical concepts behind them.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Explain the basics of machine learning and neural networks.	**Understand**
CO 2	Discuss regression and classification theory in machine learning.	**Understand**
CO 3	Apply mathematical methods in machine learning models.	**Apply**
CO 4	Explain supervised and unsupervised learning algorithms and non-metric methods.	**Understand**
CO 5	Summarize ensemble methods, dimensionality reduction, evaluation, model selection.	**Apply**

iii. SYLLABUS

Machine learning paradigms, artificial neural network – perceptron, basics of parameter estimation.
Classification and regression algorithms.
Ensemble models, SVM
Clustering, dimensionality reduction
Classification Performance measures

iv (a) TEXT BOOKS

1. Bishop, C. M. "Pattern Recognition and Machine Learning" Springer, New York, 2e, 2016.

2. Theodoridis, S. and Koutroumbas, K. "Pattern Recognition". Academic Press, San Diego, 4e, 2009.
3. Ethem Alpaydın, "Introduction to Machine Learning (Adaptive Computation and Machine Learning)", 3e, MIT Press, 2014.

(b) REFERENCES

1. Margaret H. Dunham. "Data Mining: introductory and Advanced Topics", Pearson, 2006.
2. Ryszard S. Michalski, Jaime G. Carbonell, and Tom M. Mitchell, "Machine Learning : An Artificial Intelligence Approach", Tioga Publishing Company
3. Mitchell. T, "Machine Learning", McGraw Hill, 1983

v. COURSE PLAN

Module	Contents	Hours
I	Machine learning paradigms-supervised, semi-supervised, unsupervised, reinforcement learning. Introduction to artificial neurons, Perceptron - perceptron algorithm, Neural Network - Multilayer feed forward network, Activation functions (Sigmoid, ReLU, Tanh), Backpropagation algorithm. Basics of parameter estimation - maximum likelihood estimation (MLE) and maximum a posteriori Estimation (MAP).	10
II	Regression - Linear regression with one variable, Linear regression with multiple variables, Logistic regression, gradient descent algorithm and matrix method, basic idea of overfitting in regression. Classification- Introduction to Bayes decision theory, discriminant functions and decision surfaces.	9
III	Ensemble methods: boosting, bagging. Decision trees algorithm ID3, random forest, Bootstrapping. SVM - Introduction, Maximum Margin Classification, soft margin SVM classifier, non-linear SVM, Kernels for learning non-linear functions - polynomial kernel, Radial Basis Function (RBF).	8
IV	Clustering - Similarity measures, Hierarchical Agglomerative Clustering, K-means partitional clustering, Expectation maximization (EM) for soft clustering. Dimensionality reduction: principal component analysis, Fischer's	9

	discriminant analysis.	
V	Classification Performance measures – Confusion matrix, Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve (ROC) and Area Under Curve (AUC) and their significance. Cross Validation, Bias-Variance decomposition. Case Study: Developing an effective machine learning model for a real world classification or a regression problem.	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

MINOR: BASKET III
ROBOTICS

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2ME	FUNDAMENTALS OF ROBOTICS	VAC	3	0	0	0	3	2023

i. COURSE OVERVIEW

The objective of this course is to equip the students with a comprehensive understanding of basics of robots and its application. The course will focus on key areas including sensors & actuators, different robot configurations. The students will be able to understand the basics of fuzzy logic technique and its applications in robotics.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO1	Explain the anatomy, specifications, configurations and applications of Robots	Understand
CO2	Choose the appropriate sensors and actuators for robots	Apply
CO3	Choose the appropriate Robotic configuration and gripper for a particular application	Apply
CO4	Perform the kinematic and dynamic analysis of robots	Apply
CO5	Explain the application of Fuzzy logic control in robots	Apply

iii. SYLLABUS

Robotics; Types of Robots, Anatomy of a robotic manipulator, Robot Configurations, Robot considerations for applications, Robot Applications in different fields.

Sensor- Sensor classification, Criteria for selection of sensors, Different types of sensors, Elements of vision sensor

Actuators for robots- Classification-Electric, Hydraulic, Pneumatic actuators, End effectors and classification, DC motors, DC Servo Motors, Direction control Using H Bridge, Magnetostrictive Actuators, Shape memory tools.

