THE NATIONAL INSTITUTE OF ENGINEERING

Manandavadi Road, Mysuru

ESTD : 1946

DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING

Curriculum Structure and Syllabus

2025-2026

2024 Admitted Batch

The National Institute of Engineering

Department: Electronics and Communication Engineering

Scheme of Teaching & Examination - 2022 **Effective from the Academic Year 2025-26**

B.E. 2024 Admitted Batch **Semester: III**

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper setting Board (PSB)	Teaching Hrs / Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	BEC301	Analog Electronic Circuits	EC		3	0	0		3	50	50	100	3
2	IPCC	BEC302	Analysis and Design of Digital Circuits	EC		3	0	2		3	50	50	100	4
3	PCC	BEC303	Network Analysis	EC		3	2	0		3	50	50	100	4
4	PCC	BMATEC301	AV Mathematics III for EC Engineering	Maths/EC		3	0	0		3	50	50	100	3
5	PCCL	BECL305	Analog Electronic Circuits Laboratory	EC		0	0	2		3	50	50	100	1
6	ESC	BEC306X	ESC/ETC/PLC	EC		3	0	0		3	50	50	100	3
7	UHV	BSCK307	Social Connect & Responsibility	EC		0	0	2		1	100	_	100	1
8	AEC/SEC	BEC358x	Ability Enhancement Course (AEC)/ Skill Enhancement Course (SEC) - III	EC		If the course is a Theory					50	50	100	1
						1	0	0		1				
						If the course is a Lab								
						0	0	2		2				
9	MC	BNSK359	National Service Scheme (NSS)	NSS Coordinator		0	0	2		_	100	_	100	0
		BPEK359	Physical Education (PE) Sports & Athletics	PED										
		BYOK359	Yoga	Yoga Teacher										
										Total	**600**	**400**	**1000**	**20**

Engineering Science Course (ESC/ETC/PLC)														
Sl. No	**Category**	**Course Code**	**Course Title**	**Teaching Department (TD) / Question Paper Setting Board (PSB)**	**Teaching Hours / Week**				**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical / Drawing**	**Self-study Component**					
					L	**T**	**P**	**S**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	ESC	BEC306A	Engineering Statistics and Linear Algebra	ECE	3	0	0		3	50	50	100	3
2		BEC306B	Sensors and Instrumentation		3	0	0		3	50	50	100	3
3		BEC306C	Engineering Electromagnetics		3	0	0		3	50	50	100	3
4		BEC306D	8051 Microcontroller		3	0	0		3	50	50	100	3
Ability Enhancement Course (AEC) / Skill Enhancement Course (SEC)													
1	AEC	BEC358A	Data Structures Using C++	ECE	0	0	2		2	50	50	100	1
2		BEC358B	Simulink Programming Basics		0	0	2		2	50	50	100	1
3		BEC358C	PCB Design		0	0	2		2	50	50	100	1
4		BEC358D	IOT for Smart Infrastructure		1	0	0		1	50	50	100	1

2

The National Institute of Engineering

Department: Electronics and Communication Engineering

Scheme of Teaching & Examination - 2022 **Effective from the Academic Year 2025-26**

B.E. 2024 Admitted Batch **Semester: IV**

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD) & Question Paper setting Board (PSB)	Teaching Hrs. / Week				Examination				Credits
					L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	BEC401	ARM Microcontroller	EC	3	0	0		3	50	50	100	3
2	IPCC	BEC402	Digital System Design Using Hardware Description and Verification Languages	EC	3	0	2		3	50	50	100	4
3	PCC	BEC403	Signals and Systems	EC	3	2	0		3	50	50	100	4
4	PCCL	BECL404	ARM laboratory	EC	0	0	2		3	50	50	100	1
5	ESC	BEC405X	ESC/ETC/PLC	EC	3	0	0		3	50	50	100	3
6	AEC / SEC	BEC456X	Ability Enhancement Course (AEC) / Skill Enhancement Course (SEC)	EC	If the course is a Theory					50	50	100	1
					1	0	0		1				
					If the course is a Lab								
					0	0	2		2				
7	BSC	BBOK407	Biology for Engineers	Chemistry	3	0	0		3	50	50	100	3
8	UHV	BUHK408	Universal Human Values Course	EC	1	0	0		1	50	50	100	1
		BNSK459	National Service Scheme (NSS)	NSS Coordinator									
9	MC	BPEK459	Physical Education (PE) Sports & Athletics	PED	0	0	2		_	100	_	100	0
		BYOK459	Yoga	Yoga Teacher									
									Total	**550**	**450**	**1000**	**20**

Sl. No	Category	Course Code	Course Title	Teaching Department (TD) / Question Paper Setting Board (PSB)	Teaching Hours / Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Self-study Component					
					L	T	P	S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
Engineering Science Course (ESC/ETC/PLC)													
1	ESC	BEC405A	Applied Numerical Methods	ECE	3	0	0		3	50	50	100	3
2		BEC405B	Industrial Electronics		3	0	0		3	50	50	100	3
3		BEC405C	Operating Systems		3	0	0		3	50	50	100	3
4		BEC405D	Linear Integrated Circuits		3	0	0		3	50	50	100	3
Ability Enhancement Course (AEC) / Skill Enhancement Course (SEC)													
1	AEC	BEC456A	Electronic Devices	ECE	1	0	0		1	50	50	100	1
2		BEC456B	LICs Lab using PSPICE		0	0	2		2	50	50	100	1
3		BEC456C	LabVIEW Programming		0	0	2		2	50	50	100	1
4		BEC456D	Risk Management in IoT Implementation		1	0	0		1	50	50	100	1

The National Institute of Engineering **Department: Electronics and Communication Engineering**															
Scheme of Teaching & Examination - 2022										**Effective from the Academic Year 2025-26**					
B.E. 2024 Admitted Batch														**Semester: V**	
Sl. No	**Type of Course**	**Course Code**	**Course Title**	**Teaching Department (TD)**	**Question Paper Setting Board (PSB)**	**Teaching Hrs / Week**				**Examination**					**Credits**
						L	**T**	**P**	**S**	**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**		
1	HSMS	BEC501	Engineering Management and Entrepreneurship	EC	EC	3	0	0		3	50	50	100	3	
2	IPCC	BEC502	Integrated Professional Core Courses (IPCC): Control Systems	EC	EC	3	2	0		3	50	50	100	4	
3	PCC	BEC503	Professional Core Course (PCC) Communication Systems	EC	EC	3	0	0		3	50	50	100	3	
4	PCC	BEC504	Professional Core Course (PCC) Digital Signal Processing	EC	EC	3	0	2		3	50	50	100	4	
5	PCCL	BECL505	Professional Core Course Laboratory (PCCL): Communication Systems Lab	EC	EC	0	0	2		3	50	50	100	1	
6	PEC	BEC515X	Professional Elective Course (Industry suggested course)	EC	EC	2	0	2		3	50	50	100	3	
7	PROJ	BEC586	Minor Project	EC		0	0	2		-	50	-	50	1	
8	AEC	BRMEC557	Research Methodology and IPR	Any Department	EC	2	0	0		2	50	50	100	2	
9	MC	BESK508	Environmental Studies	TD: Civil/ Chemistry	Civil	1	0	0		-	50	-	50	1	

10	MC	BNSK559	National Service Scheme (NSS)	NSS Coordinator	0	0	2		_	100	_	100	0
			Physical Education (PE) (Sports & Athletics)	PED									
			Yoga	Yoga Teacher									
									Total	**550**	**350**	**900**	**22**

Professional Elective Course (Industry suggested course)	
BEC515A	Embedded Systems for Automotive
BEC515B	Unified Verification Methodology
BEC515C	Operating System

The National Institute of Engineering

Department: Electronics and Communication Engineering

Scheme of Teaching & Examination - 2022 **Effective from the Academic Year 2025-26**

B.E. 2024 Admitted Batch **Semester: VI**

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper Setting Board (PSB)	Teaching Hrs / Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BEC601	Integrated Professional Core Courses (IPCC) Computer Networks	Department name - EC	EC	3	0	2		3	50	50	100	4
2	PCC	BEC602	Professional Core Course (PCC) Embedded System and Architecture	EC	EC	3	0	2		3	50	50	100	4
3	PEC	BEC613X	Professional Elective Course - Group II	EC	EC	3	0	0		3	50	50	100	3
4	OEC	BEC654X	Open Elective Course - Group II	EC	EC	3	0	0		3	50	50	100	3
5	PCC	BEC605	Professional Core Course (PCC) Wireless Communication	EC	EC	3	0	0		3	50	50	100	3
6	PCC	BEC606	Professional Core Course (PCC) Principles of Digital VLSI	EC	EC	3	0	0		3	50	50	100	3
7	PCCL	BECL607	Professional Core Course laboratory VLSI Lab	EC	EC	0	0	2		-	50	50	100	1
8	AEC/SDC	BEC657L	Ability Enhancement Course / Skill Development Course V / PCB Design and Fabrication	EC	EC	If the course is a Theory					50	50	100	1
						1	0	0		1				
						OR								
						If the course is a Laboratory								
						0	0	2		2				

9	MC	BNSK658	National Service Scheme (NSS)	NSS Coordinator	0	0	2		-	100	-	100	0
		BPEK658	Physical Education (PE) (Sports & Athletics)	PED									
		BYOK658	Yoga	Yoga Teacher					_	100	_	100	0
		BIKK259	Indian Knowledge System	Humanities									
									Total	**500**	**400**	**900**	**22**

Professional Elective Course - Group II			**Open Elective Course - Group II**	
BEC613A	ASIC Design		BEC654A	Internet of Things and Applications
BEC613B	Signal Processing and Machine Learning		BEC654B	Vehicular Electronics
BEC613C	Optical Fibre Communication		BEC654C	Multicore systems and programming
BEC613D	Industrial Internet of Things		BEC654D	Introduction to VLSI
BEC613E	Object Oriented Programming		BEC654E	Introduction to Radar systems for Autonomous driving
BEC613F	Transmission Lines and Radiating Systems			

The National Institute of Engineering Department: Electronics and Communication Engineering															
Scheme of Teaching & Examination - 2022											Effective from the Academic Year 2025-26				
B.E. 2024 Admitted Batch														Semester: VII	
Sl. No	Type of the Course	Course Code	Course Title	Teaching Department (TD)	Question Paper Setting Board (PSB)	Teaching Hrs / Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total marks	
1	IPCC	BEC701	Integrated Professional Core Course: Real Time Operating Systems	EC	EC	3	0	2		3	50	100	100	4
2	PCC	BEC702	Professional Core Course: Information Theory and Coding	EC	EC	3	2	0		3	50	100	100	4
3	PEC	BEC713X	Professional Elective Course - Group III	EC	EC	3	0	0		3	50	100	100	3
4	OEC	BEC754X	Open Elective Course - Group III	EC	EC	3	0	0		3	50	100	100	3
5	PROJ	BEC785	Major Project	EC	EC	3	0	0		3	100	100	200	6
										Total	**300**	**300**	**600**	**20**