Introduction to Kinematics- Euler's Angle, Translation and Rotation Representation, Homogenous Transformation Matrix, Forward Kinematics , DH Representation

Fuzzy Logic Control- Basic Fuzzy Operations- Operations, Properties, Membership functions, Fuzzification, Defuzzification, Application of Fuzzy Logic in Robotics

iv (a) TEXT BOOKS

1. Introduction to Robotics by S K Saha, McGraw Hill Education, 2nd edition, July 2017.
2. Saeed B Niku, Introduction to Robotics: Analysis Systems and Applications, John Wiley and Sons,2nd edition, 2011.
3. R K Mittal and I J Nagrath, "Robotics and Control", Tata McGraw Hill, New Delhi, 2003.

(b) REFERENCES

1. Introduction to Robotics (Mechanics and control), John.J.Craig, Pearson Education Asia 2002.
2. Ashitava Ghosal, "Robotics-Fundamental concepts and analysis", Oxford University press.
3. Robotics Technology and Flexible Automation, Second Edition, S. R.Deb

v. COURSE PLAN

Module	Contents	Hours
I	**Definitions**- Robots, Robotics; Types of Robots- Manipulators, Mobile Robots-wheeled & Legged Robots, Aerial Robots. **Anatomy of a robotic manipulator**-links, joints, actuators, sensors, controller; degrees of freedom. **Robot configurations**-PPP, RPP, RRP, RRR; features of PUMA manipulator **Robot considerations for an application-** number of axes, work volume, capacity & speed, stroke & reach, Repeatability, Precision and Accuracy, Operating environment, Robot Applications.	9
II	**Sensors**- Introduction, Sensor Characteristics, Selection of sensors, Position sensors, velocity sensors, acceleration sensors, Force sensors; Proximity Sensors Vision system - Elements of vision sensor, image acquisition, image processing.	9
III	**Actuators and drive system**- Introduction; Characteristics of Actuating systems; Comparison of Actuating systems; Hydraulic, Pneumatic actuators; Electric actuators-Stepper motors, DC motors, DC servo motors and their drivers, AC motors. Direction control of DC motors with H bridge, Magnetostrictive Actuators Shape-Memory Type Metals. **End effectors and classifications**.	9

IV	**Introduction to Kinematics**: Position and Orientation of Objects. Rotation. Euler Angles. Rigid Motion Representation using Homogenous Transformation Matrix. Kinematic Modelling: Translation and Rotation Representation, Coordinate Transformation, Forward and Inverse Kinematics. Forward Kinematics-Link Coordinates, Denavit- Hartenberg Representation.	9
V	**Fuzzy Logic Control** – Introduction to Fuzzy Logic; Fuzzy Control; Crisp values vs Fuzzy values; Fuzzy Sets; Fuzzification; Defuzzification; Application of Fuzzy Logic in Robotics.	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2MF	INTRODUCTION TO INDUSTRIAL AUTOMATION	VAC	2	1	0	0	3	2023

i. COURSE OVERVIEW

The course aims to impart knowledge of industrial automation and industrial machinery concepts and terminology.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Explain fundamental concepts of automation	Understand
CO 2	Explain components and hardwares used in industrial automation.	Understand
CO 3	Explain machine systems in industrial automation.	Understand
CO 4	Choose programming language and software tools for industrial automation.	Apply
CO 5	Explain distributed control systems	Understand

iii. SYLLABUS

Automation and Manufacturing, Important Concepts - Analog and Digital Input Electrical Power, Pneumatics and Hydraulics, Safety, Overall Equipment effectiveness. Electrostatic Discharge

Components and Hardware - Controllers, Operator Interfaces, Sensors, Power Control, Distribution, and Discrete Controls, Actuators and Movement, AC and DC Motors, Mechanisms and Machine Elements, Structure and framing

Machine Systems - Conveyors, Indexers and Synchronous Machines, Part Feeders, Robots and Robotics

Software - Programming Software- Programming Concepts, Programming Methodologies, Languages-ALP, PLC Language-Ladder Diagram, Robot Programming

Language, Design Software

Distributed Control System - Advantages of DCS.

iv (a) TEXT BOOKS

1. Frank Lamb, "Industrial Automation Hands-On' , The McGraw Hill 2013
2. S.K. Singh , " Industrial Instrumentation and Control" The McGraw Hill 2010