Professional Elective Course - Group III			
BEC713A	Static Timing Analysis	BEC713H	Vehicular Electronics
BEC713B	Mixed Signal Circuit Design	BEC713I	Radar and Lidar Systems for Autonomous Driving
BEC713C	Deep Learning Techniques	BEC713J	Digital Image Processing
BEC713D	Estimation Theory	BEC713K	Wireless Ad Hoc network
BEC713E	Low Power VLSI Design	BEC713M	Information and Network Security
BEC713F	Semiconductor IC technology	BEC713N	Data Science and Management
BEC713G	5G Wireless Systems and Industry Applications	BEC713P	Integrated Sensing and Communications
Open Elective Course - Group III			
BEC754A	Introduction to Quantum Computing	BEC754C	Mobile Communication
BEC754B	Next-Gen Wireless: 5G Systems and Cross-Industry Use Cases	BEC754D	Neuromorphic Engineering

The National Institute of Engineering

Department: Electronics and Communication Engineering

Scheme of Teaching & Examination - 2022 | **Effective from the Academic Year 2025-26**

B.E. 2024 Admitted Batch | **Semester: VIII**

Sl. No	Type of the Course	Course Code	Course Title	Teaching Department (TD)	Question Paper Setting Board (PSB)	Teaching Hrs / Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total marks	
1	PEC	BEC801X	Professional Elective - Group IV (Online Course)	EC	EC	-	-	-		-	-	50	100	3
2	OEC	BEC802X	Open Elective - Group IV (Online Course)	EC	EC	-	-	-		-	-	50	100	3
3	INT	BEC803	Internship (Industry/ Research) (14-16 weeks)	EC	EC	0	0	20		3	100	100	200	10
										Total	**100**	**200**	**400**	**16**

Professional Elective Course - Group IV (Online Courses – NPTEL / Coursera)		Open Elective Course - Group IV (Online Courses – NPTEL / Coursera)	
BEC801A	Fibre Optic Communication Technology	BEC802A	Understanding Incubation and Entrepreneurship
BEC801B	Microelectronics: Devices to Circuits	BEC802B	Data Analytics with Python
BEC801C	Semiconductor device modelling and Simulation	BEC802C	Economics of Banking and Finance Markets
BEC801D	Photonic integrated circuit	BEC802D	Patent Law for Engineers and Scientists
BEC801E	Computer Vision and Image Processing Fundamentals and Applications	BEC802E	E-Business

Course Code: BEC301 **Course: Analog Electronic Circuits**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Basic Electronics
Learning objectives	• Explain the concepts of semiconductor devices, power electronic devices • Apply the concepts to compute the DC analysis • Analyse and design the circuit and comment on its performance • Implement the specified circuit on simulators and observe its performance

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Explain the concepts/ working principle of MOSFET, Fin FET devices, power electronic devices	L1
CO2	Apply the concepts to compute the DC operating points	L2
CO3	Analyse the Amplifier circuit using the small signal models	L3
CO4	Implement different amplifiers and determine the performance at different frequencies, power efficiency.	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2	1	-	1	-	-	-	2	-	-	2		3	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2		3	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	2		3	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2		3	2	2

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1	No. of Lecture Hours
1.1	MOSFET: Device structure and physical operation, operation with VDS voltage, operating the MOS transistor in sub threshold region, current voltage characteristics, MOSFET circuits at DC conditions	6
1.2	Fin FET-structure, working principle	3
	Module 2	
2.1	Biasing- Need for biasing, Different biasing circuits- self-bias, voltage divider bias	4
2.2	MOSFET as an Amplifier: Basics for amplifier operation, Large signal operation-transfer characteristics, operation as a linear amplifier, small-signal operations and models, Applications of MOSFET devices	4
	Module 3	
3.1	Small Signal analysis – at different frequency- low, mid and high MOS Amplifier Configurations and its Frequency Response: The common source amplifier, The common source amplifier with a source resistance, common Gate amplifier, Common-Drain or source- follower amplifier.	4
3.2	Applications of voltage amplifier	4
	Module 4	
4.1	Feedback Amplifiers: Negative Feedback: Voltage series, voltage shunt, current series, current shunt, Parameters	4
4.2	Positive feedback: Oscillators- basic concept, types of oscillators, AF oscillators and RF oscillators	4
	Module 5	
5.1	Power Electronics: Basic working principle of SCR, DIAC and its current voltage characteristics, applications	3
5.2	Power Amplifiers: Class of operations, Class A, Class B , push-pull amplifier, Complementary symmetry push pull amplifier, efficiency derivations	4
	Total No. of Lecture Hours	**40**

Textbooks:

1. Fundamentals of Microelectronics, Behazad Razavi, John Wiley & Sons, 2021
2. Microelectronics Circuits Theory and applications, Adel S Sedra, Kenneth C Smith, 7th edition Oxford University Press.
3. Microelectronics Circuit Analysis and Design, Donald A. Neaman, 4th edition, McGraw-Hill, 2010.
4. Power Electronics, P S Bimbra, Khanna Publishers

Online Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105158/
2. https://archive.nptel.ac.in/courses/108/106/108106105/

Reference Books:

1. "Integrated Electronics", Millman and Halkias, Tata McGraw Hill publications, New Delhi, 1991Edition
2. "Electronic Circuits", Nashelsky and Boylested, Prentice hall India, 9th Edition, 2007.
3. "Design of Analog CMOS IC", Behzad Razavi, McGraw Hill, 2nd Edition, 2017

Course Code: BEC302 **Course: Analysis and Design of Digital Circuits**

Credits: 4 **L:T:P – 3:0:2**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Number Systems
Learning Objectives	1. Design various logic gates and simplify Boolean equations. 2. Design various flip flops, shift registers and determining outputs. 3. Design different types of counters. 4. Verifying the digital systems using Verilog HDL

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	Course Outcomes	Bloom's level
CO1	Apply algebraic and mapping techniques to minimize the hardware in implementation of combinational circuits.	L2
CO2	Design, analyse and implement of sequential circuits with timing diagram.	L4
CO3	Describe the importance of constructing state diagram and state table in implementation of sequential machines.	L2
CO4	Verify the design of combinational and sequential circuits using Verilog HDL	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2	1											3	2	
CO2	3	3	2	1										3	2	
CO3	3	3	2	1										3	2	
CO4		3	2	1										2	1	

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1	No. of Lecture Hours
1.1	Revision on Gates and Combinational Circuits,	1
1.2	SYNCHRONOUS SEQUENTIAL CIRCUITS: Flip flops – SR, JK, T, D, and Master/Slave FF – operation and excitation tables.	2
1.3	Triggering of FF, Analysis, and design of clocked sequential circuits	1
1.4	Design – Moore/Mealy models, state minimization, state assignment, circuit implementation	1
1.5	Design of Counters- Ripple Counters, Ring Counters,	2
1.6	Shift registers, Universal Shift Register.	1
	Module – 2	
2.1	ASYNCHRONOUS SEQUENTIAL CIRCUITS: Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments,	1
2.2	Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.	1
2.3	Design Procedure, Design of sequence detector.	3
2.4	More complex design problems, Eliminations of redundant states and techniques.	1
2.5	Mealy and Moore outputs, design examples,	2
	Module – 3	
3.1	Basic memory structure – ROM, RAM, Programmable Logic Devices, Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).	2
3.2	Implementation of combinational logic circuits using PLA, PAL and CLB.	1
3.3	Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin.	1

3.4	Fundamentals of FPGA architectures: Introduction, FPGA and ASIC Design Flow, Design Methodologies	1
3.5	Examples for design methodologies, FPGA Architectures	1
3.6	CLB Design for different logic circuits, Basics on IO design, Modules	1
3.7	PLI and FSM based design: Programming Language Interface	1
Module – 4		
4.1	Introduction to Verilog and Dataflow descriptions: Program structure, Logic systems	3
4.2	Nets, Variables and Constants, Vectors and Operators, Arrays, Logical operators, and expressions	2
4.3	Dataflow Design elements: Continuous assignments, delay specification	1
4.4	expressions, rise, fall, and turn-off delays, Structural description	1
4.5	Min, max, and typical delays.	1
Module – 5		
5.1	Behavioural Design elements: Structured procedures, initial and always	1
5.2	blocking and non-blocking statements,	1
5.3	delay control, generate statement, event control	1
5.4	conditional statements, multiway branching, loops, sequential and parallel blocks, Simulation, Test benches	1
5.5	Synthesis and Programs on combinational and sequential circuits,	1
5.6	ASM charts, FSM code development,	1
5.7	Introduction – FSMD, Code development of an FSMD, Design examples,	1
5.8	Example of Sequential circuit FSM synthesis.	1
Total No. of Lecture Hours		**40**
Total No. of Lab Hours		**12**

Textbooks:

1. Mano, Morris. "Digital logic." Computer Design. Englewood Cliffs Prentice-Hall
2. M. Morris Mano, Michael D. Ciletti, "Digital Design with an Introduction to the Verilog HDL", 5th Edition.
3. Samir Palnitkar, "Verilog HDL", Published by Pearson Education 2003.
4. Pong P. Chu, "FPGA Prototyping by Verilog Examples", Wiley, 2008

Reference Books:

1. Kumar, A. Anand. Fundamentals Of Digital Circuits 2Nd Ed. PHI Learning Pvt. Ltd., 2009.
2. Taub, Herbert, and Donald L. Schilling. Digital integrated electronics. New York: McGraw-Hill, 1977.
3. Charles H. Roth, "Fundamentals of Logic Design", Thomson books / Co. Publications, 5th Edition.
4. Digital Design (Verilog)-An Embedded Systems Approach Using Verilog, 1st Edition - September 10, 2007.
5. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
6. Comer "Digital Logic & State Machine Design, Oxford, 2012.

Online Resources:

1. https://www.coursera.org/learn/intro-fpga-design-embedded-systems
2. https://www.coursera.org/learn/digital-systems
3. https://www.udemy.com/topic/digital-electronic/
4. https://www.udemy.com/course/digitalelectronics/
5. https://www.udemy.com/topic/fpga/

Digital Design Lab

Simulation, Synthesis and Implementation using Vivado and Artix 7/Zynq 7 Developmental Boards. Verifying and optimizing the design by analysing the CLB's and I/O's for the given FPGA board.

1. Logic gates in Structural, Dataflow and Behavioural
2. Combinational Circuits-Adders, Subtractors, MUX, DEMUX and Encoders etc.,
3. Sequential Circuits -F/F's, Counters
4. Sequential circuits-Shift registers
5. Sequential Circuits- FSM based design.
6. RAM/ROM configuration for an application.