(b) REFERENCES

1. CD Johnson, "Process control and instrumentation technology" Phi Publication 2005.
2. W Bolton, "Programmable Logic Controllers" Forth Edition, Elsevier Publication 2006
3. E A Parr , " Industrial Control Handbook " first edition, Newnes Publication 1998.
4. Alok Barua, "Fundamentals of industrial instrumentation" Wiley India 2011

v. COURSE PLAN

Module	Contents	Hours
I	**Automation and Manufacturing, Important Concepts -** Analog and Digital, Input and Output (Data), Numbering Systems, Electrical Power, Pneumatics and Hydraulics ,Continuous, Synchronous and Asynchronous Processes, Safety, Overall Equipment effectiveness. Electrostatic Discharge	9
II	**Components and Hardware -** Controllers, Operator Interfaces, Sensors, Power Control, Distribution, and Discrete Controls, Actuators and Movement, AC and DC Motors, Mechanisms and Machine Elements, Structure and framing	9
III	**Machine Systems -** Conveyors, Indexers and Synchronous Machines, Part Feeders, Robots and Robotics - Articulated Robots, SCARA Robots, Cartesian Robots, Parallel Robots, Robot Basics and Terminology, Robot Coordinate Systems	8
IV	**Software** - Programming Software- Programming Concepts, Programming Methodologies, Languages-ALP, PLC Language-Ladder Diagram, Robot Programming Language, Design Software- Analysis Software, Office Software, SCADA and Data Acquisition, Databases and Database Programming, Enterprise Software	10

V	**Distributed Control System -** Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

MINOR: BASKET IV
BIOMEDICAL ENGINEERING

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2MG	FUNDAMENTALS OF BIOMEDICAL ENGINEERING	VAC	3	0	0	0	3	2023

i. COURSE OVERVIEW

1. To introduce basics of biomedical engineering technology
2. To understand the anatomy & physiology of major systems of the body in designing equipment for medical treatments.
3. To impart knowledge about the principle and working of different types of biomedical electronic equipment/devices
4. To Introduce the concept of Bio telemetry and electrical safety

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Explain the generation of bioelectric potential, working of bio potential electrodes and bio medical instrumentational system	Understand
CO 2	Describe Electrocardiography and working of various Therapeutic Equipments used in cardiovascular system	Understand
CO 3	Explain different Blood pressure and Blood flow measurement techniques	Understand
CO 4	Explain the functioning of Human nervous system and EMG measurement	Understand
CO 5	Describe about respiratory system, bio telemetry system and Electrical safety	Understand

iii. SYLLABUS

Introduction to bio-medical instrumentation system-overview of anatomy and physiological systems of the body.

Sources of bio-electric potential- Bioelectric potentials examples, Biopotential electrodes, Bio potential Amplifiers

Heart and cardiovascular system- ECG machine – pacemakers, cardiac defibrillators, heart– lung machine

Measurement of blood pressure: Auscultatory method-oscillometric and ultrasonic non-invasive pressure measurements- Measurement of blood flow.

The human nervous system: Neuron-action potential of brain- types of electrodes, 10-20 electrode system, block diagram of EEG machine, Applications of EEG-applications

Measurement of EMG: block diagram of EMG machine. Applications of EMG

Physiology of respiratory: Respiratory parameters, spirometer, ventilators.

Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine,

Electrical safety– shock hazards from electrical equipment

iv (a) TEXT BOOKS

1. J JCarr and J M Brown, "Introduction to Biomedical Equipment Technology", 4ed, Pearson Education
2. K S Kandpur, "Hand book of Biomedical instrumentation", Tata McGraw Hill 2nd e/d.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, PHI, 2nd Edition, 2004

(b) REFERENCES

1. Barbara Christe, Introduction to Biomedical Instrumentation, Cambridge University Press, 2008.
2. John G Webster, "Medical Instrumentation application and design", 3ed,John Wiley
3. Richard Aston, "Principle of Biomedical Instrumentation and Measurement", Merrill Education/Prentice Hall

v. COURSE PLAN

Module	Contents	Hours
I	Introduction to bio-medical instrumentation system, overview of anatomy and physiological systems of the body. Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Bioelectric potentials examples (ECG, EEG, EMG, ERG, EOG, EGG, etc introduction only.) Biopotential electrodes: Microelectrodes, skin surface electrodes, needle electrodes. Bio potential Amplifiers: Differential and Instrumentation amplifier.	9
II	Heartand cardiovascular system (brief discussion), Electrocardiogram: Generation of ECG, Recording of ECG: lead configurations, Einthoven triangle, ECG machine – Block diagram, Arrhythmias: rate abnormalities, fibrillation. Principle, block schematic diagram and working of: pacemakers, cardiac defibrillators, heart–lung machine	9
III	Measurement of blood pressure: Direct method, Auscultatory method, oscillometric and ultrasonic non-invasive pressure measurements. Measurement of blood flow: Electromagnetic blood flow meters and ultrasonic blood flow meters, plethysmography	9
IV	The human nervous system. Neuron, action potential of brain, brain waves, types of electrodes, 10-20 electrode system, block diagram of EEG machine, Applications of EEG, Evoked potentials- visual, auditory & somatosensory – applications. Electrical activity of muscles- EMG. Measurement of EMG - block diagram of EMG machine. Applications of EMG	9
V	Physiology of respiratory system (brief discussion), Respiratory parameters, spirometer, ventilators. Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG. Electrical safety– physiological effects of electric current – shock hazards from electrical equipment – method of accident prevention	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23EL2MH	ASSISTIVE TECHNOLOGIES	VAC	3	0	0	0	3	2023

i. COURSE OVERVIEW

The objective of this course is to equip the students with a comprehensive understanding of the technologies designed to enhance accessibility and inclusivity for individuals with diverse impairments. The course will focus on key areas, including assistive technology for visual impairment, auditory impairment, cognitive impairment, physical impairment, and the principles of universal design.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Explain the need for inclusion, and classify the sensory aids used to address specific challenges faced by individuals with visual impairment	Understand
CO 2	Classify assistive technologies designed for individuals with hearing/speech impairment	Understand
CO 3	Summarize the assistive technologies designed to facilitate mobility and transportation	Understand
CO 4	Categorize and describe the augmentative and alternative communication systems for disabilities affecting speech, language, and communication	Understand
CO 5	Identify best practice strategies in Universal Design, and the challenges involved in the idea-to-market transition in assistive technology	Apply

iii. SYLLABUS

Introduction to Assistive Technology (AT): Definitions, Indian laws, Inclusive Education and early intervention. AT classification, types of visual impairment,sensory aids for persons with visual improvement

Technologies for hearing/speech impaired: Overview of hearing, hearing aids, Assistive listening devices, Cochlear implants, audiometry, air conduction testing, bone conduction testing, audiometric masking. Case study.

Assistive Technologies for mobility and transportation: Wheelchair classification, Major characteristics of manual and power mobility systems, Smart wheelchairs, Vehicle restraint systems, Vehicle access, modifications in driving.

Augmentative and Alternative Communication (AAC): Disabilities affecting speech, language, and communication, AAC systems – types, options for making

selections in an AAC device, AAC strategies for pre-intentional communicators, Intentional informal communicators, and Intentional formal communicators, Case study.

Universal Design and Access: Need for accessibility, Principles of Universal Design. Designand Redesign Strategy for a barrier-free environment, Accessibility to the built environment, Accessibility for Mainstream Information and Communication Technologies, Idea to Market transition in Assistive Technology.

iv(a) TEXT BOOKS

1. Albert M. Cook, Janice Miller Polgar, Assistive Technologies – Principles and Practices, Elsevier, 5th edition, 2016
2. Shirly G., Akila Surendran, et al., Perspectives: Assistive Technologies in Limited Resource settings, National Institute of Speech and Hearing, 1st edition, 2022
3. Dr. Ramakrishna Pettala, Assistive Technology and Hearing Impairment, Discovery Publishing House, 1st edition, 2020
4. Diane P. Bryant and Brian R. Bryant, Assistive Technology for People with Disabilities, Pearson, 2002
5. Roberta Null, Universal Design: Principles and Models, CRC Press, 2013