Course Code: BEC303 **Course: Network Analysis**

Credits: 3 **L:T:P – 3:2:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Pre-requisites if any	Basic Electronics & Communication Engineering and Laplace Transform
Learning objectives	• Understand DC analysis, Transient Analysis, Sinusoidal Steady state analysis of electric network. • Analyse Electrical Network in Phasor-Domain • Analyse Electrical Network in S-Domain • Modelling of Two port Electrical Network

Course Outcomes:

On the successful completion of the course, the student will be able to:

COs	Course Outcomes	Bloom's level
CO1	Apply the Nodal, Mesh methods and Network Theorems to understand DC analysis.	L3
CO2	Analyse Transient Behaviour of RC, RL and RLC circuits	L4
CO3	Analyse RC, RL circuits by using Sinusoidal Steady-Analysis.	L4
CO4	Apply Laplace transforms to perform transient analysis of RL, RC and RLC circuits.	L3
CO5	Analyse two port networks.	L4

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1	3	1	1
CO3	3	3	1	-	-	-	-	-	-	-	-	1	3	1	1
CO4	3	3	1	-	-	-	-	-	-	-	-	1	3	1	1
CO5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

	Module 1	No. of Lecture Hours	No. of Tutorial Hours
1.1	DC Analysis: Introduction to Circuit Theory, The Passive Sign Convention for Calculating Power, Ideal Voltage and Current Sources, Dependent and Independent Sources.	2	1
1.2	Ohm's Law, Kirchhoff's Current and Voltage Laws, Series and Parallel Connected Sources.	2	2
1.3	Nodal Analysis and Super Node Analysis;	2	1
1.4	Mesh Analysis and Super Mesh Analysis	2	1
	Module 2		
2.1	Superposition, Thevenin's, Norton Theorem, Maximum Power Transfer and Millman's Theorem.	4	1
2.2	Transient Analysis: First order Source Free and Source Driven RC and RL circuits for DC	2	1
2.3	First order Source Free and Source Driven RC and RL circuits for AC excitations.	2	2
	Module 3		
3.1	Sinusoidal Steady-Analysis: Phasor analysis or Sinusoidal Steady-Analysis: Complex forcing function, The Phasor relationships for R, L, and C, Impedance and Admittance.	1	1
3.2	Nodal Analysis and Super Node Analysis for RC and RL circuit.	2	1
3.3	Mesh Analysis and Super Mesh Analysis for RC and RL circuit	2	1
3.4	Resonant circuits: Parallel resonance transfer function.	1	2
3.5	Frequency – response of parallel circuits.	1	1
3.6	Q-factor, Bandwidth of Parallel resonance	2	1
	Module 4		

4.1	Circuit Analysis in the S-Domain: Definition of the Laplace Transform, Laplace Transforms of Simple Time Functions. Inverse Transform Techniques.	2	2
4.2	The Initial-Value and Final-Value Theorems. Solution of networks to step, ramp and impulse functions, transformed networks and their solution.	4	2
4.3	Modelling of Resistor, Inductor and Capacitor in S-Domain. Nodal and Mesh Analysis in the s-Domain	2	1
Module 5			
5.1	Two Port Network Parameters: Admittance Parameters or Y-parameters,	2	1
5.2	Z-parameters	1	1
5.3	ABCD-parameters, h-parameters,	2	2
5.4	Relationship between parameters sets.	2	1
Total No. of Lecture Hours		**40**	**-**
Total No. of Tutorial Hours			**26**

Text Book:

1. W. H. Hayt Jr., J. E. Kemmerly, “Engineering Circuit Analysis”, TMH, 6th Edition.

Reference Books:

1. M.E. Van Valkenburg, “Network Analysis”, PHI, 2nd Edition
2. F. F. Kuo, “Network Analysis and Synthesis” Wiley Publications, 2nd Edition.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee64/preview
2. https://archive.nptel.ac.in/courses/108/104/108104139/

Course Code: BMATEC301 **Course: AV Mathematics III for EC Engineering**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	
Learning objectives	The goal of the course Fourier Transforms, Z-Transforms, Ordinary Differential Equations and Statistics is to 1. Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis and to enable the student to express non-periodic functions to periodic functions using the Fourier series and Fourier transforms. 2. Analyze signals in terms of Z-Transforms 3. Develop the knowledge of solving differential equations and their applications in Electronics & Communication engineering. 4. To find the association between attributes and the correlation between two variables

Course Outcomes:

On the successful completion of the course, the student will be able to

CO's	Course Outcomes	Bloom's level
CO1	Demonstrate the Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing, and field theory.	L2, L3, L4
CO2	To use Fourier transforms to analyse problems involving continuous-time signals	
CO3	To apply Z-Transform techniques to solve difference equations	
CO4	Understand that physical systems can be described by differential equations and solve such equations	

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1		-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1		-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1		-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1		-	-	-

Strong: 3 Medium: 2 Low: 1

Course Content

	Module – 1 Fourier series and practical harmonic analysis	No. of Lecture Hours
1.1	Periodic functions, Dirichlet’s condition.	1
1.2	Fourier series expansion of functions with arbitrary period:	2
1.3	Periodic rectangular wave, Half-wave rectifier, rectangular pulse, Saw tooth wave.	1
1.4	Half-range Fourier series, Practical harmonic analysis.	2
	Module – 2 Infinite Fourier Transforms	
2.1	Infinite Fourier transforms	2
2.2	Fourier cosine and sine transforms	2
2.3	Inverse Fourier transforms, Inverse Fourier cosine and sine transforms,	2
2.4	Discrete Fourier transform (DFT)	2
2.5	Fast Fourier transform (FFT).	2
	Module – 3 Z-Transforms	
3.1	Definition, Z-transforms of basic sequences and standard functions.	2
3.2	Properties: Linearity, scaling, first and second shifting, multiplication by n.	2

3.3	Initial and final value theorem. Inverse Z- transforms.	2
3.4	Application to difference equations.	2
Module –4 Ordinary Differential Equations of Higher Order		
4.1	Higher-order linear ODEs with constant coefficients - Inverse differential operator, problems. (e , sin ax or cos ax , x , e v, x v).	2
4.2	Method of variation of parameters, Linear differential equations with variable Coefficients - Legendre's differential equations–Problems.	2
4.3	Application of linear differential equations to L-C circuit and L-C-R circuit.	2
Module –5 Curve fitting, Correlation, and Regressions		
5.1	Principles of least squares, Curve fitting by the method of least squares in the form $y = a + bx$,	2
5.2	$y = a + bx + cx^2$, and $y = ax^b$.	2
5.3	Correlation, Coefficient of correlation, Lines of regression, Angle between regressions lines, standard error of estimate.	2
5.4	Rank correlation.	2
Total No. of Lecture Hours		**40**

Assessment Pattern:

Bloom's level	Continuous Internal Examination			End Semester Examination
	Test 1	Test 2	Assignment / Quiz / AAT	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓			✓
Analyze	✓			✓
Evaluate	✓			
Create				

Detailed Lesson Plan:

Sl No. of Module	Number of related learning Objectives	Weeks/ Dates	Online Mode		ICT Tool/ Platform / LMS	Face-to-face Mode	
			Resource (OER/ URL/ IM/ CP)	Activity (Describe activity in detail)		Resource (OER/ URL/ IM/ CP)	Activity
1.1	1	1	https://youtu.be/5Iy5jzpm4-4?feature=shared	-	Smart board, Moodle	-	Group Discussion & Presentation
1.2	1	1		-		-	
1.3	1	2		-		-	
1.4	1	3		-		-	
2.1	1	3		-		-	
2.2	1	4		-		-	
2.3	1	4		-		-	
2.4	1	4		-		-	
2.5	1	5		-		-	
3.1	2	5		-		-	
3.2	2	6		-		-	
3.3	2	6		-		-	
3.4	2	7		-		-	
4.1	3	8		-		-	
4.2	3	8		-		-	
4.3	3	9		-		-	
5.1	4	10		-		-	
5.2	4	11		-		-	
5.3	4	11		-		-	
5.4	4	12		-		-	

Suggested Learning Resources:

Textbooks:

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna Publishers, 44thEd. 2021.
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd. 2018.

Reference Books:

1. V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11thEd., 2017
2. Srimanta Pal & Subodh C.Bhunia: "Engineering Mathematics" Oxford University Press, 3rdEd. 2016.
3. N.P Bali and Manish Goyal: "A Textbook of Engineering Mathematics" Laxmi Publications, 10thEd. 2022.
4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw– Hill Book Co., New York, 6thEd. 2017.
5. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", McGraw Hill Education (India) Pvt. Ltd 2015.
6. H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication, 3rdEd. 2014.
7. James Stewart: "Calculus" Cengage Publications, 7thEd. 2019.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Course Code: BECL305 **Course Title: Analog Electronic Circuits Laboratory**

Credits: 1 **CIE: 50 Marks**

L: T: P: 0:0:2 **SEE: 50 Marks**

SEE Hours: 3 **Total Marks: 100**

Prerequisites if any	Basic Electronics & Communication Engineering, BES lab
Learning objectives	➢ Apply the concepts to compute the DC analysis, AC analysis and transient analysis. ➢ Analyse and design the circuit and comment on its performance. ➢ Implement the specified circuit on simulators and compare the simulation results with experiment results.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Design, analyse and conduction of Experiments on applications of diodes, MOSFET circuits, BJT Oscillators and power amplifiers	Analyse

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	-	1	3	1	-	2		3	2	2

Mapping strength: 3 – Strong 2 – Medium 1 – Low

List of Experiments	
1	Design Regulated DC power supply.
2.	Design and analyse the transfer and drain characteristics of a n-Channel MOSFET and calculate its drain resistance, mutual conductance and amplification factor
3.	Design the voltage divider biasing circuit and analyse the operating point variations with respect to design parameters
4.	Design and analyse the single stage common source amplifier using n- Channel MOSFET for a given gain & determine bandwidth, Zi, Zo and draw its frequency response.
5.	Design and analyse the Hartley and Colpitts oscillator for a given frequency and gain requirements
6.	Design and analyse RC phase shift oscillator for a given frequency and gain requirements
7.	Design and analyse the complementary symmetry class B push – pull power amplifier and calculate the efficiency.
8.	Design and analyse the complementary symmetry class AB push – pull power amplifier and calculate the efficiency.
9.	LAB Project - Hardware
10.	LAB Project - simulation

Course Code: BEC306A **Course Title: Engineering Statistics and Linear Algebra**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites	Probability Theory
Learning Objectives	1. Study the statistics for ECE applications. 2. Study the linear algebra for ECE applications

Course Outcomes:

On the successful completion of the course, the student will be able to,

COs	**Course Outcomes**	**Bloom's level**
CO1	Study and analyse of random spaces and variables for ECE applications	L4
CO2	Analyse vector spaces and determinants for ECE applications	L4

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2									2	3	2	1
CO2	3	3	3									2	3	2	1

Mapping strength: 3 – Strong 2 – Medium1 – Low

Course Structure

	Module-1	No. of Lecture Hours
1.1	Single Random Variables: Definition of random variables, cumulative distribution function continuous and discrete random variables; probability mass function, probability density functions and properties.	3

1.2	Expectations, Characteristic functions, Functions of single Random Variables, Conditioned Random variables.	2
1.3	Application exercises to Some special distributions: Uniform, Exponential, Laplace, Gaussian; Binomial, and Poisson distribution.	3
Module–2		
2.1	Multiple Random variables: Concept, Two variable CDF and PDF, Two-Variable expectations (Correlation, orthogonality, Independent),Two variable transformations, Two Gaussian Random variables.	4
2.2	Sum of two independent Random Variables, Sum of IID Random Variables – Central limit Theorem and law of large numbers, Conditional joint Probabilities, Application exercises to Chi-square RV, Student-t RV, Cauchy and Rayleigh RVs	4
Module–3		
3.1	Random Processes: Ensemble, PDF, Independence, Expectations, Stationarity, Correlation Functions (ACF, CCF, Addition, and Multiplication), Ergodic Random Processes.	4
3.2	Power Spectral Densities (Wiener Khinchin, Addition and Multiplication of RPs, Cross spectral densities), Linear Systems (output Mean, Cross-correlation and Autocorrelation of Input and output), Exercises with Noise.	4
Module–4		
4.1	Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem, Linear Transformations.	4
4.2	Vector Spaces: Vector spaces and Null subspaces, Rank and Row reduced form, Orthogonality: Orthogonal Vectors and Subspaces, Projections and Least-squares,	4
4.3	Orthogonal Bases and Gram- Schmidt Orthogonalization procedure.	4
Module–5		
5.1	Determinants: Properties of Determinants, Permutations and Cofactors.	4
5.2	Eigenvalues and Eigen vectors: Review of Eigenvalues and Diagonalization of a Matrix, Special Matrices (Positive Definite, Symmetric) and their properties, Singular Value Decomposition.	4
Total No. of Lecture Hours		**40**

Text Books:

1. Richard H Williams, “Probability, Statistics and Random Processes for Engineers” Cengage Learning, 1st Edition, 2003, ISBN 13: 978-0-534- 36888-3, ISBN 10: 0-53436888-
2. Gilbert Strang, “Linear Algebra and its Applications”, Cengage Learning, 4th Edition, 2006, ISBN 97809802327

Reference Books:

1. Hwei P. Hsu, “Theory and Problems of Probability, Random Variables, and Random Processes” Schaums Outline Series, McGraw Hill. ISBN 10: 0-07- 030644-3.
2. K. N. HariBhat, K Anitha Sheela, Jayant Ganguly, “Probability Theory and Stochastic Processes for Engineers”, Cengage Learning India, 2019,

Online Resources:

1. https://www.coursera.org/courses?query=linear%20algebra.