(b) REFERENCES

1. Suzanne Robitaille, The Illustrated Guide to Assistive Technology & Devices: Tools and Gadgets for Living Independently, Demos Medical Publishing, 2009
2. Wolfgang Preiser, Korydon Smith, Universal Design Handbook, 2nd edition, McGraw-Hill, 2011

v. COURSE PLAN

Module	Contents	Hours
I	**Introduction to Assistive Technology (AT):** Definitions of Assistive Technology, Indian Laws, AT – needs and Challenges, Inclusion in education. Early intervention, Goals of early intervention. AT types – Low, Mid, and High-Tech Assistive Technologies. **Sensory aids for persons with visual impairments:** Types of visual impairment. Assistive Technologies for vision, Auditory substitution, Optical and Non-optical aids, electronic aids, limitations of printed Braille, refreshable braille displays, recorded audio materials, canes, and alternative mobility devices	9
II	**Technologies for hearing/speech impaired:** Overview of hearing, Hearing aids – principles and technologies, benefits. Assistive listening devices – Induction loop systems, IR systems, FM systems. Alarm and alerting devices, Cochlear implants, risks of implantation.	9

	Audiometry, functional diagram of an audiometer, air conduction, and bone conduction testing, audiometric masking. Speech synthesis for the speech and hearing impaired. *Case study:* Recent advancements in hearing technology.	
III	**Assistive Technologies for mobility:** Wheelchair classification, Major characteristics of manual and power mobility systems – supporting structure, Frame types, Propelling structure, Specialized bases for wheelchairs. Smart wheelchairs. **Technologies for transportation:** Vehicle restraint systems for children with disabilities, Vehicle access, and modifications for driving.	9
IV	**Augmentative and Alternative Communication (AAC):** Disabilities affecting speech, language, and communication. The role of technology in AAC: No-tech, low-tech, and high–tech AAC systems, options for making selections in an AAC device. AAC strategies for pre-intentional communicators, Intentional informal communicators, and Intentional formal communicators. *Case study:* Emerging access technology for AAC. E.g.:- Brain-Computer Interface (BCI), Neuralink, etc.:-	9
V	**Universal Design and Access**: Need for accessibility, Principles of Universal Design. Designand Redesign Strategy for a barrier-free environment, Accessibility to the built environment. Accessibility for Mainstream Information and Communication Technologies - Challenges in using Mainstream ICTs for Persons with Disabilities, Cross-Platform Accessibility, Computer Access, Access to Phones and Tablets. Lab to market transition in Assistive Technology.	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

HONOURS: GROUP I

VLSI AND EMBEDDED SYSTEMS

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2HB	NANOELECTRONICS	VAC	3	0	0	0	3	2023

PREREQUISITE **23PYL10A Engineering Physics, 23ECL20B Solid State Devices**

i. COURSE OVERVIEW

The goal of this course is to introduce the students to the fundamental concepts of nanoelectronics devices and materials.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Explain the fundamental concepts associated with low-dimensional semiconductors.	Understand
CO 2	Describe the characteristics of different quantum well structures.	Understand
CO 3	Describe the carrier transport mechanisms in different nanostructures.	Understand
CO 4	Discuss the structure and operation of various nanoelectronic devices.	Understand
CO 5	Explain the fabrication methods and characterization tools for nanomaterials.	Understand

iii. SYLLABUS

Introduction to nanotechnology - Limitations of conventional microelectronics, Characteristic lengths in mesoscopic systems, Quantum mechanical coherence. **Low dimensional structures** - Quantum wells, wires and dots, DOS and dimensionality. **Heterojunctions and Quantum wells -** Basic properties of quantum wells, Modulation doped quantum wells, Multiple quantum wells, concept of superlattices, Kronig - Penney model of superlattice **Transport of charge under electric field: Parallel transport -** Electron scattering mechanisms, MODFETS, Hot electron transistors. **Perpendicular Transport** - Resonant tunnelling transport and Resonant Tunneling devices. **Quantum Transport -** Coulomb blockade effect, Structure and operation of Single Electron Transistor. **Transport of charge under magnetic field** - Effect of magnetic field on a crystal, Aharonov-Bohm effect, Shubnikov-de Hass effect. **Optoelectronic nanostructure devices** - Heterostructure semiconductor laser, Quantum well laser, quantum dot LED, quantum dot laser. **Introduction to fabrication methods:** Deposition techniques, Ion Implantation, Sol Gel, Fabrication of quantum dots. **Introduction to characterization tools:** Principle of operation of various microscopes.

iv (a) TEXT BOOKS

1) J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda, Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006.