Course Code: BEC306B **Course: Sensor and Instrumentation**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites	Electronic devices and circuits
Learning Objectives	Study of sensors, virtual instrumentation, acquisition systems and intelligent sensors

Course Outcomes:

On the successful completion of the course, the student will be able to,

COs	**Course Outcomes**	**Bloom's level**
CO1	Understanding working principles and measurement of sensor s and virtual instrumentation.	L2
CO2	Study of acquisition systems and intelligent sensors	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2									2	3	2	1
CO2	3	3	3									2	3	2	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Module-1		No. of Lecture Hours
1.1	Sensors & Transducer: Definition, Classification &selection of sensors, Measurement of displacement using Potentiometer.	3
1.2	LVDT & Optical Encoder, Measurement of force using strain gauge,	2

1.3	Measurement of pressure using LVDT based diaphragm& piezoelectric sensor.	3
Module–2		
2.1	Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive &Capacitive.	4
2.2	Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic& Capacitive.	4
Module–3		
3.1	Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops.	4
3.2	Arrays, Clusters &graphs, Structures: Case, Sequence & Formula nodes, Need of Software based instruments for industrial automation.	4
Module–4		
4.1	Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta.	4
4.3	Types of DAC: Weighted Resistor andR-2R Ladder type, Use of Data Sockets for Networked Communication.	4
Module–5		
5.1	Intelligent Sensors: General Structure of smart sensors &its components, Characteristic of smart sensors: Self calibration, Self-testing& self-communicating,	4
5.2	Application of smart sensors: Automatic robot control & automobile engine control	4
Total No. of Lecture Hours		**40**

Textbooks:

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.

4. Gary Johnson / Lab VIEW Graphical Programing II Edition / McGraw Hill 1997.

Reference Books:

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2. A.D. Helfrick and W.D. cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001
3. Hermann K.P. Neubert, “Instrument Transducers” 2nd Edition 2012, Oxford University Press.

Online Resources:

1. https://nescacademy.nasa.gov/catalogs/si
2. https://onlinecourses.nptel.ac.in/noc23_ee105/preview

Course Code: BEC306C **Course: Engineering Electromagnetics**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Vector Calculus
Learning objectives	• To understand of Coulomb's law, Gauss's law to find Static electric field and to understand current and capacitance • To understand the concept of potential and to find capacitance of conductors. • To understand the steady magnetic field and magnetic force • To understand and analyse the time-varying fields, Maxwell's equations, and electromagnetic wave propagation in different media.

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	**Course Outcomes**	**Bloom's level**
CO1	Apply knowledge of Coulomb's law, gauss law to find Static electric field.	L3
CO2	Apply the knowledge of potential to find capacitance of conductors.	L3
CO3	Apply knowledge of Biot-Savarts law, Ampere's circuital law to find static magnetic field.	L3
CO4	Analyse the effects of time varying electric and magnetic field, understand the TEM wave propagation in different media.	L4

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2					3		2		3	2	
CO2	3	3	2	2					3		2		3	2	
CO3	3	3	2	2					3		2		3	2	
CO4	3	3	2	2					3		2		3	2	

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Module – 1 : Static Electric Field, Current and Capacitance		No. of Lecture Hours
1.1	Static Electric Field: Experimental law of Coulomb	1
1.2	Electric field intensity	1
1.3	Field due to various charge distribution	1
1.4	Electric flux density	1
1.5	Gauss's law and its applications,	2
1.6	Divergence and Maxwell's first equation	1
1.7	Vector operator and Divergence theorem	1
Module – 2 : Energy and Potential		
2.1	Energy expended in moving a point charge in an electric field	1
2.2	Line integral	2
2.3	Definition of potential difference and potential,	1
2.4	Potential field of point charge and systems of charges	2
2.5	Potential gradient.	2
Module – 3 : Current, Conductors and Capacitance		
3.1	Current: current and current density	1
3.2	Continuity of current	1
3.3	Conductors: metallic conduction	1
3.4	Conductor properties and boundary conditions	1
3.5	Capacitance: Capacitance	1
3.6	Parallel-Plate Capacitor	1
3.7	Several Capacitance Examples	2
Module – 4 : The Steady Magnetic Field and Magnetic Force		

4.1	The steady magnetic field: Biot-Savart's law,	1
4.2	Ampere's circuital law	1
4.3	Curl, Strokes theorem	1
4.4	Magnetic flux and flux density.	1
4.5	Magnetic force: Force on a moving charge	1
4.6	Force on a differential current element	1
4.7	Force between differential current elements	1
4.8	Force and Torque on a closed circuit	1
Module – 5: Time Varying Fields and Electro Magnetic Waves		
5.1	Time Varying Fields: Faraday's law, and integral form.	1
5.2	Displacement current	1
5.3	Maxwell's equations in point form	1
5.4	Maxwell's equations in integral form	1
5.5	Electro Magnetic Waves: Wave propagation in free space	1
5.6	Wave propagation in dielectrics	1
5.7	Wave propagation in good conductors.	1
5.8	Poynting Theorem.	1
Total No. of Lecture Hours		**40**

Textbooks:

1. William.H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill publications, 8th edition, 2012.

Reference Books:

1. Mathew N O Sadiku, "Elements of Electromagnetics", Oxford University Press.
2. John Krauss and David A, "Electromagnetic with applications", Fleisch McGraw- Hill, 5th edition, 1999.

Online sources:

1. https://onlinecourses.nptel.ac.in/noc21_ee83/preview
2. https://www.coursera.org/lecture/electrodynamics-introduction/1-1introduction- to-electromagnetism-qiIQb

Course Code: BEC306D **Course: 8051 Microcontroller**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Analog Electronics, Network Theory
Learning objectives	• To understand the design procedure of a MOSFET-based single-stage and a two-stage differential amplifier. • To understand the working of various Op Amp-based circuits. • To understand the working principle and applications of some • special function ICs.

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	Course Outcomes	Bloom's level
CO1	Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051	L4
CO2	Develop 8051 Assembly level programs using 8051 instructions set.	L3
CO3	Develop 8051 Assembly / C language program to generate timings and waveforms using 8051timers, to send & receive serial data using 8051 serial port.	L2
CO4	Develop 8051 Assembly / C language programs to generate square wave on 8051 I/O port pin using interrupt and C Programme to send & receive serial data using 8051 serial port.	L3
CO5	Interface various peripheral devices to 8051 using I/O ports.	L4

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3									1	3		1
CO2	3	3	3									1	3		1
CO3	3	3	3									1	3		1
CO4		3	2	1									2	1	1
CO5	3	3	3	3	2								3	3	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Module – 1		No. of Lecture Hours
1.1	8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers.	4
1.2	8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	4
Module – 2		
2.1	8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical Instructions.	4
2.2	Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.	4
Module – 3		
3.1	8051 Jump and Call instructions & Embedded C Jump and Call Instructions, Calls & Subroutine instructions.	4
3.2	Assembly language program examples on subroutine and involving loops	4
Module – 4		
4.1	8051 Timers and Serial Port: 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin.	4

4.2	8051 Serial Communication- Basics of Serial Data Communication, RS-232 standard, 9 pin RS232signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially	4
Module – 5		
5.1	8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt.	4
5.2	Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly and C language interfacing programming.	4
Total No. of Lecture Hours		**40**

Text Books:

1. "The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D McKinlay; PHI, 2006 / Pearson, 2006.
2. "The 8051 Microcontroller", Kenneth J Ayala, 3rd Edition, Thomson/Cengage Learning.

Reference Books:

1. The 8051 Microcontroller Based Embedded Systems", Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

Online Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105102/
2. https://www.udemy.com/course/8051-microcontroller/

Course Code: BEC358A **Course: Data structure with C++**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Knowledge of C Programming is preferred.
Learning objectives	Introduce the students for object orient and data base concepts

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	**Course Outcomes**	**Bloom's level**
CO1	Understand the object-oriented concepts and their needs.	L2
CO2	Use function overloading, inheritance concepts	L3
CO3	Write code to search, sort data, insert, delete members in a structure	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		3	2							1	3	2	1
CO2		2		3	2							1	3	2	1
CO3		2		3	2							1	3	2	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Sl. No	List of Experiments
1	• Write a C++ program to implement all arithmetic operators (if and switch). • Write a C++ program to check the size for all data types including void, short int, signed double. • Write a C++ program to swap two numbers without temporary variables.

2	• Write a C++ program to create a class for calculator which should perform following functionalities based on user inputs: • Addition, multiplication, division subtraction. • Base conversion from decimal to hex, decimal to binary vice versa. • Note: Each operation should have separate Member function. • Write a C++ program to implement all types of Constructors and destructors.
3	Write a C++ programme to demonstrate operator overloading to overload "+" operator to perform concatenation of char of two array.
4	Write a C++ program to implement Inheritance of below types: a. Single Inheritance i mMulti-level inheritance ii Multiple Inheritance
5	Write a C++ program to implement Double and single Linked list which performs below Functions: • Insert at end of node. • Display. • Insert a node with value at particular position. • Delete a node at end of LL.
6	Write a C++ program for following searching and sorting algorithms. • Binary search • Insertion sort • Selection sort • Quick sort
7	Write C++ program that read a file and count the number of words, sizes, lines and Print these quantities. Then write C++ Program to Count no. of alphabets and spaces present in a file.
8	Write a C++ program to overload- Pre decrement to post decrement. Post decrement to pre decrement.
9	Write a program to simulate a perceptron: Assume weights w1, w2, bias (B) and Threshold (theta) are available. program should read x1 and x2 from keyboard should Calculate z= (x1.w1) + (x2.w2) +B. If this value is more than threshold, the o/p y =1 else y =0(Use the Heaviside Step Fn.)

Resources:

i https://www.youtube.com/watch?v=LZFoktwiars&list=PLmp4ylk-B4KrM9uOEdvPIVFUkU3jNc6D2

ii https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html

iii https://cse01-iiith.vlabs.ac.in/List%20of%20experiments.html

Course Code: BEC358B **Course: Simulink Programming Basics**

Credits: 1 **L:T:P – 0:0:2**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 2 Hrs **Max. Marks: 100**

Prerequisites	Knowledge of MATLAB is preferred.
Learning objectives	To introduce the students to a block diagram environment used to design and simulate systems with multi domain models

Course Outcomes:

On successful completion of the course, the student will be able to use Simulink for:

COs	Course Outcomes	Bloom's level
CO1	Signal generation and observe the output in time and frequency domain.	L30
CO2	Simple signal processing operations like adding, multiplying and convolving signals, verify sampling theorem.	L3
CO3	Observe the responses of first and second order differential system.	L4

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		3	3							1	2	3	1
CO2		2		3	3							1	2	3	1
CO3		2		3	3							1	2	3	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Sl No	List of Experiments
1	Introduction to Simulink, blocks, interconnection, compiling and running: Simulation of scope and spectrum analyser.
2	Generating different types of signals like saw tooth, square, random etc.
3	Adding and multiplying two sinusoid signals.
4	Integrator and differentiator.
5	Transfer functions of $1^{st}$and 2^{nd} order systems
6	Verification of Sampling theorem
7	Playing an audio file using Simulink. Add noise to audio file. Observe the effect of convolving noisy signal with [0.5 0.5] and [0.5, -0.5].
8	Generation of: If-then-else generation For loop
9	Application – Simulation of bouncing ball.

Online Resources:

1. https://engineering.purdue.edu/~ece495/Power_Electronics_Lab/exp1.pdf
2. https://eelabs.faculty.unlv.edu/docs/guides/Simulink_Basics_Tutorial.pdf
3. https://www.science.smith.edu/~jcardell/Courses/EGR326/Modeling_1st2nd_order_s ystems.pdf
4. https://www.tutorialspoint.com/matlab_simulink/matlab_simulink_build_model_and_ apply_ifelse_logic.htm
5. https://www.tutorialspoint.com/matlab_simulink/matlab_simulink_for_loop.htm
6. https://www.youtube.com/watch?v=67MeCJ4nQkY
7. https://in.mathworks.com/help/simulink/slref/simulation-of-a-bouncing-ball.html

Course Code: BEC358C **Course: PCB Design Lab**

Credits: 1 **L:T:P – 0:0:2**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 2 Hrs **Max. Marks: 100**

Prerequisites	Knowledge of analog and digital circuits
Learning objectives	• The need for PCB Design and steps involved in PCB design and fabrication process. • To familiarize schematic and layout design flow using Electronic Design Automation (EDA) Tools.

Course Outcomes:

On the successful completion of the course, the student will be able to

Cos	**Course Outcomes**	**Bloom's level**
CO1	Understand the steps involved in schematic, layout, fabrication, and assembly process of PCB design.	L2
CO2	Design (schematic and layout) PCB for analog circuits, and digital circuits.	L4
CO3	Design (schematic and layout) and fabricate PCB for simple circuits.	L4

Mapping with POs and PSOs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			3				1	1		1	3	3	
CO2	3	3	3	3	3				1	1		1	3	3	
CO3	3	3	3	3	3				1	1		1	3	3	

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl No	List of Experiments
1	Introduction to PCB design steps of Schematic design, layout design, create new schematic components and component footprint.
2	Regulator circuit using 7805
3	Full-wave Rectifier
4	Astable multivibrator using IC555
5	Monostable multivibrator using IC555
6	Full-Adder using half-adders.
7	Design an 8051-development board having serial communication section consisting of Max232 capacitor, DB9 connector, jumper, and LED.
8	Fabricate single-sided PCB, mount the components, and assemble in a cabinet for any one of the circuits mentioned above. - 1
9	Fabricate single-sided PCB, mount the components, and assemble in a cabinet for any one of the circuits mentioned above. - 2
10	Identification of various types of PCB and soldering techniques

Tools: OrCAD/NI Multisim/ Proteus 8/ TINAPRO/KiCad

Text books:

1. Printed Circuit Board by RS Khandpur, Tata McGraw Hill Education Pvt Ltd., New Delhi
2. Electronic Product Design Volume-I by S D Mehta, S Chand Publications

Online Resources:

3. Open source EDA Tool KiCad Tutorial: http://kicad-pcb.org/help/tutorials/
4. PCB Fabrication user guide page: http://www.wikihow.com/Create-Printed-Circuit- Boards
5. PCB Fabrication at home(video): https://www.youtube.com/watch?v=mv7Y0A9YeUc, https://www.youtube.com/watch?v=imQTCW1yWkg

Course Code: BEC358D **Course: IOT for Smart Infrastructure**

Credits: 1 **L:T:P – 1:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 2 Hrs **Max. Marks: 100**

Prerequisites if any	Knowledge of embedded systems
Learning objectives	Study of different smart applications using IoT

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Understand the intelligence in IoT.	L2
CO2	Study of different smart applications and solutions for real time problems	L2

Mapping with POs and PSOs:

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2									2	2	1	3
CO2	3	3	3									2	2	1	3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1 Introduction:		No. of Lecture Hours
1.1	Role of Machine Learning and Deep Learning in Internet of Things enabled Smart Cities	1

1.2	Understanding New Age of Intelligent Video Surveillance and Deeper Analysis on Deep Learning Techniques for Object Tracking	1
1.3	Tech to Take Care: IoT-Based Smart Solution for Real-Time Supervision	1
Module – 2 IoT for Drones and other Smart City applications		
2.1	Smart Drone Controller Framework—Toward an Internet of Drones	1
2.2	Automated Weather Monitoring Station Based on IoT for Smart Cities	1
2.3	Building of Efficient Communication System in Smart City Using Wireless Sensor Network Through Hybrid Optimization Technique	1
Module 3: Industrial and Vehicular IoT :		
3.1	Industrial IoT and Its Applications	1
3.2	An Interactive Analysis Platform for Bus Movement: A Case Study of One of the World's Largest Annual Gathering	1
3.3	Vehicle Payload Monitoring System	1
3.4	Estimation of Range for Electric Vehicle Using Fuzzy Logic System	1
Module 4: IOT in Health care:		
4.1	IoT in Healthcare: A 360-Degree View	1
4.2	Applications	1
Module 5: Security and Sustainable development:		
5.1	Towards the Sustainable Development of Smart Cities Through Cloud Computing	1
5.2	Security and Privacy Threats in IoT-Enabled Smart Cities	1
Total no of Lecture Hours		**15**

Textbook:

1. AI and IoT for Smart City Applications, Vincenzo Piuri, Rabindra Nath Shaw, Ankush Ghosh, Rabiul Islam, Springer Singapore, 2022
2. IoT for Sustainable Smart Cities and Society, Joel J. P. C. Rodrigues, Parul Agarwal, Kavita Khanna, Springer Cham, 2022

Online Resources:

https://link.springer.com/book/10.1007/978-3-030-89554-9#about-this-book

Course Code: BEC401 **Course: ARM Microcontroller**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Digital Electronics & Computer Architecture
Learning objectives	• Understand the basic hardware components and their selection method based on the characteristics and attributes of an Embedded System. • Describe the architectural features and instructions of 32-bit ARM Cortex M3 microcontroller. • Understand the programming of different microcontrollers in different programming languages using different software development tools on different operating system platform • Understand various Sensors, Actuators & Interfacing Modules with different processors and controllers Boards. • Understand the development of embedded system applications • programming using ARM Cortex based Microcontrollers

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Describe the ARM processor architecture features	L1
CO2	Develop assembly language programs to perform specific tasks using ARM instructions.	L3
CO3	Develop ARM microcontroller peripherals applications using Embedded C language.	L2
CO4	Develop ARM microcontroller communication protocols applications using Embedded C language.	L2

CO5	Design and develop program to interface external hardware with LPC17EC microcontroller.	L3

Mapping with POs and PSOs:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
CO2	1	2	3	2	2	-	-	-	-	-	-	-	3	2	2
CO3	1	2	3	2	2	-	-	-	-		-	-	3	2	2
CO4	1	2	3	2	2	-	-	-	-	-	2	-	3	2	2
CO5	1	2	3	3	2	1	-	-					3	2	2

Mapping Strength: Strong – 3 Medium – 2 Low – 1

Course Structure

	Module – 1	No. of Lecture Hours
1.1	ARM Embedded Systems and ARM Processor fundamentals: Introduction to Microprocessors, Microcontrollers and Embedded Systems, ARM Technology Overview and Design Philosophy.	4
1.2	ARM Processor Families, ARM Processor Embedded System Hardware and Software, ARM Memory Mapping, ARM Processor Modes.	2
1.3	ARM Registers Set, ARM Core Data Flow Model, Stack Operation, Pipeline-Characteristics, Exceptions, Interrupts and Vector Table.	2
	Module 2	
2.1	ARM Processor Instruction Sets and Programming: Data Processing Instructions, Data Transfer Instructions, Control Flow Instructions, Conditional Execution	4
2.2	Introduction to THUMB, Differences between ARM and THUMB, Bit-Banding, General Structure of ARM Assembly Module and Assembler Directives, ARM ALP Example Programs.	4

	Module-3	
3.1	ARM Microcontroller Peripherals and Programming: GPIOs Configuration, Timers, SysTick Timers, Watch Dog Timers, NVIC Controller	4
3.2	PWMs, RTC, PLL, DAC, ADC and Other System Control Units, ARM Microcontroller Peripherals Embedded C Example Programs	4
	Module-4	
4.1	ARM Microcontroller Communication Protocols and Programming: UARTs, Wireless Technologies, I2C, SPI and CAN Protocols Specification, Configuration	4
4.2	Peripherals and Modules, ARM Microcontroller Communication Protocols Embedded C Example Programs	4
	Module-5	
5.1	ARM Microcontroller Interfacing and Programming: Interfacing IO devices and its type – LEDs, Switches, Buzzer, Seven Segment Display, LCD (4bit, 8 bit Mode), Keypad (4*4)	4
5.2	DC Motor, Stepper Motor, Servo motor, Relay, Analog Sensors and its Types- Ultrasonic Sensor, Temperature, Humidity, Soil Moisture Sensor, PIR sensor	4
	Total no of Lecture Hours	**40**

Text books:

1. The Definitive Guide to ARM Cortex M3, 2nd Edition by Joseph Yiu.
2. ARM System Developer's Guide By Andrew N Sloss, Dominic Symes, Chris Wright

Reference books:

1. ARM System-On-Chip Architecture by Steve Furber, Addison Wesley, Pearson Education, 2^{nd} edition.
2. ARM ASSEMBLY LANGUAGE Fundamentals and Techniques, William Hohl, Christopher Hinds, 2^{nd} Edition, CRC Press, 2015.
3. ARM Assembly Language an Introduction, Gibson Second Edition, 2007.