2) W.R. Fahrner, Nanotechnology and Nanoelectronics, Springer, 2005

3) Chattopadhyay, Banerjee, Introduction to Nanoscience and Technology, PHI, 2012.

(b) REFERENCES

1) George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.

2) Murty, Shankar, Text book of Nanoscience and Nanotechnology, Universities Press, 2012.

3) Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013.

v. COURSE PLAN

Module	Contents	Hours
I	**Introduction to nanotechnology -** Limitations of conventional microelectronics, Characteristic lengths in mesoscopic systems, Quantum mechanical coherence. **Low dimensional structures** - Quantum wells, wires and dots, DOS and dimensionality - Density of states of 1D and 2D nanostructures.	9
II	**Heterojunctions and Quantum wells -** Basic properties of square quantum wells of finite depth, parabolic and triangular quantum wells, Modulation doped quantum wells, Multiple quantum wells concept of superlattices, Kronig - Penney model of superlattice, Zone folding	9
III	**Transport of charge under electric field: Parallel transport -** Electron scattering mechanisms, Structure and operation of MODFETS, Hot electrons, Hot electron transistors. **Perpendicular Transport** - Resonant tunnelling transport, Working principle of Resonant Tunneling Diode, Resonant Tunneling Transistors Carbon Nanotubes (CNT) transistors, Properties of Graphene.	9
IV	**Quantum Transport -** Coulomb blockade effect, Structure and operation of Single Electron Transistor. **Transport of charge under magnetic field** - Effect of magnetic field on a crystal, Aharonov-Bohm effect, Shubnikov-de Hass effect. **Optoelectronic nanostructure devices** - Heterostructure semiconductor laser, Quantum well laser, quantum dot LED, quantum dot laser.	9
V	**Introduction to fabrication methods:** Physical vapour deposition, Laser ablation, Chemical vapour deposition, Molecular Beam Epitaxy, Ion Implantation, Sol Gel, Fabrication of quantum dots. **Introduction to characterization tools:** Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Transmission Electron Microscope	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

HONOURS: GROUP II

COMMUNICATION

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2HD	RANDOM PROCESS AND APPLICATIONS	VAC	2	1	0	0	3	2023

PREREQUISITE : Basic probability theory

i. COURSE OVERVIEW

The Goal of this course is to familiarize the student with the theory and applications of probability theory, and thereby aid in understanding phenomena which evolve with respect to time in a probabilistic manner.

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Apply the fundamental knowledge of basic probability concepts.	Apply
CO 2	Use probability distributions for various applications.	Apply
CO 3	Apply the concept of probability theory to analyze random processes.	Apply
CO 4	Explain the various applications of probability theory.	Understand

iii. SYLLABUS

Introduction: Review of probability theory and random variables, Bayes' Theorem and applications.

Significance of Probability Distribution Function, Probability Density function, Common density functions, Conditional and Joint Distributions and densities, independence of random variables.

Expectation: Fundamental Theorem of expectation, Conditional Expectation

Random Vector: - Definition, Joint statistics, Correlation, Covariance matrix and its properties.

Random Sequences: Basic Concepts. Convergence of Random Sequences: Definitions, Laws of large numbers.

Random Processes: - Poisson Process, Wiener Process, WSS Processes, Power spectral density, Central Limit Theorem.

Markov Processes, Markov Random sequences, Markov Chains.

Ergodicity, Karhunen-Leove Expansion

iv (a) TEXT BOOKS

1. Henry Stark and John W. Woods, Probability and Random Processes with Applications to Signal Processing, Pearson Education, Third edition.
2. Athanasios Papoulis and S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, TMH
3. Oliver C. Ibe., Fundamentals of Applied Probability and Random Process, Elsevier, 2005.
4. Olivier Sigaud, Olivier Buffet, "Markov Decision Processes in Artificial Intelligence", 2013, John Wiley & Sons

(b) REFERENCES

1. Gray, R. M. and Davisson L. D., An Introduction to Statistical Signal Processing, Cambridge University Press, 2004 (Available at: http://www.ee.stanford.edu/~gray/sp.pdf)