Online Resources:

https://www.udemy.com/course/embedded-system-programming-on-arm-cortex-m3m4/

Course Code: BEC402

Course: Digital System Design Using Hardware Description and Verification Languages

Credits: 4 **L:T:P – 3:0:2**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Number Systems
Learning Objectives	• To know the basic language features of Verilog HDL and the role of HDL in digital logic design. • To know the behavioural modelling of combinational and simple sequential circuits. • To know the synthesis of combinational and sequential descriptions. • To know the architectural features of programmable logic devices. • To understand the verification of digital systems using System Verilog. • To know the basic constructs of advanced HDL and HVL techniques.

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	**Course Outcomes**	**Bloom's level**
CO1	Design and verify the digital circuit by mean of Computer Aided Engineering tools which involves programming with the help of Verilog HDL.	L3
CO2	Develop the System Verilog codes and test benches for digital system design and verification.	L2
CO3	Construct the constrained random tests and functional coverage for verification.	L2
CO4	Study the basic constructs of Chiesel, MyHDL and PyMTL.	L1

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3	2	2	1						2	2		3	2	1
CO2	3	3	2	2	1						2	2		3	2	1
CO3	3	3	2	2	1						2	2		3	2	1
CO4	3	3	2	2	1						2	2		3	2	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1: Verilog: Tasks and Functions	No. of Lecture Hours
1.1	Review on Basics of Verilog, Tasks, Functions and Advanced constructs Tasks	2
1.2	Functions, Differences Between Tasks and Functions,	1
1.3	Procedural Continuous Assignments, Overriding Parameters,	1
1.4	Conditional Compilation and Execution	1
1.5	Time Scales, Useful System Tasks	1
1.6	Timing and delays, Verification of Gate-Level Netlist.	1
1.7	The verification process, basic test bench functionality, test bench components	1
	Module – 2: Introduction to System Verilog	
2.1	Data Types: Built in Data types, fixed and dynamic arrays	1
2.2	Queues, associative arrays, linked lists, array methods.	1
2.3	choosing a storage type, Procedural statements, Tasks, Functions and void functions,	2
2.4	Routine arguments, returning from a routine, time values,	1
2.5	Separating the test bench and design, the interface construct, Stimulus timing, Interface driving and sampling, Synthesis guidelines for interface methods	2
2.6	System Verilog assertions.	1

Module – 3: Randomization and IPC		
3.1	Introduction, Randomization in System Verilog	1
3.2	Constraint details, Solution probabilities, Valid constraints	1
3.3	In-line constraints, Random number functions, Common randomization problems,	2
3.4	Iterative and array constraints, Random control.	1
3.5	Working with threads, Disabling threads, Interposes communication, Building a test bench with threads and Interposes Communication,	3
Module – 4: Coverage		
4.1	Coverage types, Coverage strategies, Simple coverage example	2
4.2	Anatomy of Cover group and Triggering a Cover group, Coverage options.	2
4.3	SV ATM example, Data abstraction, Interface encapsulation, Design top level, Receivers and transmitters, Test bench.	4
Module – 5: Advanced Hardware Description Languages		
5.1	Chisel: Basic Components: Signal Types and Constants, building Combinational and Sequential Circuits, Structure with Bundle and Vec, Wire, Reg, and IO, Chisel Generates Hardware, Writing simple examples and testing.	3
5.2	MyHDL-Introduction to MyHDL, Signals and concurrency, Parameters, ports and hierarchy: create a higher-level function with four instances of the lower-level functions.	2
5.3	PyMTL: Why PyMTL, The PyMTL Workflow, PyMTL basics which serve as the foundation for productive multi-level modelling and VLSI design, hardware implementation of a variant of Fletcher's checksum algorithm, Modelling Processors in PyMTL, Multi-Level Composition in PyMTL.	3
Total No. of Lecture Hours		**40**
Total No. of Lab Hours		**12**

Digital Systems Design using HDVL Laboratory

Part-A	
Simulate, Synthesis and Implement (Physical Design) (using NC Sim, Genesis and Innovus tools) following circuit by HDL based design entry using Cadence tool (ASIC/SoC flow).	
Exp 1	Combinational Circuits- adders (min 8 bit) and multipliers (4 bit min).
Exp 2	Sequential Circuits- 4 bit Synchronous and Asynchronous Counter
Exp 3	Implementation of FSM based design for 4-way 2 line traffic light controller
Part-B	
Write the SV code for the following and execute using any EDA tool like CADENCE.	
Exp 4	Write the test bench using SV for FSM based 4-way 2 line traffic light controller DUT.
Exp 5	Evaluate the test vectors using randomization technique in SV for FSM based 4-way 2 line traffic light controller DUT.
Exp 6	Design the interfaces in SV for FSM based 4-way 2 line traffic light controller DUT.

Textbooks:

1. Samir Palnitkar, “Verilog HDL”, Published by Pearson Education 2003.
2. Chris Spear, “System Verilog for Verification – A guide to learning the Test bench language features”, 2nd Edition, Springer Publications, 2010.
3. Pong P. Chu, “FPGA Prototyping by Verilog Examples”, Wiley, 2008
4. Digital Design with Chisel, Martin Schoeberl, 3rd edition, Kindle Direct Publishing.
5. J. Decaluwe. MyHDL: A Python-based Hardware Description Language. Linux journal, 2004(127):5, Nov. 2004.

Reference Books:

1. Lattice Semiconductor Corporation, “A verilog HDL Test bench Primer”, 1999
2. Ming Bo Lin, “Advanced Digital Design using Verilog HDL”, TMH, 2008
3. Clive Maxfield, “The Design Warrior’s Guide to FPGAs”, Mentor Graphics-Xilinix, Elsevier, 2004.

4. Stuart Sutherland, Simon Davidmann, Peter Flake, “System Verilog for Design A guide to using system Verilog for Hardware design and modelling”, 2nd Edition, Springer Publications, 2006.

5. Stuart Sutherland, “RTL modelling with System Verilog for simulation and synthesis: using System Verilog for ASIC and FPGA design” Tualatin, 2017

Online Resources:

1. http://www.myhdl.org/
2. https://www.csl.cornell.edu/courses/ece4750/handouts/ece4750-tut3-pymtl.pdf
3. https://www.csl.cornell.edu/pymtl2019/

Course Code: BEC403 **Course: Signals and Systems**

Credits: 4 **L:T:P – 3:2:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	None
Learning objectives	• To understanding the basic characteristics of signals and systems in both continuous time and discrete time. • To develop mathematical skills to analyse and solve the problems involving convolution, filtering, and sampling. • To provide insights into advanced subjects like digital signal processing, Digital Image Processing, communication system and control systems through different transformation techniques (Fourier Transforms and Z-Transform).

Course Outcome:

On successful completion of the course, the students will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand CT and DT signals and systems using mathematical model.	L1
CO2	Apply mathematical equations for the representation of LTI systems	L2
CO3	Apply various transformation technique to analyse and solve an efficient signal processing and Linear Time Invariant (LTI) Systems.	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3			3									3	3	2
CO2	3	3			3									3	3	2
CO3	3	3			3									3	3	2

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1 Introduction to Signals	No. of Lecture Hours	No. of Tutorial Hours
1.1	Definitions of signal	1	4
1.2	classification of signals	2	
1.3	Basic elementary signals	2	
1.4	Basic operations on signals	3	
	Module – 2 Introduction to Systems:		
2.1	Definitions of system	1	6
2.2	Properties of systems	2	
2.3	Systems viewed as interconnections of operations	1	
2.4	Difference equations	2	
2.5	Block diagram representations of a LTI system	2	
	Module 3: LTI System		
3.1	Introduction to Impulse response representation,	1	4
3.2	Convolution- convolution sum,	2	
3.3	Properties of convolution sum	2	
3.4	Properties of impulse response representation	2	
3.5	Step Response of LTI system	1	
	Module 4: Fourier and Z-transforms for Signals:		
4.1	Fourier representation: Fourier representations for four signal classes, orthogonality of complex sinusoidal signals	1	4
4.2	Properties of Fourier representations (Only DTFS)	1	
4.3	Discrete-Time-Fourier-Series representations (DTFS)	1	
4.4	Discrete-Time-Fourier-Transform representations (DTFT)	2	
4.5	Z-transform: Properties of ROC, Inverse Z-transform	2	

4.6	transforms analysis of LTI systems, transfer function, stability, and causality	2	
Module 5: Sampling and Reconstruction:			
5.1	Sampling of Continuous time signals and reconstruction of Continuous time signals from samples	2	4
5.2	Sampling Theorem, Aliasing, and its effects.	2	
5.3	Applications: Different Types of sensors for signal processing applications,	2	
5.4	Interfacing of the sensors and actuators, Biomedical Signal (ECG) storage and its analysis using tools like Arduino/Lab view/HRV/ELVIS/MATLAB.	2	2
Total no of Lecture Hours		**40**	**-**
Total no of Tutorial Hours			**26**

Textbook:

1. "Signals and Systems", Simon Haskin and Barry Van Veen, John Wiley and Sons, Ed-2, John Wiley, Indian Ed, 2008, Reprint 2012.

Reference Books:

1. "Signals and Systems: Analysis of signals through Linear Systems", Michel J Roberts, Tata McGraw Hill, 2004.
2. "Signals and Systems", Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, Pearson Education Asia, 2nd Edition, 2014.

Online Resources:

1. NPTEL lecture Video on Signals and Systems by Prof. S. C. Dutt Roy, http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html
2. http://www.scilab.org/
3. https://octave-online.net/ and http://www.gnu.org/software/octave/
4. http://www.vlab.co.in and http://www.arduino.cc

Course Code: BECL404 **Course: ARM Laboratory**

Credits: 1 **L:T:P – 0:0:2**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 2 Hrs **Max. Marks: 50**

Prerequisites if any	Digital Electronics, Computer Architecture and C Lab
Learning objectives	• Understanding the set of the assembly language instructions and assembly language programming structure. • Understanding the embedded C language program structure, analyse and debugging the programming logic.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Develop and implement assembly level language programs for ARM CortexM3 based LPC17EC microcontroller using Keil software tool.	L4
CO2	Design and implement Embedded System applications using Embedded C language for ARM CortexM3 based LPC17EC microcontroller.	L3

Mapping with PO's and PSO's:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	2	2	-	-	1	3	1	-	2	3	2	2
CO2	1	2	3	2	2	-	-	1	3	1	-	2	3	2	2

Mapping Strength: Strong – 3 Medium – 2 Low – 1

Course Structure

PART-A	
Sl. No	Develop and demonstrate the following operation with the help of a suitable program in ALP using ARM Cortex M3 Evaluation board and the required software tool
1	Data transfer operations
2	Arithmetic operations
3	Logical operations
4	Code Conversions
Part - B	
Sl. No	Conduct the following experiments on an ARM CORTEX M3 evaluation board using Embedded 'C' & Keil Micro vision (Keil µvision) tool / compiler.
1	Interface a simple Switch and display its status through Relay, Buzzer and LED.
2	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
3	Interface a 4x4 keyboard and display the key code on an LCD.
4	Interface DC Motors, Stepper Motor, and Servo Motor rotate clockwise, anticlockwise and in angle (45^o, 90^o, 180^o).
5	Generate different delay using Timers and count external pulses using counters
6	Generate an Interrupt process and demonstrate the use of an external interrupt to toggle an LED On/Off.
7	Using the Internal PWM module of ARM controller generate PWM and vary its duty cycle to Speed Control of DC motor and to change the intensity of Light.
8	Generate non-sinusoidal and sinusoidal waveforms with variable amplitude and frequency using internal DAC.
9	Display output for given analog input using internal ADC. (Use of Analog Sensors like Ultrasonic Sensor, Temperature, Humidity, Soil Moisture Sensor, PIR sensor)
10	Interface Bluetooth Module, GPS module, GSM module, RF module and RFID cards to send & receive Data using internal UARTs.

Course Code: BEC405A **Course: Applied Numerical Methods**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Engineering Mathematics
Learning objectives	• Understanding the numerical methods

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Analyse errors arising in numerical computation of solutions to mathematical and applied problems.	L3
CO2	Apply numerical techniques to compute approximate solutions of nonlinear equations and differential equations and analyse error issues	L2
CO3	Apply numerical techniques for interpolation, differentiation and quadrature problems and analyse error issues.	L2
CO4	Communicate advantages and disadvantages of various numerical techniques and select appropriate numerical methods for specific problems	L1

Mapping with PO's and PSO's:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										2		
CO2	3	2	1										2		
CO3	3	2	1										2		
CO4	3	2	1										2		

Mapping Strength: Strong – 3 Medium – 2 Low – 1

Course Structure

	Module – 1: Taylor series	No. of Lecture Hours
1.1	Taylor series: Nested multiplication and Horner's algorithm.	4
1.2	Floating-point representation. Roundoff error. Loss of significance.	4
	Module – 2: Nonlinear Equations	
2.1	Nonlinear Equations: Bisection method. Newton's method. Secant method. Fixed-point iteration.	4
2.2	Interpolation and Numerical Differentiation: Polynomial interpolation. Cubic splines. B-splines. Estimating derivatives.	4
	Module – 3: Numerical Integration	
3.1	Numerical Integration: Trapezoid, Simpson's and Newton-Cotes rules. Gaussian quadrature.	4
3.2	Linear Systems: Gaussian elimination. Gaussian elimination with scaled partial pivoting.	4
	Module – 4: Condition Numbers	
4.1	Condition Numbers. Tridiagonal and banded systems. LU decomposition. Eigenvalues and eigenvectors. Singular value decomposition. Power method. Aitken acceleration. Inverse and shifted inverse power method. Linear least squares.	5
4.2	Initial Values Problems: Vector fields. Taylor series methods. Euler's method. Types of errors. Runge-Kutta methods.	3
	Module – 5: Partial Differential Equations	
5.1	Partial Differential Equations: Parabolic problems: heat equation model. Finite-differences and Crank-Nicolson methods.	4
5.2	Hyperbolic problems: wave equation model. Lax and upwind models. Elliptic problems: Helmholtz equation. Finite-element methods.	4
	Total No. of Lecture Hours	**40**

Textbooks:

1. Numerical Mathematics and Computing, 7th international edition, 2013, Authors: Ward Cheney, David Kincaid, Cengage Learning.
2. Scientific Computing: An Introductory Survey, 2nd international edition, 2001, Author: Michael T. Heath, McGraw-Hill Europe.

Course Code: BEC405B **Course: Industrial Electronics**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	Analog Electronic Circuits
Learning objectives	• To give an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics. • To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC-AC converters and Power supplies • To explain the working of actuators and medical equipment's • To explain PLCs and develop applications • To apply the knowledge in industrial heating and high voltage equipment's

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	Course Outcomes	Bloom's level
CO1	Analyse operation, model, characteristics, and turn-on and turn- off methods of power devices	L2
CO2	Analyse, evaluate and apply the power converter circuits in Industry	L2
CO3	Explain principle of working of actuators	L1
CO4	Apply the knowledge in the Domestic/Industrial control system applications.	L3
CO5	Analyse operation of PLCs and Automation	L2

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2										1		3		
CO2	3	3	3									1		3		
CO3	3	2										1				
CO4	3	3	2		2							1				
CO5	3	2										1		2		

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Module – 1:Introduction to power electronics and power devices		No. of Lecture Hours
1.1	Introduction: Applications of power electronics, power semiconductor devices, control characteristics, types of power electronic circuits, peripheral effects.	3
1.2	SCR and Thyristor: Principles of operation and characteristics of SCR, Triggering of Thyristors, Uni-junction Transistor.	5
Module – 2: Applications of power electronics		
2.1	Controlled rectifiers: Introduction, principle of phase-controlled converter operation	1
2.2	DC Choppers: Introduction, principle of step-down operation, step-down chopper with R- L loads	2
2.3	Inverters: Introduction, principle of operation, single phase bridge inverters Power supplies, switched- mode DC power supplies and configurations, AC power supplies (UPS only)	5
Module – 3 : Actuators and medical equipment’s		

3.1	Actuators: DC and AC stepper motors, Dosing equipment weigh feeders, dosing pumps, extrusion – bulk and film electronic components.	6
3.2	Medical equipment's.	2
Module – 4 :PLCs and Automation		
4.1	Programmable controllers and PLCs. Rotory encoders, digipots.	4
4.2	Automation: Transfer machines, robotics basics, Application of PLCs,	4
Module – 5 : Industrial heating and high voltage equipment's		
5.1	Industrial heating: Arc furnace, high frequency heating, High frequency source for induction heating, dielectric heating and microwave heating, Ultrasonic- Generation and applications.	5
5.2	High voltage equipment's: voltage multipliers, electrostatic charging	3
Total No. of Lecture Hours		**40**

Text Books:

1. Power Electronics - M. H. Rashid, Prentice Hall of India Pvt. Ltd., 2nd edition New Delhi, 2002.
2. Charles A. Schuler and William.L. Mc. Namee, "Indistrial Electronics and Robotics, International McGraw Hill, 1986.

Reference Books:

1. Power Electronics- M. D. Sing and Khanchandani K. B., Tata McGraw Hill Publishing Company Limited, Reprint 2001.
2. S. K. Bhattacharya and S. Chatterjee, "Industrial Electronics &Control", Tata Mc Graw Hill, 2003

Online Resources:

1. NPTEL course on power and industrial electronics, Industrial automation and control
2. Virtual labs

Course Code: BEC405C **Course: Operating Systems**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites	Computer Organization.
Learning Objectives	• To familiarize students with the foundations of operating system. • Understand different Operating system Structures and Services.

Course Outcomes:

On the successful completion of the course, the student will be able to,

CO's	Course Outcomes	Bloom's level
CO1	Understand & compare Operating system structures and CPU scheduling algorithms	L2
CO2	Apply various main memory management techniques	L3
CO3	Understand file management techniques and deadlock handling methods	L2
CO4	Analyse Disk scheduling algorithms and I/O operation implementation techniques	L4

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2									2	3	2	1
CO2	3	3	3									2	3	2	1
CO3	3	3	3									2	3	2	1
CO4	3	3	3									2	3	2	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Module–1		No. of Lecture Hours
1.1	Introduction to operating systems: Definition, User view and System view of the Operating system, Operating system structure, Operating system services	2
1.2	Process: Process concept, Process Control block, Context switching.	3
1.3	CPU Scheduling: Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, Round Robin	3
Module–2		
2.1	Memory Management: Swapping, Contiguous memory allocation: Fixed Partitioning, Variable Partitioning. Non-Contiguous memory allocation: Paging.	4
2.2	Virtual memory: Demand paging, Page replacement Algorithms: FIFO, Optimal, LRU.	4
Module–3		
3.1	File System Interface: File Concept, Access Methods: Sequential, Indexed, and Direct	4
3.2	File System Implementation: File-System Structure, Allocation Methods: Contiguous, Linked and Indexed.	4
Module–4		
4.1	Deadlocks: System model, deadlock characterization: Mutual Exclusion, Hold and Wait, Non pre-emption, Circular wait.	4
4.3	Deadlock Prevention, Deadlock Avoidance: Banker's algorithm.	4
Module–5		
5.1	Device Management: Disk Scheduling algorithms: FCFS, SSTF, SCAN.	4
5.2	I/O System: I/O hardware, Application I/O Interface	4
Total No. of Lecture Hours		**40**

Textbooks:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, 9th Edition (2016), Wiley India.
2. Andrew S. Tanenbaum, Modern Operating Systems, 2nd Edition (2001), Pearson Education, Asia.
3. Dhananjay, Dhamdhere. M , Operating System-concept based approach,3'd edition (2009), Tata McGraw Hill, Asia M Gopal, “Control Systems- Principles and Design”, TMH, Second Edition,2006.

Reference Books:

1. Robet Lovei Linux Kernel Development, (2004) Pearson Education
2. Richard Stevens, Stephen Rago, Advanced Programming in the UNIX Environment, 3rd Edition (2013), Pearson Education.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs88/

Course Code: BEC405D Course: Linear Integrated Circuits

Credits: 3 L:T:P – 3:0:0

CIE: 50% Marks SEE: 50% Marks

SEE Hours: 3 Hrs Max. Marks: 100

Prerequisites	Analog Electronic Circuits
Learning objectives	• To study and analyse differential amplifiers. • To understand OPAMP parameters and working of basic configurations • To apply Op-amp basics in building linear and nonlinear circuits • To understand Op-amp based ICS and their working.

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	Course Outcomes	Bloom's level
CO1	Understand and Analyze MOS Differential Amplifiers	L2, L3, L4
CO2	Design BJT and BIFET Op-amp based signal processing circuits	L2, L3, L4
CO3	Understand the fundamentals of data converters and apply for architectures	L2, L3
CO4	Understand Op-amp based special function ICs and design applications.	L2, L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3												
CO2	3	3	3		2										
CO3	3	3	3		2										
CO4	3	3	3		2										

3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1 : Differential and multistage amplifiers	No. of Lecture Hours
1.1	The MOS differential pair: operation with a common mode input voltage, operation with a differential input voltage, Large signal and small signal operations, The differential amplifiers with current mirror load, it's gain, G_m and R_D	5
1.2	Multistage Amplifiers: A two stage CMOS Op-Amp, input offset voltage.	1
1.3	Operational amplifier parameters	2
	Module – 2: Op-amp Signal processing circuits	
2.1	Op-amp as DC amplifiers: Biasing, voltage follower, non-inverting and inverting amplifiers, performance analysis	3
2.2	Analysis and design of Instrumentation amplifiers, Precision Rectifiers, Integrators, differentiators	5
2.3	Nonlinear circuits: Analysis and design Crossing detectors, Schmitt triggers	2
	Module – 3: Active Filters	
3.1	All pass filters, Low pass and high pass filters: Analysis and design of First and second order filters	4
3.2	Bandpass, Band stop, Biquad filters analysis	3
	Module – 4: Data Converters	
4.1	Fundamentals: Transfer characteristics, Offset error, Gain error, Integral and differential Non-linearity, Quantization error, S/N ratio, Dynamic Range	3
4.3	DAC architectures: R-2R DAC, Charge scaling DAC	2
4.4	ADC architectures: Flash ADC, SAR ADC	2
	Module – 5: Special function ICs	
5.1	Multivibrators: Astable and bistable operation using 555Timer IC	2

5.2	Voltage Regulators (78EC and 79EC): Voltage regulator basics, three terminal fixed and adjustable voltage regulators	3
5.3	Phase locked loop (565 IC): Basic principles, Phase detector / comparator, VCO(566 IC), Low pass filter, locking range, capture range	3
Total No. of Lecture Hours		**40**

Note: Design problems should be solved for BJT based and BI-FET based OPAMPS in module 2 and module3. Sufficient numerical should be solved in all the modules. Assignments may be worked out using simulators.

Suggested Learning Resources:

Text Books:

1. Adel S Sedra and Kennel C Smith, Microelectronic Circuits Theory and applications”,7th Edition, Oxford Publishers.
2. David A.Bell, Operational Amplifiers and Linear ICs”, Second Edition, PHI.
3. D. Roy Choudhury and Shail B Jain, “Linear Integrated Circuits”,4th Edition, New Age Techno Press.

Reference Books:

1. Bezad Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw-Hill 2002.
2. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits”,4th Edition, PHI
3. R .Jacob Baker, Harry W. Li and David E .Boyce,” Principles of Data Conversion systems”,1995.

Course Code: BEC456A **Course: Electronic Devices**

Credits: 1 **L:T:P – 1:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 2 Hrs **Max. Marks: 50**

Learning objectives	To understand the working principle of different non-linear electronic devices.

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	**Course Outcomes**	**Bloom's level**
CO1	Understand the internal working principle through analysing passive components of the electronics devices.	L1

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2									2	3	2	1

Mapping strength: 3 – Strong2 Medium1 – Low

Course Structure

Module – 1: Semiconductor Physics		No. of Lecture Hours
1.1	Energy bands in intrinsic and extrinsic silicon, carrier transport	3
1.2	Diffusion current, drift current, mobility and resistivity, sheet resistance, design of resistors.	3
Module – 2: MOSFET characteristics		

2.1	C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor.	3
2.2	Diode Current Equations.	3
Module – 3: Other Semiconductor Devices		
3.1	LED, Photo diode solar cells, Photo transistor.	4
Total No. of Lecture Hours		**16**

Textbooks:

1. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson, 2014.
2. D. Neamen, D. Biswas, "Semiconductor Physics and Devices," McGraw-Hill Education.
3. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, “Fundamentals of Solid-State Electronics,” World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, “Operation and Modelling of the MOS Transistor,” Oxford univ. press, 2011.
6. Muhammad H. Rashid, “Electronic Devices and Circuits,” Cengage publication, 2014.

Course Code: BEC456B **Course: LIC Lab using P Spice**

Credits: 1 **L:T:P – 0:0:2**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 2 Hrs **Max. Marks: 50**

Prerequisites if any	Analog Electronics, Network Theory
Learning objectives	• To understand the working of various Op Amp-based circuits. • To understand the working principle and applications of some special function ICs.

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	**Course Outcomes**	**Bloom's level**
CO1	Construct independent circuits, analyse and troubleshoot circuits containing opamps, resistors, diodes, capacitors and independent sources.	L2
CO2	Relate to the manufacturer's data sheets of IC 555 timer and IC µa741 op-amp.	L3
CO3	Realize and verify the operation of analog integrated circuits like Amplifiers, Precision Rectifiers, Comparators and Waveform generators, Active filters, Timer circuits, Data converters and compare the experimental results with theoretical values.	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3	3	3	2					1	1	1		3	3	1
CO2	3	3	3	3	2					1	1	1		3	3	1
CO3	3	3	3	3	2					1	1	1		3	3	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Sl No	List of Experiments
1	Design and verify op-amp based Inverting Amplifier and Non-Inverting Amplifier.
2	Design and verify op-amp based summing and differential Amplifier.
3	Design and verify the working of an Op-Amp based Integrator and Differentiator.
4	Design and verify the working of an Op-Amp based Precision Rectifiers.
5	Design and verify the working of an Op-Amp based Instrumentation Amplifier.
6	Design and verify the working of an Op-Amp based Comparator and Schmitt Trigger.
7	Design and verify the frequency response of various Op-Amp based Filters.
8	Design and implement 4 - bit R-2R Digital to Analog Converter.
9	Design and verify the working of an Astable and Monostable multivibrators using 555 timer IC.

Course Code: BEC456C **Course: LabVIEW Programming**

Credits: 1 **L:T:P – 0:0:2**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 2 Hrs **Max. Marks: 50**

Prerequisites if any	
Learning objectives	1. To understand the usage of LabVIEW software for data acquisition, analysis, display operations and interface options.

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	**Course Outcomes**	**Bloom's level**
CO1	Use Lab VIEW to create data acquisition, analysis and display operations	L3
CO2	Create and analyse user interfaces with charts, graph and buttons	L4
CO3	Analyse programming structures and data types that exist in Lab VIEW	L4

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3	3	3	2					1	1	1		3	3	1
CO2	3	3	3	3	2					1	1	1		3	3	1
CO3	3	3	3	3	2					1	1	1		3	3	1

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Sl No	List of Experiments
1	Basic arithmetic operations: addition, subtraction, multiplication and division. Boolean operations: AND, OR, XOR, NOT and NAND.
2	Sum of ‘n’ numbers using ‘for’ loop. Factorial of a given number using ‘for’ loop.
3	Determine square of a given number. Factorial of a given number using ‘while ‘loop.
4	Sorting even numbers using ‘while’ loop in an array.
5	Finding the array maximum and array minimum Demonstration Experiments.
6	Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
7	Build a Virtual Instrument that simulates a Basic Calculator (using formula node).
8	Build a Virtual Instrument that simulates a Water Level Detector.
9	Demonstrate how to create a basic VI which calculates the area and perimeter of a circle.

Course Code: BEC456D **Course: Risk Management in IoT implementation**

Credits: 1 **L:T:P – 0:0:2**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 2 Hrs **Max. Marks: 50**

Prerequisites if any	IoT
Learning objectives	To understand risk management analysis for IOT

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	Course Outcomes	Bloom's level
CO1	Identify the components and describe the process of risk assessment and apply appropriate methodologies to assess risk.	L3
CO2	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community	L3

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3	2	2					3		2			3	2	
CO2	3	3	2	2					3		2			3	2	

Mapping strength: 3 – Strong 2 – Medium 1 – Low

Course Structure

Module – 1		No. of Lecture Hours
1.1	Introduction to Risk Management and Risk Identification: Risk- Risk and Uncertainty-Types of Risk-Burden of Risk-Sources of Risk-Methods of handling Risk-Degree of Risk-Management of Risk.	3

1.2	Risk Management-Risk Management Process-Identification Loss exposures-Analysing Loss exposures-Objectives of Risk Management-Select the Appropriate Risk Management Technique- Implement and Monitor the Risk Management Program-Risk Management by Individuals and Corporations-Risk Management objectives-Need for a Rationale for Risk Management in Organizations- Understanding the cost of Risk-Individual Risk Management and the Cost of Risk-Risk Management and Societal Welfare.	3
Module – 2		
2.1	Risk Identification- Business Risk Exposures-Individual Exposures-Exposures of Physical Assets -Exposures of Financial Assets.	4
2.2	Exposures of Human Assets -Exposures to Legal Liability - Exposure to Work-Related Injury-Basic concepts form probability and Statistics.	
Module – 3		
3.1	Disaster risk management -Core elements and phases of Disaster Risk Management Measures for Disaster Risk Reduction - prevention, mitigation, and preparedness.	3
3.2	Disaster response- objectives, requirements; response planning; types of responses. Relief; international relief organizations.	3
Total No. of Lecture Hours		**16**

Textbook

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
2. UNDP, Disaster Risk Management Training Manual, 2016
3. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015
4. M. M. Sulphey, Disaster Management, PHI Learning, 2016

Course Code: BBOK407 **Course: Biology for Engineers**

Credits: 3 **L:T:P – 3:0:0**

CIE: 50% Marks **SEE: 50% Marks**

SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	
Learning objectives	• Develop a comprehensive understanding of biomimicry and its relevance to electronics and communication engineering. • Integrate biological principles into the design and innovation of electronic systems and communication technologies. • Evaluate the potential and challenges of biomimetic approaches in advancing engineering practices. • Foster interdisciplinary thinking and collaboration to solve complex engineering problems through biomimetic solutions.

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	**Course Outcomes**	**Bloom's level**
CO1	Able to comprehend and articulate the fundamental principles of biomimicry and its significance in engineering innovation.	L1
CO2	Identify and apply biological inspirations to develop innovative electronic systems, including sensors, actuators, and energy harvesting devices.	L1
CO3	Capable of designing and implementing communication systems inspired by biological methods, including the use of bio-inspired algorithms and swarm intelligence.	L2
CO4	Proficient in utilizing biomimetic materials and fabrication techniques to create advanced electronic components, emphasizing self-healing and nano-fabrication processes.	L2

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	1	3	3	3	1	3	1	1	3	3	2	2
CO2	1	1	3	1	3	3	3	1	3	1	1	3	3	2	2
CO3	1	1	3	1	3	3	3	1	3	1	1	3	3	2	2
CO4	1	1	3	1	3	3	3	1	3	1	1	3	3	2	2

3 – Strong 2 – Medium 1 – Low

Course Structure

Module 1: Introduction to Biomimicry		No. of Lecture Hours
1.1	Definition and history of biomimicry	1
1.2	Importance and applications in various fields	1
1.3	Principles of biomimicry: Nature as model, measure, and mentor	2
1.4	Case studies: Examples of biomimicry in nature	2
Module 2: Biological Inspirations in Electronic Systems		
2.1	Overview of biological systems and their functions	1
2.2	Bio-inspired sensors and actuators	2
2.3	Energy harvesting inspired by biological processes	2
2.4	Case studies: Bio-inspired electronic devices	1
Module 3: Biomimetic Communication Systems		
3.1	Communication methods in biological systems (e.g., neural networks, pheromones, echolocation)	2
3.2	Bio-inspired algorithms for communication networks	1
3.3	Swarm intelligence and its applications in communication	2

3.4	Case studies: Bio-inspired communication technologies	1
Module 4: Biomimetic Materials and Fabrication Techniques		
4.1	Properties of biomimetic materials	1
4.2	Nano- and micro-fabrication inspired by biological processes	2
4.3	Self-healing materials and their applications in electronics	2
4.4	Case studies: Innovative biomimetic materials and fabrication methods	1
Module 5: Future Directions and Challenges in Biomimicry		
5.1	Emerging trends in biomimicry for electronics and communication	1
5.2	Ethical and sustainability considerations in biomimicry	2
5.3	Challenges in integrating biomimicry into engineering practices	2
5.4	Interdisciplinary collaboration for advancing biomimetic research	1
Total No. of Lecture Hours		**40**

Suggested Learning Resources:

Textbooks:

1. "Biomimicry: Innovation Inspired by Nature" by Janine M. Benyus
2. "Biomimetics: Nature-Based Innovation" by Yoseph Bar-Cohen

Online resource link, if any.

https://www.youtube.com/watch?v=Muzfdq25Qbc

Reference Books:

1. "Biomimetics: Biologically Inspired Technologies" edited by Yoseph Bar-Cohen
2. "Biological Inspired Design: Computational Methods and Tools" edited by Ashok K. Goel, Daniel A. McAdams, and Robert B. Stone
3. "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies" by Dario Floreano and Claudio Mattiussi