2. Gardner, W. A., Introduction to Random Processes with applications to Signals and Systems, 2nd edition, McGraw-Hill, Inc., 1990

v. COURSE PLAN

Module	Contents	Hours
I	**Introduction**: Review of probability theory and random variables, Joint, Conditional and Total Probability, Bayes' Theorem and applications. Significance of Probability Distribution Function, Probability Density function, Common density functions	9
II	**Conditional and Joint Distributions** and densities, Independence of random variables. **Expectation**: Fundamental Theorem of expectation, Conditional Expectation	9
III	**Random Vector**: - Definition, Joint statistics, Correlation, Covariance matrix and its properties. **Random Sequences**: Basic Concepts. Convergence of Random Sequences: Definitions, Laws of large numbers. ***Case study I***: Simulate a coin toss for small and large numbers, using relevant computational tools. Compute the probability, p, of getting a head in each case. Compute the absolute error in each case and understand the law of large numbers.	9
IV	**Random Processes**: - Poisson Process, Wiener Process, WSS Processes, Power spectral density, Central Limit Theorem. ***Case study II***: Simulate various random processes using relevant computational tools	9
V	**Markov Processes**, Markov Random sequences, Markov Chains, Applications of Markov Decision Process Model in AI/Machine learning/Deep learning ***Case study III***: Simulate Markov processes using relevant computational tools	9
	Total Hours	**45**

vi. ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

HONOURS: GROUP III

SIGNAL PROCESSING

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ECL2HF	WAVELET TRANSFORM AND APPLICATIONS	VAC	2	1	0	0	3	2023

i. COURSE OVERVIEW

To expose the students to the basics of wavelet theory and to illustrate the use of wavelet processing for data compression and noise suppression

ii. COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Apply the mathematical basis of the wavelet transform and its performance in the analysis of non- stationary signals	Apply
CO 2	Apply the concepts of wavelet transform and packet transform to analyse filter banks.	Apply
CO 3	Apply dyadic multi resolution analysis.	Apply
CO 4	Construct Wavelets using the time domain and frequency domain approaches	Apply
CO 5	Explore the applications of wavelets and wavelet packets.	Understand

iii. SYLLABUS

Introduction- Stationary and non-stationary signals, frames, Short time Fourier transform, Time -frequency analysis, Filter banks

Multi resolution formulation: Wavelets, Classes of wavelets – Haar, Daubechies, bi-orthogonal

Continuous Wavelet Transform - Time and frequency, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, **Inverse continuous wavelet transform** - Redundancy, Zoom property,Filtering

Filter banks – Orthogonal and biorthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks

Discrete wavelet transform– Non-linear approximation, multi resolution analysis, Construction and Computation

Multi Resolution Analysis – Multirate discrete time systems, Parameterization Bi-orthogonal wavelet bases, Two dimensional wavelet transforms, Extensions to higher dimensions, wave packets

Applications - Signal and Image compression, analysis and classification of audio signals using CWT, de-noising and energy compaction, Adaptive wavelet techniques

iv (a) TEXT BOOKS

1. Insight into wavelets from theory to practice, K P Soman and KL Ramachandran, PHI, 2010.
2. A Wavelet Tour of Signal Processing, 3rd edition, S. Mallat, Academic Press, 2008.
3. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011

(b) REFERENCES

1. Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichel Poggi, John Wiley & Sons, 2010
2. A premier on Wavelets and their scientific applications, J S Walker, CRC press, 2002.
3. Wavelets and signal processing: An application based introduction, Stark, Springer, 2005.
4. A friendly guide to Wavelets, Gerald keiser, Springer, 2011

v. COURSE PLAN

Module	Contents	Hours
I	Introduction Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Time - frequency analysis, Bases of time frequency: orthogonal, Filter banks Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.	9
II	**Continuous Wavelet Transform** - Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal **Inverse continuous wavelet transform**- Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.	9
III	**Discrete Wavelet Transform And Filter banks** - Orthogonal and biorthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks **Discrete wavelet transform -** Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.	9
IV	**Multi Resolution Analysis** - Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets	9
V	**Applications** - Signal and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, coding and lossy transmission, Digital Communication and Multicarrier Modulation, Trans multiplexers, Image fusion, Edge Detection and object isolation.	9
	Total Hours	**45**

vi. ASSESSMENTPATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii. CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

Viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours