

BVVS

Basaveshwar Engineering College, Bagalkote
Department of Electronics and Communication Engineering
Vision, Mission Statements and Values

Vision

To achieve excellence in electronics and communication engineering through quality education and research for developing competent professionals.

Mission

1. Foster a dynamic teaching and learning process.
2. Encourage research through innovation and collaboration.
3. Imbibe moral, ethical values and social responsibilities.

Values

The values of the department are

1. Work is Worship
2. Ethics and Integrity
3. Empathy and Compassion
4. Indian Ethos
5. Mutual Respect

BVVS
Basaveshwar Engineering College, Bagalkote
Department of Electronics and Communication Engineering
SWOC Analysis

S: Strength:

1. Infrastructure
 - i. ICT enabled classrooms/seminar hall with good ambience
 - ii. Well equipped laboratories to cater curriculum requirements
 - iii. Department library with good number of titles and volumes
 - iv. Scope for academic extension programmes.
2. Faculty
 - i. 75% of faculty with Ph.D
 - ii. Faculty with minimum of 12 years teaching experience
 - iii. Faculty retention ratio is 100 %.
3. Students
 - i. Students with academic and competitive bent of mind
 - ii. 75% of the students are placed in reputed industries
 - iii. 10% to 15% of the students are registering for B.E. Honours Degree.
4. Curriculum
 - i. Research and industry oriented adaptive curriculum
 - ii. Curriculum with integrated courses.
5. Alumni
 - i. Alumni works in reputed organizations across the world.
 - ii. Alumni interactions with students and faculty to bridge the gap between campus and corporate.

W: Weakness:

1. IPR competencies are inadequate
2. Relatively less number of memberships in professional bodies
3. Limited collaborative activities
4. Less number of inter-disciplinary courses and projects
5. Less number of industry supported laboratories/courses
6. Inadequate number of funded projects
7. Less scope for co-curricular and cultural activities.

O: Opportunities:

1. Establishment of Distant Learning Center (DLC) using existing resources
2. Participation in collaborative projects/ research work with allied institutions
3. Fostering alumni participation in academics and placement activities
4. Establishment of Skilling Centers for students
5. Faculty exchange programs with academia and industry
6. Organizing conferences
7. Facilitating incubation centers for alumni
8. Scope for academic extension programmes
9. Training on computer usage/ programming languages for general public
10. Enhancing consultancy activities.

C: Challenges:

1. To incorporate experiential teaching learning process
2. Adapting curriculum to future industry needs
3. Fostering collaboration to enhance research, innovation and entrepreneurship activities
4. Attracting diversified students
5. Strategies to strengthen the placement activities for higher packages and core companies
6. Secure additional research grants and consultancy opportunities
7. Enhance quality publications and file patents.

Programme Outcomes

- a) **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f) **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k) **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

1. Analyze and design systems for electronics, communication, and signal processing applications
2. Use domain specific tools for design, analysis, synthesis, and validation of VLSI and embedded systems
3. Demonstrate the conceptual knowledge with respect to architecture, design analysis and simulation of computer networking and applications.

Programme Educational Objectives (PEOs)

PEO1: Our graduates will be able to lead a successful career by solving complex Engineering Problems of society/industry

PEO2: Enable graduates to excel in academia, industry, entrepreneurship and engage in research and lifelong learning

PEO3: Graduates will be able to work effectively as individuals in multidisciplinary environments with high integrity, ethics, human values and societal responsibilities

PEO4: Graduates will be able to exhibit strong leadership, communication, and teamwork skills to succeed in dynamic professional environments and contribute to the global challenges

Curriculum Framework for BE Program
(For the Students admitted to first year from 2024-2025 onwards and to 2nd year lateral entry from 2025-2026 onwards)

S.No.	Category	VTU	AICTE	BEC Present	BEC Revised
1.	HSMC: HSS (English:2, Kannada:1, UHV,: 1 Constitution:1, EV:1), HRM:3 (Offered by Dept) = 9 AEC (Scientific foundations of Health: 1, Innovation and design Thinking: 1, SS:2, IKS: 1, MOOCS: 3) = 08	14+8 =22	15	9+10 =19	9+8 =17
2.	BSC: Basic Science Courses (Physics, Chemistry and Mathematics)	22	23	22	22
3.	ESC/ETC: Engineering Science Courses (Basic Elect/Electronics/Computer/Mechanics/Workshop/Drawing etc.)	18	17	18	18
4.	PCC: Professional Core Courses	57	61	56	61
5.	PEC: Professional Elective Courses relevant to the branch with at least one course either fully or partially supported by industry	12	12	12	12
6.	OEC: Open Electives Courses/ Subjects from other technical/Arts/Commerce (3 MOOCS + 6)	9	12	09	09
7.	Mini (2) and Major projects (9)/Industrial Internships (10)	20	20	24	21
8.	Mandatory Course: PE, Yoga, NSS, Bridge course Maths 1 and 2 (lateral Entry)	00	00	00	00
Total		160	160	160	160

Suggestive Break-up of Credits for B.E (Common to all Branches)

(For the Students admitted to first year from 2024-2025 onwards and to 2nd year lateral entry from 2025-2026 onwards)

Sem.	BSC	ESC/ETC	HSMC	AEC	PCC	PEC	OEC	Proj.	Int.	Total
1.	08	09	02	1(SFH)						20
2.	08	09	02	1(IDT)						20
3.	03				17					20
4.	03		01		16					20
5.			01	2 (SS)	09	03	03	02		20
6.				1(IKS)	13	03	03			20
7.			03		06	06		09		24
8.				3 (MOOCS)			3 (MOOCS)		10	16
Tot.	22	18	09	08	61	12	09	11	10	160

I SEMESTER (Physics Cycle)

Sl. No	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
1	ASC (IC)	BMAE101C	Mathematics-I	Maths Dept.	3	0	2	0	3	50	50	100	4
2	ASC (IC)	BPHE102C	Physics for Electrical Sciences	Physics Dept.	3	0	2	0	3	50	50	100	4
3	ESC	BECA103C	Basic Electronics	Dept.	3	0	0	0	3	50	50	100	3
4	ESC-I	BCSA104N	Engineering Science Course-I	Dept.	2/3	0/0	2/0	0	3	50	50	100	3
5	ETC-I	BECB105B	Emerging Technology Course-I	Dept.	3	0	0	0	3	50	50	100	3
7	HSMC	BHSA106C	Communicative English	HSS Dept.	1	0	0	0	1	50	50	100	1
8	HSMC	BHSA107C	Indian Constitution	HSS Dept.	1	0	0	0	1	50	50	100	1
9	AEC	BHSA108C	Scientific Foundations of Health	HSS Dept.	1	0	0	0	1	50	50	100	1
				Total	17	0	6	0	18	400	400	800	20

Sl. No.	Emerging Technology Course-I ETC-I	Engineering Science Course-I ESC-I	Engineering Science Course ESC
1.	Introduction to Embedded System	Introduction to C Programming	Basic Electronics
2.	Smart Materials and Systems	Introduction to Electronics & Communication	
3.	Introduction to Nano Technology		
4.	Introduction to Sustainable Engineering		
5.	Introduction to Internet of Things (IOT)		

Note: Department is offering Subject: Introduction to Electronics & Communication (22UEC114N/214N) to other department students

I SEMESTER (Chemistry Cycle)

Sl. No .	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
1	ASC (IC)	BMAE201C	Mathematics-II	Maths Dept.	3	0	2	0	3	50	50	100	4
2	ASC (IC)	BCHE202C	Chemistry for Electrical Sciences	Chemistry Dept.	3	0	2	0	3	50	50	100	4
3	ESC	BMEB203C	Computer Aided Engineering & Drawing	Civil / Mechanical Dept.	2	0	2	0	3	50	50	100	3
4	ESC-II	BXXXXX	Engineering Science Course-II	EEE Dept.	3	0	0	0	3	50	50	100	3
5	PLC-II	BXXXXX	Programming Language Course-II	Dept.	2	0	2	0	3	50	50	100	3
6	AEC	BXXXXX	Professional Writing Skills in English	HSS Dept.	1	0	0	0	1	50	50	100	1
7	HSM C	BHSAXXX	Sanskritika Kannada	HSS Dept.	1	0	0	0	1	50	50	100	1
8		BHSBXXX	Balake Kannada										
9	SDC		Innovation and Design Thinking	Dept.	1	0	0	0	1	50	50	100	1
				Total	16	0	8	0	24	400	400	800	20

Sl. No.	Programming Language Course-II PLC-II	Engineering Science Course-II ESC-II	Engineering Science Course ESC
1.	Introduction to C++ Programming	Introduction to Electrical Engineering	CAED
2.	Introduction to Python Programming	Introduction to Electronics & Communication	
3.	Basics of JAVA programming		

II SEMESTER (Physics Cycle)

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical /Drawing	Self-Study Compon	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
1	ASC (IC)	BMAE201C	Mathematics-I for Electrical and Electronics Engineering stream	Maths Dept.	3	0	2	0	3	50	50	100	4
2	ASC (IC)	BCHE202C	Physics for Electrical Sciences	Physics Dept.	3	0	2	0	3	50	50	100	4
3	ESC	BECA203C	Basic Electronics	Dept.	3	0	0	0	3	50	50	100	3
4	ESC-I	BCSA204N	Engineering Science Course-I	Dept.	2/3	0/0	2/0	0	3	50	50	100	3
5	ETC-I	BECB205B	Emerging Technology Course-I	Dept.	3	0	0	0	3	50	50	100	3
7	HSMC	BHSA206C	Communicative English	HSS Dept.	1	0	0	0	1	50	50	100	1
8	HSMC	BHSA207C	Indian Constitution	HSS Dept.	1	0	0	0	1	50	50	100	1
9	AEC	BHSA208C	Scientific Foundations of Health	Dept.	1	0	0	0	1	50	50	100	1
				Total	17	0	6	0	18	400	400	800	20
	Sl. No.	Emerging Technology Course-I ETC-I		Engineering Science Course-I ESC-I					Engineering Science Course ESC				
	1.	Introduction to Embedded System		Introduction to C Programming					Basic Electronics				
	2.	Smart Materials and Systems		Introduction to Electronics & Communication									
	3.	Introduction to Nano Technology											
	4.	Introduction to Sustainable Engineering											
	5.	Introduction to Internet of Things (IOT)											

Note: Department is offering Subject: Introduction to Electronics & Communication (22UEC114N/214N) to other department students

II SEMESTER (Chemistry Cycle)

Sl. No	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
1	ASC (IC)	BMAE 201C	Mathematics-II I for Electrical and Electronics Engineering stream	Maths Dept.	3	0	2	0	3	50	50	100	4
2	ASC (IC)	BCHE 202C	Chemistry for Electrical Sciences	Chemistry Dept.	3	0	2	0	3	50	50	100	4
3	ESC	BMEB 203C	Computer Aided Engineering & Drawing	Civil / Mechanical Dept.	2	0	2	0	3	50	50	100	3
4	ESC-II	BXXX XX	Engineering Science Course-II	EEE Dept.	3	0	0	0	3	50	50	100	3
5	PLC-II	BXXX XX	Programming Language Course-II	Dept.	2	0	2	0	3	50	50	100	3
6	AEC	BXXX XX	Professional Writing Skills in English	HSS Dept.	1	0	0	0	1	50	50	100	1
7	HSM C	BHSA XXX	Sanskritika Kannada	HSS Dept.	1	0	0	0	1	50	50	100	1
8		BHSB XXX	Balake Kannada										
9	SDC		Innovation and Design Thinking	Dept.	1	0	0	0	1	50	50	100	1
				Total	16	0	8	0	24	400	400	800	20

Sl. No	Programming Language Course-II (PLC-II)	Engineering Science Course-II (ESC-II)	Engineering Science Course (ESC)
1.	Introduction to C++ Programming	Introduction to Electrical Engineering	CAED
2.	Introduction to Python Programming	Introduction to Electronics & Communication	
3.	Basics of JAVA programming		

III SEMESTER													
Sl. No	Course	Course Code	Course Title	Teaching Department and Question Paper Setting Board	Teaching Hours/Week				Examination				Credits
					Lecture	Tutorial	Practical	SDA	Duration In hours	CIE Marks	SEE Marks	Total Marks	
1.	BSC	BMAE301C	Mathematics – III for Electrical Science Stream	MATHEMATICS	3	0	0	0	03	50	50	100	3
2.	PCC	BECA301C	Digital System Design using Verilog	ECE DEPT.	3	0	0	0	03	50	50	100	3
3.	PCC	BECA302C	Electronic Circuits	ECE DEPT.	3	0	0	0	03	50	50	100	3
4.	PCC	BECA303C	Network Analysis	ECE DEPT.	3	0	0	0	03	50	50	100	3
5.	PCC	BECA304C	Data Structures using C++	ECE DEPT.	3	0	0	0	03	50	50	100	3
6.	PCC	BECA305C	Basics of AI&ML	ECE Dept	3	0	0	0	03	50	50	100	3
7.	PCCL	BECA306L	Digital System Design using Verilog Laboratory	ECE Dept	0	0	2	0	03	50	50	100	1
8.	PCCL	BEC307L	Electronic Devices and Circuits Laboratory	ECE DEPT.	0	0	2	0	03	50	50	100	1
9.	MC	BHSA360M	Yoga	Yoga Teacher	0	0	2			100	---	100	0
		BHSB360M	National Service Scheme (NSS)	NSS Coordinator									
		BHSC360M	Physical Education (PE) (Sport sand Athletics)	Physical Education Director									
Total					18	0	6		24	500	400	900	20
PCC: Professional Core Course, PCCL: Professional Core Course Laboratory, MC: Mandatory Course (Non-credit), AEC: Ability Enhancement Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Examination, SDA: Self Study													

IV SEMESTER													
Sl. N o	Course	Course Code	Course Title	Teaching Department and Question Paper Setting Board	Teaching Hours/Week				Examination				Credits
					Lecture	Tutorial	Practical	SDA	Duration In hours	CIE Marks	SEE Marks	Total Marks	
1.	PCC	BECA401C	Signals and Systems	ECE DEPT.	3	0	0	0	03	50	50	100	3
2.	PCC	BECA402C	Analog and Digital Communication	ECE DEPT.	3	0	0	0	03	50	50	100	3
3.	PCC	BECA403C	Linear Integrated Circuits	ECE DEPT.	3	0	0	0	03	50	50	100	3
4.	PCC	BECA404C	ARM Microcontrollers	ECE DEPT.	3	0	0	0	03	50	50	100	3
5.	BSC	BBTA405C	Biology for Engineers	BT DEPT.	3	0	0	0	03	50	50	100	3
6.	HSMC	BHSA424C	Universal human values	ECE DEPT.	1	0	0	0	01	50	50	100	1
7.	PCCL	BECA405L	Communication Engineering Laboratory	ECE DEPT.	0	0	3	0	03	50	50	100	1.5
8.	PCCL	BECA406L	Linear Integrated Circuits Laboratory	ECE DEPT.	0	0	3	0	03	50	50	100	1.5
9.	PCCL	BECA407L	ARM Microcontroller Laboratory	ECE DEPT	0	0	2	0	03	50	50	100	1
10.	MC	BHSA460M	Yoga	Yoga Teacher	0	0	2			100	---	100	0
		BHSB460M	National Service Scheme (NSS)	NSS COORDINATOR									
		BHSC460M	Physical Education (PE) (Sport sand Athletics)	PHYSICAL EDUCATION DIRECTOR									
Total					16	0	08	00	25	550	450	1000	20
PCC: Professional Core Course, PCCL: Professional Core Course Laboratory, HSMC: MC: Mandatory Course (Non-credit), L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Examination, AC: Audit Course, SDA: Self Study													

V SEMESTER													
Sl. No	Course	Course Code	Course Title	Teaching Department and Question Paper Setting Board	Teaching Hours/Week				Examination				Credits
					Lecture	Tutorial	Practical	SDA	Duration In Hours	CIE Marks	SEE Marks	Total Marks	
1.	PCC	BECA501C	Digital Signal Processing	ECE DEPT.	3	0	0	0	03	50	50	100	3
2.	PCC	BECA502C	Computer Networks	ECE DEPT.	3	0	0	0	03	50	50	100	3
3.	PEC	BECX503E	Professional Elective Course	ECE DEPT.	3	0	0	0	03	50	50	100	3
4.	OEC	BECXXXXN	Open Elective Course	Other Dept	3	0	0	0	03	50	50	100	3
5.	AC	BHSXXXXC	Qualitative Aptitude and Soft Skills	TPC	1	3	0	0	02	50	50	100	2
6.	PROJ	BECA504P	Mini Project	ECE DEPT.	0	0	4	0	03	100	00	100	2
7.	HSMC	BBTAXXXC	Environmental Studies	BT DEPT.	1	0	0	0	03	50	50	100	1
8.	PCCL	BECA505L	Computer Networks Laboratory	ECE DEPT.	0	0	3	0	03	50	50	100	1
9.	PCCL	BECA506L	Digital Signal Processing Laboratory	ECE DEPT.	0	0	3	0	03	50	50	100	1
10.	PCCL	BECA507L	Data Structures Using C++ Laboratory	ECE DEPT.	0	0	3	0	03	50	50	100	1
11.	MC	BHSA560M	Yoga	Yoga Teacher	0	0	2	0	0	100	0	100	0
		BHSB560M	National Service Scheme (NSS)	NSS Coordinator									
		BHSC506M	Physical Education (Sports and Athletics)	PE Director									
Total					14	03	12	00	26	650	450	1100	20

Professional Elective Course (PEC)		Open Elective Course (OEC)	
Java Programming	BECA503E	Communication Systems	
Mobile Communication	BECB503E	Fuzzy Logic	
Speech Processing	BECC503E	Micro Electro Mechanical Systems	
CMOS Analog VLSI Design	BECD503E		
Advanced Python Programming	BECE503E		

PCC: Professional Core Course, **PCCL:** Professional Core Course Laboratory, **UHV:** Universal Human Value, **MC:** Mandatory Course (Non-credit), **L:** Lecture, **OEC:** Open Elective Course, **PEC:** Professional Elective Course, Tutorial, P: Practical **S= SDA:** Skill Development Activity, AC: Audit Course, HSMC:

VI SEMESTER													
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1.	PCC	BECA601C	Electromagnetic Theory	ECE DEPT	3	0	0	0	03	50	50	100	3
2.	PCC	BECA602C	Control Systems	ECE Dept	3	0	0	0	03	50	50	100	3
3.	PCC	BECA603C	CMOS Digital VLSI Design	ECE DEPT	3	0	0	0	03	50	50	100	3
4.	PCC	BECA604C	Multimedia Communication	ECE Dept	2	0	0	0	03	50	50	100	2
5.	PEC	BECX605E	Professional Elective Course	ECE DEPT	3	0	0	0	03	50	50	100	3
6.	OEC	BECXXXXN	Open Elective Course	RESPECTIVEDEPT	3	0	0	0	03	50	50	100	3
7.	AEC	BECA606C	Indian Knowledge System	ECE DEPT	1	0	0	0	03	50	50	100	1
8.	PCCL	BECA607L	Robotics Laboratory		0	0	2	0	03	50	50	100	1
9.	PCCL	BECA608L	CMOS VLSI Design Laboratory	ECE DEPT	0	0	2	0	03	50	50	100	1
10.	MC	BHSA660M	Yoga	YOGATEACHER	0	0	2			100	---	100	0
		BHSB660M	National Service Scheme(NSS)	NSSCOORDINATOR									
		BHSC660M	Physical Education(PE) (Sports and Athletics)	PHYSICALEDUCATION DIRECTOR									
Total					18	0	06	00	27	550	400	950	20

Sl. No.	Professional Elective Course (PEC)	Subject Code	Open Elective Course (OE)	Subject Code
1.	Robotics and Automation	BECA605E	Sensor Technology	
2.	Digital Image Processing	BECB605E	Wireless Networks and Mobile Architecture	
3.	Nanotechnology	BECC605E		
4.	Embedded System Design using Embedded C	BECD605E		
5.	Micro Electro Mechanical Systems	BECE605E		

PCC: Professional Core Course, **PCCL:** Professional Core Course Laboratory, **UHV:** Universal Human Value, **MC:** Mandatory Course (Non-credit), **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity,

VII SEMESTER (Swappable VII and VIII SEMESTER)													
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	PCC	BECA701C	Microwave Engineering and Antenna Theory	ECE DEPT	3	0	0	0	03	50	50	100	3
2.	PCC	BECA702C	Information Theory and Coding	ECE DEPT	3	0	0	0	03	50	50	100	3
3.	HSMC	BHSXXXXC	Research Methodology & IPR	ECE DEPT	2	0	0	0	03	50	50	100	2
4.	PEC	BECX703E	Professional Elective Course – I	RESPTIVE DEPT	3	0	0	0	03	50	50	100	3
5.	OEC	BECX704E	Professional Elective Course - II	ECE DEPT	3	0	0	0	03	50	50	100	3
6.	PCCL	BECA705L	Advanced Communication Laboratory	ECE DEPT	0	0	2	0	03	50	50	100	1
7.	PROJ	BECA706P	Major Project	ECE DEPT	0	0	18	0	03	100	100	200	9
					14	0	20	0	21	400	400	800	24

Sl. No.	Professional Elective Course (PEC)	Subject Code	Professional Elective Course (PEC)	Subject Code
1.	Application Specific Integrated Circuit	BECA703E	Automotive Electronics	BECA704E
2.	Wireless AdHoc Networks (AVS)	BECB703E	Sensors and Actuators	BECB704E
3.	Cyber Security	BECC703E	Satellite Communication	BECB703E
4.	Fiber Optics and Networks	BECD703E	Wireless Sensor Networks (AVS)	
	Digital Verification	BECE703E		
PCC: Professional Core Course, PCCL: Professional Core Course Laboratory, UHV: Universal Human Value, MC: Mandatory Course (Non-credit), L: Lecture, T: Tutorial, P: Practical S= SDA: Skill Development Activity, AC: Audit Course				

VIII SEMESTER (Swappable VII and VIII SEMESTER)													
Sl. No.	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PEC		Professional Elective (Online Courses) MOOCS		3	0	0	0	03	50	50	100	3
2	OEC		Open Elective (Online Courses) MOOCS		3	0	0	0	01	50	50	100	3
3	INT		Internship (Industry/Research) (14-20weeks)		0	0	12	0	03	100	100	200	10
			Total		6	0	14	0	10	200	200	400	16
Professional Elective Course													
	BOS Recommended Course				BOS Recommended Course								
	BOS Recommended Course				BOS Recommended Course								
Open Elective Courses													
	BOS Recommended Course				BOS Recommended Course								
	BOS Recommended Course				BOS Recommended Course								
PCC: Professional Core Course, PCCL: Professional Core Course Laboratory, UHV: Universal Human Value, MC: Mandatory Course (Non-credit), L: Lecture, T: Tutorial, P: Practical S= SDA: Skill Development Activity, AC: Audit Course													

I/II Semester Syllabus

SUBJECT CODE: BECA103C	Basic Electronics (For ECE and Allied Branches)	Credits: 03
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50
MODULE-I		08 Hrs.
Semiconductor Diodes: Introduction, PN Junction diode, Characteristics and Parameters, Diode Approximations, DC Load Line analysis (Text 1: 2.1,2.2,2.3,2.4) Diode Applications: Introduction, Half Wave Rectification, Full Wave Rectification, Full Wave Rectifier Power Supply: Capacitor Filter Circuit, RC π Filter (includes numerical) (Text 1: 3.1,3.2,3.4,3.5) Zener Diodes: Junction Breakdown, Circuit Symbol and Package, Characteristics and Parameters,Equivalent Circuit, Zener Diode Voltage Regulator. (Text1:2.9, 3.7)		
MODULE-II		08 Hrs.
Bipolar Junction Transistors: Introduction BJT Voltages & Currents, BJT Amplification, Common Base Characteristics, Common Emitter Characteristics, Common Collector Characteristics, BJT Biasing: Introduction, DC Load line and Bias point(Text 1: 4.2, 4.3, 4.5,4.6, 5.1) Field Effect Transistor: Junction Field Effect Transistor, JFET Characteristics, MOSFETs: Enhancement MOSFETs, Depletion Enhancement MOSFETs (Text 1: 9.1,9.2,9.5)		
MODULE-III		08 Hrs.
Operational Amplifiers: Introduction, The Operational Amplifier, Block Diagram Representation of Typical Op-Amp, Schematic Symbol, Op-Amp parameters - Gain, input resistance, Output resistance, CMRR, Slew rate, Bandwidth, input offset voltage, Input bias Current and Input offset Current, The Ideal Op-Amp, Equivalent Circuit of Op-Amp, Open Loop Op-Amp configurations, Differential Amplifier, Inverting & Non Inverting Amplifier Op-Amp Applications: Inverting Configuration, Non-Inverting Configuration, Differential Configuration, Voltage Follower, Integrator, Differentiator (Text 2: 1.1, 1.2, 1.3, 1.5, 2.2, 2.3, 2.4, 2.6, 6.5.1, 6.5.2, 6.5.3, 6.12, 6.13).		
MODULE-IV		10 Hrs.
Boolean Algebra and Logic Circuits: Binary numbers, Number Base Conversion, octal & Hexa Decimal Numbers, Complements, Basic definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations, Digital Logic Gates (Text 3: 1.2, 1.3, 1.4, 1.5,2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7) Combinational logic: Introduction, Design procedure, Adders- Half adder, Full adder (Text 3:4.1, 4.2, 4.3)		
MODULE-V		10 Hrs.
Introduction to Transducers: Introduction, Resistive Transducers, Inductive Transducers, Capacitive Transducers, Thermal transducers, Optoelectronic transducer, and Piezoelectric transducers (Text 4: Chapter 18: 18.1, 18.2, 18.3, 18.4, 18.5) Communications: Introduction to communication, Communication System, Modulation (Text book 5: 1.1, 1.2, 1.3)		
Reference Books		
1. David A Bell, “Electronic Devices and Circuits”, 5 th Edition, Oxford, 2016 2. Ramakanth A Gayakwad, “Op-amps and Linear Integrated Circuits”, Pearson Education, 4 th Edition 3. M. Morris Mano, “Digital Logic and Computer Design”, PHI Learning, 2008 ISBN-978-81-203-0417-8 4. David A. Bell, “Electronic Instrumentation and Measurements” 3rd Edition, Oxford University Press,2013 5. George Kennedy, “Electronic Communication Systems”, 4 th Edition, TMH.		

Activity-Based Learning(Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignment
- Seminars

Course Outcomes

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

CO1:Develop the basic knowledge on construction, operation and characteristics of semiconductor devices.(Level: C3)

CO2:Apply the acquired knowledge to construct small scale circuits consisting of semiconductor devices (Level: C3)

CO3:Develop competence knowledge to construct basic digital circuit by make use of basic gate and its function.(Level: C3)

CO4: Construct the conceptual blocks for basic communication system. (Level: C3)

CO5: Apply the knowledge of various transducers principle in sensor system. (Level: C3)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	0	2	2	0	0	0	0	0	0	0	3	0
CO2	3	2	3	0	2	1	0	0	0	0	0	0	0	3	0
CO3	3	2	3	0	3	0	0	0	1	0	0	0	0	3	0
CO4	2	1	1	0	2	1	0	0	1	0	0	1	0	3	0
CO5	2	1	1	0	2	1	0	0	1	0	0	1	0	3	0

SUBJECT CODE: BECA104N	Introduction to Electronics and Communication	Credits: 03
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50
MODULE-I		08 Hrs.
Power Supplies –Block diagram, Half-wave rectifier, Full-wave rectifiers and filters, Voltage regulators, Output resistance and voltage regulation, Voltage multipliers. Amplifiers – Types of amplifiers, Gain, Input and output resistance, Frequency response, Bandwidth, Phase shift, Negative feedback, multi-stage amplifiers. (Text 1)		
MODULE-II		08 Hrs.
Oscillators – Barkhausen criterion, sinusoidal and non-sinusoidal oscillators, Ladder network oscillator, Wein bridge oscillator, Multivibrators, Single-stage astable oscillator, Crystal controlled oscillators (Only Concepts, working, and waveforms. No mathematical derivations) Operational amplifiers -Operational amplifier parameters, Operational amplifier characteristics, Operational amplifier configurations, Operational amplifier circuits. (Text 1)		
MODULE-III		08 Hrs.
Boolean Algebra and Logic Circuits: Binary numbers, Number Base Conversion, octal & Hexa Decimal Numbers, Complements, Basic definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations, Digital Logic Gates (Text 2: 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7) Combinational logic: Introduction, Design procedure, Adders- Half adder, Full adder (Text 2: 4.1, 4.2, 4.3)		
MODULE-IV		10 Hrs.
Embedded Systems – Definition, Embedded systems vs general computing systems, Classification of Embedded Systems, Major application areas of Embedded Systems, Elements of an Embedded System, Core of the Embedded System, Microprocessor vs Microcontroller, RISC vs CISC Sensors and Interfacing – Instrumentation and control systems, Transducers, Sensors, Actuators, LED, 7-Segment LED Display. (Text 3)		
MODULE-V		10 Hrs.
Analog Communication Schemes – Modern communication system scheme, Information source, and input transducer, Transmitter, Channel or Medium – Hardwired and Soft wired, Noise, Receiver, Multiplexing, Types of communication systems. Types of modulation (only concepts) – AM , FM, Concept of Radio wave propagation (Ground, space, sky) Digital Modulation Schemes: Advantages of digital communication over analog communication, ASK, FSK, PSK, Radio signal transmission Multiple access techniques. (Text 4)		
Reference Books		
1. Mike Tooley, “Electronic Circuits, Fundamentals & Applications”, 4 th Edition, Elsevier, 2015. DOI https://doi.org/10.4324/9781315737980 . eBook ISBN 9781315737980 2. M. Morris Mano, “Digital Logic and Computer Design”, PHI Learning, 2008 ISBN-978-81-203-0417-84. 3. K V Shibu, “Introduction to Embedded Systems”, 2nd Edition, McGraw Hill Education (India), Private Limited, 2016 4. S L Kakani and Priyanka Punglia, “Communication Systems”, New Age International Publisher, 2017.		
Activity-Based Learning(Suggested Activities in Class)/Practical-Based Learning		
● Quizzes ● Assignment ● Seminars		

Course Outcomes

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

CO1: Differentiate and analyze the applications of electronic devices and circuits.

CO2: Analyze the operation of oscillators, op amps and its applications.

CO3: Analyze different number systems and logic circuits built with basic gates.

CO4: Decide type of transducer, sensor and modulation for a given application.

CO5: Describe communication system and modulation techniques for a given application.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	0	2	2	0	1	1	0	0	0	3	0	0
CO2	3	2	3	0	2	1	0	1	1	0	0	0	3	0	0
CO3	3	2	3	0	3	0	0	1	1	0	0	0	3	0	0
CO4	3	1	1	0	2	1	0	1	1	0	0	0	3	0	0
CO5	3	2	2	0	2	1	0	1	1	0	0	0	3	0	0

SUBJECT CODE: BECB105B	Introduction To Embedded Systems	Credits: 03
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50
MODULE-I		08 Hrs.
Introduction: Embedded Systems and general purpose computer systems, history, classifications, applications and purpose of embedded systems Chapter 1 – Text 1 Core of Embedded Systems : Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators Light Emi ng Diode (LED) and 7-Segment LED Display, communication interface: Inter Integrated Circuit (I2C) Bus, Serial Peripheral Interface (SPI) Bus, Universal Asynchronous Receiver Transmitter (UART) and RS-232 C and RS-485, embedded firmware, other system components : Oscillator Unit and Watchdog Timer, PCB and passive components Chapter 2 – Text 1		
MODULE-II		08 Hrs.
Characteristics and quality attributes of embedded systems: Characteristics, Operational and nonoperational quality attributes, application specific embedded system - washing machine, domainspecific – automotive Chapter 3 & 4 – Text 1		
MODULE–III		08 Hrs.
Hardware Software Co design and Program Modelling : Fundamental issues in Hardware Software Co-design, Computational models in Embedded System Design Chapter 7 – Text 1: 7.1, 7.2 Embedded Hardware Design and Development: Analog Electronic Components, Digital Electronic Components, VLSI & Integrated Circuit Design, Electronic Design Automation Tools Chapter 8 – Text 1: 8.1, 8.2, 8.3, 8.4		
MODULE–IV		10 Hrs.
Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages Chapter 9 – Text 1: 9.1, 9.2 Embedded System Development Environments: Types of files generated on cross compilation (only explanation – programming codes need not be dealt), disassemble/ decompiler, Simulators, Emulators and Debugging Chapter 13 – Text 1: 13.2, 13.3,13.4		
MODULE–V		10 Hrs.
Real-time Operating System(RTOS) based Embedded System Design: Operating System basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessingand Multitasking, Task Scheduling Chapter 10 – Text 1: 10.1 to 10.5		
Reference Books		
1. Shibu K V, “Introduction to Embedded Systems”, Second Edition, McGraw Hill Education.		
Web links and Video Lectures (e-Resources): NPTL Lectures: https://nptel.ac.in/courses/108102045 Embedded Systems, IIT Delhi, Prof. Santanu Chaudhary		
Course Outcomes		
At the end of the course, the student will be able to: CO1: Explain characteristics of Embedded System design CO2: Acquire knowledge about basic concepts of circuit emulators, debugging and RTOS CO3: Analyse embedded system software and hardware requirements CO4: Develop programming skills in embedded systems for various applications. CO5: Design basic embedded system for real time applications		

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	0	1	1	1	1	1	1	0	1	3	0	0
CO2	3	2	2	0	1	1	1	1	1	2	0	1	3	0	0
CO3	3	2	2	0	1	2	1	1	2	1	0	2	3	0	0
CO4	3	2	1	0	2	1	1	1	1	1	0	1	3	0	0
CO5	3	2	2	0	1	2	1	1	1	1	0	1	3	0	0

SUBJECT CODE: BECB205B	Introduction to Nanotechnology	Credits: 03
L:T:P - 2 : 0: 2		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50
MODULE-I		08 Hrs.
Introduction to Nanomaterials: Nanotechnology, Frontier of future-an overview, Length Scales, Variation of physical properties from bulk to thin films to nanomaterials, Confinement of electron in 0D, 1D, 2D and 3D systems, Surface to Volume Ratio, Synthesis of Nanomaterials: Bottom-Up approach: Chemical Routes for Synthesis of nanomaterials-Sol-gel, Precipitation, Solution Combustion synthesis, Hydrothermal, SILAR, Chemical Bath Deposition. Top-Down approach- Ball milling technique, Sputtering, Laser Ablation		
MODULE-II		08 Hrs.
Characterization of Nanomaterials: Basic principles and instrumentations of Electron Microscopy – Transmission Electron Microscope, Scanning Electron Microscope, Scanning Probes- Scanning Tunneling microscope, Atomic Force Microscope –different imaging modes, comparison of SEM and TEM, AFM and STM, AFM and SEM. Basic principles of working of X-ray diffraction, derivation of Debye-Scherrer equation, numericals on Debye Scherrer equation, Optical Spectroscopy- Instrumentation and application of IR, UV/VIS (Band gap measurement)		
MODULE-III		08 Hrs.
Carbon Based Materials: Introduction, Synthesis, Properties (electrical, Electronic and Mechanical), and Applications of Graphene, SWCNT, MWCNT, Fullerenes and other Carbon Materials: Carbon nanocomposites, nanofibres, nanodiscs, nanodiamonds.		
MODULE-IV		10 Hrs.
Nanotechnology in Energy storage and conversion: Solar cells: First generation, Second generation and third generation solar cells: Construction and working of Dye sensitized and Quantum dot sensitized solar cells. Batteries: Nanotechnology in Lithium ion battery- working, Requirements of anodic and cathodic materials, classification based on ion storage mechanisms, limitations of graphite anodes, Advances in Cathodic materials, Anodic materials, Separators. Fuel Cells: Introduction, construction, working of fuel cells and nanotechnology in hydrogen storage and proton exchange membranes.		
Self study for lifelong learning: Super capacitors: Introduction, construction and working of supercapacitor		
MODULE-V		10 Hrs.
Applications of Nanotechnology: Nanotech Applications and Recent Breakthroughs: Introduction, Significant Impact of Nanotechnology and Nanomaterial, Medicine and Healthcare Applications, Biological and Biochemical Applications (Nano biotechnology), Electronic Applications (Nano electronics), Computing Applications (Nano computers), Chemical Applications (Nano chemistry), Optical Applications (Nano photonics), Agriculture and Food Applications, Recent Major Breakthroughs in Nanotechnology.		
Self study for lifelong learning: Nano coatings (Photocatalysts) and super hydrophobic coatings (Lotus effect)		
Reference Books		
1. A.K. Bandyopadhyay, “Nano Materials”, New Age Publishers 2. C.N.R. Rao, P. John Thomas and G. U. Kulkarni, “Nanocrystals: Synthesis, Properties and Applications”, Springer Series in Materials Science 3. T. Pradeep, “Nano Essentials”, TMH 4. Peter J. F. Harris, “Carbon nanotube science: synthesis, properties, and applications”, Cambridge University Press, 2011		

5. M.A. Shah, K.A. Shah, "Nanotechnology: The Science of Small", Wiley India, ISBN 13: 9788126538683

Practical Based learning (Any 5 experiments x 2 hours = 10 practical hours)

- Preparation of silver nanoparticles and characterization of particle size by optical spectroscopy
- Preparation of ZnO nanoparticles by combustion technique
- Preparation of Al₂O₃ nanoparticles by precipitation method
- Preparation of Silica nanoparticles by sol-gel method
- Preparation of metal oxide nanoparticles by hydrothermal method
- Determination of thermal conductivity of nanofluids using a thermal analyser
- Preparation of thin films by SILAR method
- Determination of Band gap of given material using Tauc plot.

Course Outcomes

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

CO1: Demonstrate the synthesis of nanoparticles by various techniques. [L2]

CO2: Explain working of basic instruments used in characterization of nanoparticles. [L2]

CO3: Discuss the application of nanotechnology to mechanical and civil domains [L2]

CO4: Classify the nanomaterials based on the dimensions. [L3]

CO5: Assess the suitability of nanomaterials for various device applications. [L4]

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	0	0	0	0	0	2	1	0	0	3	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0	3	0	0
CO3	3	3	0	0	0	0	0	0	0	0	0	0	3	0	0
CO4	3	3	0	0	0	0	0	0	2	1	0	2	3	0	0
CO5	3	3	0	0	0	0	0	0	2	1	0	2	3	0	0

III Semester Syllabus

SUBJECT CODE: BMAE301C	MATHEMATICS – III FOR Electrical Science Stream (EE,EC,ECS)	Credits: 03
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50
UNIT-I		10 Hrs.
Curve fitting, Correlation and Regressions: Principles of least squares, Curve fitting by the method of least squares in the form $y = a + bx$, $y = a + bx + cx^2$, $y = ab^x$. Correlation, Regression and rank correlation. (RBT Levels: L1, L2 and L3)		
UNIT-II		10 Hrs.
Fourier series and practical harmonic analysis: Periodic functions, Dirichlet’s condition. Fourier series expansion of functions with period 2π and with arbitrary period: periodic rectangular wave, Half-wave rectifier, rectangular pulse, Saw tooth wave. Half-range Fourier series. Half range expansions, Practical harmonic analysis, and variation of periodic current. (RBT Levels: L1, L2 and L3)		
UNIT–III		10 Hrs.
Infinite Fourier Transforms: Infinite Fourier transforms, Fourier cosine and sine transforms, Inverse Fourier transforms, Inverse Fourier cosine and sine transforms, discrete Fourier transform (DFT). Z-transforms (RBT Levels: L1, L2 and L3)		
UNIT–IV		10 Hrs.
Ordinary Differential Equations of Higher Order: Higher-order linear ODEs with constant coefficients - Inverse differential operator, problems. Linear differential equations with variable Coefficients-Cauchy’s and Legendre’s differential equations – Problems. Application of linear differential equations to L-C circuit and L-C-R circuit. (RBT Levels: L1, L2 and L3)		
Reference Books		
1. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons,9 th Edition , 2006. 2. B. S. Grewal “Higher Engineering Mathematics”, Khanna publishers, 44 th Ed., 2021. 3. G Haribaskaran “Probability, Queuing Theory and Reliability Engineering”, Laxmi Publication, Latest Edition, 2006 4. Irwin Miller & Marylees Miller, John E. Freund’s “Mathematical Statistics with Applications”, Pearson. Dorling Kindersley Pvt. Ltd. India, 8 th edition, 2014. 5. S C Gupta and V K Kapoor, “Fundamentals of Mathematical Statistics”, S Chand and Company, Latest edition. 6. Robert V. Hogg, Joseph W. McKean & Allen T. Craig, “Introduction to Mathematical Statistics”, Pearson Education 7 th edition, 2013. 7. Jim Pitman. “Probability”, Springer-Verlag, 1993. 8. Sheldon M. Ross, “Introduction to Probability Models”11 th edition. Elsevier, 2014. 9. A. M. Yaglom and I. M. Yaglom, “Probability and Information” D. Reidel Publishing Company, Distributed by Hindustan Publishing Corporation (India) Delhi, 1983. 10. P. G. Hoel, S.C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, (Reprint), 2003. 11. S. Ross, “A First Course in Probability”, Pearson Education India, 6 th Ed., 2002. 12. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, Wiley, 3 rd Ed., 1968. 13. N. P. Bali and Manish Goyal, “A Text book of Engineering Mathematics”, Laxmi Publications, Reprint, 2010. 14. Veerarajan T, “Engineering Mathematics(for semester III)”,Tata McGraw-Hill, New Delhi		

Activity-Based Learning(Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignment
- Seminars

Course Outcomes

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

CO1: Make use of correlation and regression analysis to fit a suitable mathematical model for Statistical data

CO2: Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing, and field theory.

CO3: To use Fourier transforms and Z-Transform to analyze problems involving continuous-time signals and solve difference equations

CO4: Understand that physical systems can be described by differential equations and solve such equations

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	0	0	0	0	0	0	0	0	0	3	0	0
CO2	3	2	0	0	0	0	0	0	0	0	0	3	0	0
CO3	3	2	0	0	0	0	0	0	0	0	0	3	0	0
CO4	3	2	0	0	0	0	0	0	0	0	0	3	0	0

Course Code: BECA301C	Digital System Design Using Verilog	Credits: 03
L:T:P – 03:0:0		CIE Marks:50
Total Hours/Week: 40		SEE Marks:50
UNIT-I		10 Hrs.
Principles of Combinational Logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps upto 4 variables, Quine-McCluskey Minimization Technique. Quine-McCluskey using Don't Care Terms. (Section 3.1 to 3.5 of Text1).		
Logic Design with MSI Components and Programmable Logic Devices: Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs) (Section 5.1 to 5.7 of Text 2)		
UNIT-II		10 Hrs.
Flip-Flops and its Applications: The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip-flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, J K, D and SR flip-flops. (Section 6.4, 6.6 to 6.9 (Excluding 6.9.3) of Text 2), State diagrams.		
UNIT-III		10 Hrs.
Introduction to Verilog: Structure of Verilog module, Operators, Data Types, Styles Description. (Section 1.1 to 1.6.2, 1.6.4 (only Verilog), 2 of Text 3)		
Verilog Data flow description: Highlights of Data flow description, Structure of Data flow description. (Section 2.1 to 2.2 (only Verilog) of Text 3)		
UNIT-IV		10 Hrs.
Verilog Behavioral description: Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (2:1, 4:1, 8:1). (Section 3.1 to 3.4 (only Verilog) of Text 3)		
Verilog Structural description: Highlights of Structural description, Organization of structural description, Structural description of ripple carry adder.(Section 4.1 to 4.2 of Text 3)		
Reference Books *		
1. John M. Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2001. 2. Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2002. 3. Nazeih M. Botros, "HDL Programming: VHDL and Verilog", 2009 reprint, Dreamtech Press. 4. Charles H. Roth Jr., "Fundamentals of Logic Design", Cengage Learning. 5. Sudhakar Samuel, "Logic Design", Pearson/Sanguine, 2007. 6. Cyril P. R., "Fundamentals of HDL", Pearson/Sanguine, 2010.		
Course Outcomes**		
After completion of the course student will be able to		
CO1: Simplify Boolean functions using K-map and the Quine-McCluskey minimization technique.		
CO2: Analyze and design combinational logic circuits.		
CO3: Analyze the concepts of flip-flops (SR, D, T, and JK) and design synchronous sequential circuits using flip-flops.		
CO4: Model combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Verilog descriptions.		

Course Articulation Matrix:

Course Outcomes (COs)	Program Outcomes												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3	1	2	0	0	0	0	0	0	0	0	0	3	0
CO2	2	3	1	2	0	0	0	0	0	0	0	0	0	3	0
CO3	2	3	1	2	0	0	0	0	0	0	0	0	0	3	0
CO4	2	2	1	2	3	0	0	0	0	0	0	0	0	3	0

Course Code: BECA302C	Electronic Circuits	Credits: 03
L:T:P - 3: 0: 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50
UNIT-I		10 Hrs.
Diode Circuits: Introduction, Load- line Analysis, Series Diode Configurations, Parallel and Series – Parallel configurations, AND/OR Gates, Clippers, Clampers, Zener Diodes, Voltage-Multiplier Circuits. Power Supplies: Introduction, General Filter Considerations, Capacitor Filter, RC Filter, Discrete Transistor Voltage Regulation. Self Study Component: Basics of IC voltage regulators.		
UNIT-II		10 Hrs.
Transistor Biasing: BJT Biasing- Voltage–Divider Bias, Accurate VDB Analysis, VDB Load Line and Q point, Two Supply Emitter Bias. FET Biasing- Introduction, Fixed- Bias Configuration, Self- Bias Configuration, Voltage- Divider Biasing, Common- Gate Configuration, Special Case of $V_{GSQ}=0V$, Depletion-Type MOSFETs, Enhancement-Type MOSFETs, p- Channel FETs, Universal JFET Bias Curve. Self Study Component: Principles of bias stabilization		
UNIT-III		10 Hrs.
BJT Amplifier Circuits: Single-Stage Common- Emitter Amplifier, Single-Stage Common-Source Amplifier, Series Voltage Negative Feedback, Two-Stage CE Amplifier with Series Voltage Negative Feedback. FET Amplifier Circuits- Introduction, JFET Small Signal Model, Fixed Bias Configuration, Self-Bias Configuration, and Voltage-Divider Configuration. Self Study Component: Basics of Tuned Amplifiers.		
UNIT-IV		10 Hrs.
Power Amplifier: Introduction-Definitions and Amplifier Types, Series-Fed Class A Amplifier, Transformer-Coupled Class A Amplifier, Class B Amplifier Operation, Class B Amplifier Circuits, Class C and Class D Amplifiers. Feedback and Oscillator Circuits- Feedback Concepts, Feedback Connection Types, Feedback Amplifier-Phase and Frequency Considerations, Oscillator Operation, Phase-Shift Oscillator, Wien Bridge Oscillator. Self Study Component: Principles of unijunction oscillator.		
Reference Books *		
1. Robert L. Boylestad and Louis Nashelsky (2009), “Electronic Devices And Circuit Theory” (10 th Edition), Pearson Education, Inc. 2. David A. Bell (2008), “Electronic Devices and Circuits” (5 th Edition), Oxford University Press. 3. Albert Malvino and David J Bates (2008), “Electronic Principles” (7 th Edition), TATA McGRAW HILL		
Course Outcomes		
After completion of the course students will be able to design and analyze CO1: Basic electronic circuits using semiconductor diodes. CO2: BJT and FET biasing circuits using analytical and graphical methods. CO3: BJT and FET amplifier circuits to meet the given specifications. CO4: Oscillator circuits to meet the given specifications.		

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	1	0	0	0	0	0	1	0	3	1	0
CO2	3	2	2	1	1	0	0	0	0	0	1	0	3	1	0
CO3	3	2	2	1	1	0	0	0	0	0	1	0	3	1	0
CO4	3	2	2	1	1	0	0	0	0	0	1	0	3	1	0

Subject Code: BECA303C	Network Analysis	Credits: 03
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 40		SEEMarks:50
UNIT-I		10 Hrs.
Basic Concepts: Practical sources, source transformations, network reduction using Star-Delta transformation, loop and node analysis with linearly dependent and independent sources for DC and AC networks.		
UNIT-II		10 Hrs.
Network Theorems: Superposition, Millman's, Thevenin's, Norton's theorem, Maximum Power transfer theorems.		
UNIT-III		10 Hrs.
Laplace Transformation: Basic theorems, laplace transform of periodic functions step, ramp and impulse functions, waveform Synthesis. Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations.		
UNIT-IV		10 Hrs.
Resonance Circuits: Series and parallel resonance circuits, frequency of resonance, frequency responses, Q-factor, bandwidth. Two port network parameters: Definition of Z, Y, h and Transmission parameters, relationship between parameters sets.		
Reference Books		
1. Roy Choudhary (2006), "Networks and systems" (2), New Age International Publications 2. Hayt, Kemmerly and Durbin (2010), "Engineering Circuit Analysis" (7), TMH 3. Van Valkenburg M. E. (2000), "Network Analysis" (3), Prentice Hall of India 4. Mithal G. K. (1997), "Network Analysis", Khanna Publishers		
Web links and Video Lectures (e-Resources): • https://nptel.ac.in/courses/108105159 • https://nptel.ac.in/courses/108102042 • https://psim.software.informer.com/11.1/ • https://www.ni.com/multisim		
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning 1. Demonstrate the operation of the following circuits using suitable simulation software (Open source such as Psim, Pspice, Proteus, Simulink, eSim) • Determination of current through each branch of a given network using mesh analysis • Determination of current through each branch of a given network using nodal analysis • Simplification of given network using source transformation and finding the current in load 2. Practical based learning to verify mesh analysis, node analysis and Superposition, Millman's, Thevenin's & Maximum Power transfer theorems.		

Course Outcomes

After completion of the course student will be able to

CO1: Apply source transformation, mesh analysis, and nodal analysis techniques to compute currents and voltages in electrical networks, and simplify circuits using star-delta transformation.

CO2: Analyze complex electrical networks by applying network theorems to determine node voltages and branch currents.

CO3: Evaluate the transient behavior of circuit elements during switching operations using Laplace transformation methods.

CO4: Analyze the frequency response of series and parallel resonant circuits, and determine two-port network parameters using standard electrical network models.

Course Articulation Matrix:

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	0	1	1	0	0	0	0	0	1	3	0	0
CO2	3	3	0	1	1	0	0	0	0	0	1	3	0	0
CO3	3	3	0	1	1	0	0	0	0	0	1	3	0	0
CO4	3	3	0	1	1	1	0	0	0	0	1	3	0	0

Course Code: BECA304C	Data Structures using C++	Credits: 3
L:T:P - 3 : 0 : 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50
UNIT-I		10 Hrs.
C++ Review: Introduction, Functions and parameters, Exceptions, Dynamic memory allocation, Your very own data type, Recursion. (Section 1.1 to 1.5 and 1.7 of Text book 1)		
UNIT-II		10 Hrs.
Stacks: Concept of stacks, Stacks, Stack Abstract Data Type, Representation of stacks using sequential organization (arrays), Stacks using template, Applications of stack: Converting infix expression to postfix and prefix expressions, Evaluating the postfix expression, Checking well-formed (nested) parenthesis, Reversing a string. Recursion: Introduction, Recurrence, use of stack in recursion. (Section 3.1 to 3.5, and 3.7 (First four applications), 4.1 to 4.3 of Text book 2)		
UNIT-III		10 Hrs.
Recursion: Variants of recursion, Execution of recursive calls, Recursive functions, Examples. Queues: Concept of queues, Queue as abstract data type, Realization of queues using arrays, Circular queue, Multi-queues, Deque, Priority queue, Applications of queues, Queues using template. (Section 4.4 to 4.6, and 5.1 to 5.9 of Text book 2)		
UNIT-IV		10 Hrs.
Linked Lists: Introduction, Linked List, Realization of linked lists, Linked list abstract data type, Dynamic memory management, Linked list variants, Doubly linked list, Examples. Trees: Introduction, Types of trees, Binary tree, Realization of a binary tree, Binary tree traversal: Preorder, Inorder, Postorder, Examples. (Section 6.1 to 6.7, 7.1-7.3, 7.5, and 7.7 (7.7.1-7.7.3) of Text book 2)		
Reference Books *		
1. Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", Universities Press, Second Edition. 2. Varsha H. Patil, "Data Structures Using C++", Oxford University Press, 2012. 3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson, 4th Edition, 2013. 4. Michael T. Goodrich, Roberto Tamassia, David M. Mount, "Data Structures and Algorithms in C++", Wiley India, 2nd Edition, 2011. 5. D.S. Malik, "Data Structures Using C++", Cengage Learning, 2nd Edition, 2010.		
Course Outcomes**		
After completion of the course student will be able to		
CO1: Demonstrate the ability to implement C++ programs using functions, recursion, exception handling, and dynamic memory allocation.		
CO2: Apply stack data structures and templates in C++ to solve problems such as expression conversion, evaluation, and parenthesis checking.		
CO3: Design and implement queue structures circular, priority, and Deque using templates and analyze their applications.		
CO4: Develop and manipulate dynamic data structures such as linked lists and binary trees to represent hierarchical data and perform tree traversals.		

Course Articulation Matrix:

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	3	1	1	0	0	0	0	0	0	0	0	3	0
CO2	2	3	1	2	0	0	0	0	0	0	0	0	3	0
CO3	2	3	2	2	0	0	0	0	0	0	0	0	3	0
CO4	2	3	1	2	3	0	0	0	0	0	0	0	3	0

Course Code: BECA305C	Basics of AI and ML	Credits: 3
L:T:P - 3 : 0 : 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50
UNIT-I		10 Hrs.
Introduction to Artificial Intelligence: Definition of AI, goals and scope of AI, applications of AI in ECE such as signal classification, embedded intelligence, and smart communication. History and evolution of AI; different approaches to AI.		
AI versus human intelligence: Turing test and Total Turing Test. Components of AI: knowledge representation, reasoning, learning, perception, and action. Introduction to intelligent agents: definition, structure of agents, and the agent-environment interaction. Characteristics of intelligent agents; concept of rationality. PEAS framework (Performance measure, Environment, Actuators, Sensors); types of agents – simple reflex agents, model-based agents, goal-based agents, utility-based agents and learning agents.		
UNIT-II		10 Hrs.
Problem Solving in AI: Problem formulation, initial state, goal state, and operators. Examples of Search space and search tree. Uninformed search strategies: Breadth-First Search (BFS), Depth-First Search (DFS), Uniform Cost Search – their working principles, advantages, and limitations. Informed search strategies: Greedy Best-First Search and A* Search algorithm. Heuristic evaluation functions. Criteria for search algorithm performance – completeness, optimality, time complexity, and space complexity. Real-world applications of AI search strategies in robotics path finding, circuit diagnosis, and smart system optimization.		
UNIT-III		10 Hrs.
Introduction to Machine Learning: Definition and components of machine learning, types of learning – supervised and unsupervised. Supervised learning: concept of classification and regression, model representation and learning process. Algorithms for supervised learning: k-nearest neighbors, linear regression, logistic regression, decision trees. Training and testing phases, performance metrics – accuracy, precision, recall, F1-score. Bias-variance trade-off, overfitting and underfitting. Solved examples using classification and regression.		
UNIT-IV		10 Hrs.
Unsupervised learning: concept and importance, clustering and dimensionality reduction. Clustering algorithms: k-means clustering, hierarchical clustering – working, distance measures and cluster evaluation. Dimensionality reduction techniques: principal component analysis (PCA), applications in feature extraction. Introduction to anomaly detection, ensemble learning and real-world applications of unsupervised learning. Implementation examples and interpretation of outputs.		
Reference Books *		
1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, 3rd Edition, Pearson Education, 2010. 2. Ethem Alpaydin, “Introduction to Machine Learning”, 2nd Edition, MIT Press, 2010.		
Course Outcomes**		
After completion of the course student will be able to CO1: Define and explain fundamental AI concepts and agent-based design. CO2: Analyze different types of environments and rational behavior of intelligent agents. CO3: Formulate problems and apply suitable AI search strategies. CO4: Implement supervised and unsupervised ML algorithms for real-world applications.		

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	2	3	2	2	2	1	1	3	0	0	2
CO2	3	2	2	2	3	2	2	2	1	1	3	0	0	2
CO3	3	2	2	2	3	2	2	2	1	1	3	0	0	2
CO4	3	2	2	2	3	2	2	2	1	1	3	0	0	2

SUBJECT CODE: BECA306L	Digital System Design Using Verilog Laboratory	Credits: 01
L:T:P – 0-0-2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50
Course Objectives: 1. To develop skills in designing, simulating, and verifying combinational and sequential digital circuits using Verilog HDL. 2. To provide hands-on experience in synthesizing Verilog designs and implementing them on programmable logic devices.		
Sl. No.	Experiments	
1	To simplify the given Boolean expressions and realize using Verilog program	
2	To realize Adder/Subtract or (Full/half) circuits using Verilog data flow description.	
3	To realize 4-bit ALU using Verilog program.	
4	To realize the following Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa	
5	To realize using Verilog Behavioral description: 8:1 mux, 8:3 encoder, and Priority encoder	
6	To realize using Verilog Behavioral description: 1:8 De-mux, 3:8 decoder, 2-bit Comparator	
7	To realize using Verilog Behavioral description: Flip-flops: a) JK type b) SR type c) T type and d) D-type	
8	To realize Counters-up/down (BCD and binary) using Verilog Behavioral description.	
9	Write Verilog code for the given sequential circuit problem statement or state diagram.	
Demonstration Experiments (For CIE only–not to be included for SEE) Use FPGA/CPLD kits for down loading Verilog codes and check the output for inter facing experiments.		
10	Verilog Program to interface a Stepper motor to the FPGA/CPL D and rotate the motor in the specified direction (by N steps).	
Course Outcomes**		
After completion of the course student will be able to CO1: Design, simulate, and verify combinational and sequential circuits using various Verilog modeling styles. CO2: Synthesize and implement Verilog-based designs on programmable logic devices and validate their functionality.		

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	0	2	0	3	0	0	0	0	0	0	0	3	0
CO2	1	0	2	0	3	0	0	0	0	0	0	0	3	0

Course Code: BECA307L		Electronic Devices and Circuits Laboratory	Credits: 01
L:T:P - 0 : 0 : 2			CIE Marks:50
Total Hours/Week: 02			SEE Marks:50
Sl. No.	List of Experiments		
1	Design and verification of clipper circuits.		
2	Design and verification of clamper circuits.		
3	Design and verification of full wave rectifier circuit with capacitor filter.		
4	Design and verification of voltage regulator circuit using Zener diode.		
5	Verification of V-I characteristics of FET and MOSFET.		
6	Design and analysis of common emitter amplifier circuit.		
7	Design and analysis of series voltage feedback amplifier circuit.		
8	Design and analysis of common source amplifier circuit.		
9	Design and analysis of series fed class-A power amplifier circuit.		
10	Design and analysis of RC phase shift oscillator.		
Course Outcomes			
After completion of the course student will be able to			
CO1: Design and analyze clipper and clamper circuits.			
CO2: Design and analyze amplifiers circuits using BJT and FET.			
CO3: Design and analyze oscillator circuits.			
CO4: Design and verify regulated power supply circuit.			

Course Code: BHSA360M	YOGA (Common to All Branches)	Credit :	00
Hours/Week : (L:T:P:S) : 0:0:2:0		CIE Marks :	100
Total Hours Per Semester : 26hrs		SEE Marks :	00

Semester III

Yoga, its origin, history and development. Yoga, its meaning, definitions.

Different schools of yoga, Aim and Objectives of yoga, importance of prayer

Yogic practices for common man to promote positive health

Rules to be followed during yogic practices by practitioner

Yoga its misconceptions,

Difference between yogic and non yogic practices

Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar 12 count, 2 rounds

Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana

Different types of Asanas

Sitting	1. Padmasana 2. Vajrasana
Standing	1. Vrikshana 2. Trikonasana
Prone line	1. Bhujangasana 2. Shalabhasana
Supine line	1. Utthitadvipadasana 2. Ardhalasana

Course Outcomes (Course Skill Set):

By the end of this course, students will be able to:

CO1:	Understand the meaning, aims, and objectives of Yoga and explain its relevance in daily life.
CO2:	Perform and Teach Suryanamaskar , demonstrating its correct sequence, technique, and explaining its physical and mental benefits.
CO3:	Identify, Demonstrate, and Teach Various Asanas by name, including their significance, correct methods of practice, and associated benefits for overall well-being
CO4:	Instruct and Explain Kapalabhati , including its purpose, technique, precautions, and health benefits
CO5:	Teach Different Types of Pranayama , detailing their names, procedures, safety precautions, and therapeutic uses.
CO6:	Coach Various Yogic Kriyas , explaining their methods, importance, and practical applications for maintaining internal cleansing and health

Assessment Details (both CIE and SEE)

1.	Students will be assessed with internal test by a. Multiple choice questions b. Descriptive type questions (Two internal assessment tests with 25 marks/test)
2.	Final test shall be conducted for whole syllabus for 50 marks.
3.	Continuous Internal Evaluation shall be for 100 marks (including IA test)

Suggested Learning Resources and Books:

1.	Yogapravesha in Kannada by Ajitkumar
2.	Light on Yoga by BKS Iyengar
3.	Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly
4.	Yoga Instructor Course hand book published by SVYASA University, Bengaluru

5.	Yoga for Children –step by step – by Yamini Muthanna
Web links and Video Lectures (e-Resources): Refer links https://youtu.be/KB-TYlgd1wE https://youtu.be/aa-TGOWg1Ls	

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	0	0	1	0	0	1	1	1	0	1	0	1	0	0	0
CO2	0	0	1	0	0	1	1	1	0	1	0	1	0	0	0
CO3	0	0	1	0	0	1	1	1	0	1	0	1	0	0	0
CO4	0	0	1	0	0	1	1	1	0	1	0	1	0	0	0
CO5	0	0	1	0	0	1	1	1	0	1	0	1	0	0	0
CO6	0	0	1	0	0	1	1	1	0	1	0	1	0	0	0

Course Code: BHSB360M	National Service Scheme (NSS)	Credits: 00
L:T:P - 0 : 0 : 2		CIE Marks:100
Total Hours/Week: 02		SEE Marks:-

Course objectives:

National Service Scheme(NSS)will enable the students to:

1. Understand the community in general in which they work.
2. Identify the needs and problems of the community and involve them in problem–solving.
3. Develop among themselves a sense of social & civic responsibility & utilize their. Knowledge in finding practical solutions to individual and community problems.
4. Develop competence required for group-living and sharing of responsibilities & gains kills In mobilizing community participation to acquire leadership qualities and democratic attitudes.
5. Develop capacity to meet emergencies and natural disasters &practice national integration and social harmony in general.

General Instructions-Pedagogy:

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students’ theoretical and applied social and cultural skills.
2. State the need for NSS activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning home work, grading assignments and quizzes, and documenting students’ progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

National Service Scheme (NSS)–Contents

1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.
2. Waste management–Public, Private and Govtorganization,5R’s.
3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4. Water conservation techniques – Role of different stake holders–Implementation.
5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical vocation.
7. Developing Sustainable Water management system for rural areas and implementation approaches.
8. Contribution to any national level initiative of Government of India. For eg.: Digital India, Skill India, Swatch Bharat, Atma nirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.
9. Spreading public awareness under rural out reach programs. (minimum 5 programs).
10. Social connect and responsibilities.
11. Plantation and adoption of plants. Know your plants.
12. Organize National integration and social harmony events/ workshops/ seminars. (Minimum 02 programs).
13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

NOTE:

1. Student/s in individual or in a group should select any one activity in the beginning of each semester till

end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.

2. At the end of every semester, activity report should be submitted for evaluation.

Sem	Topics/Activities to be Covered
3rd Sem for 25 Marks	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management–Public, Private and Govt organization, 5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4th Sem for 25 Marks	1. Water conservation techniques –Role of different take holders–Implementation. 2. Preparing an action able business proposal for enhancing the village in come and approach for implementation. 3. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/vocational education.
5th Sem for 25 Marks	1. Developing Sustainable Water management system for rural areas and implementation approaches. 2. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanir bhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs). 4. Social connect and responsibilities.
6th Sem for 25 Marks	1. Plantation and adoption of plants. Know your plants. 2. Organize National integration and social harmony events/ workshops/ seminars. (Minimum 02 programs). 3. Govt. school Rejuvenation and helping them to achieve good infrastructure.

Plan of Action (Execution of Activities For Each Semester)

Sl.NO	Practice Session Description
1	Lecture session by NSS Officer
2	Students Presentation on Topics
3	Presentation- 1, Selection of topic, PHASE-1
4	Commencement of activity and its progress-PHASE- 2
5	Execution of Activity
6	Execution of Activity
7	Execution of Activity
8	Execution of Activity
9	Execution of Activity
10	Case study based Assessment, Individual performance
11	Sector wise study and its consolidation
12	Video based seminar for 10 minutes by each student At the end of semester with Report.
- In every semester from 3rd semester 6th semester, each student should do activities according to the scheme and syllabus. - At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion. - At last in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.	

Course Outcomes**

After completion of the course student will be able to

CO1: Recognize and understand their roles and responsibilities towards society for its betterment

CO2: Analyze environmental and societal issues and design effective and sustainable solutions

CO3: Assess existing systems critically and propose practical, innovative solutions to promote sustainable development

CO4: Plan and implement government-led or self-initiated projects efficiently for community and societal welfare

CO5: Develop the ability to respond to emergencies and natural disasters, while fostering national integration, social harmony, and unity.

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	0	0	1	0	0	1	2	1	1	1	2	1	0	0	0
CO2	0	0	1	0	0	1	2	1	1	1	2	1	0	0	0
CO3	0	0	1	0	0	1	2	1	1	1	2	1	0	0	0
CO4	0	0	1	0	0	1	2	1	1	1	2	1	0	0	0
CO5	0	0	1	0	0	1	2	1	1	1	2	1	0	0	0

Course Code :22UHS003M		PHYSICAL EDUCATION AND SPORTS (PE) (Common to All Branches)	Credits :	00
Course Code :BHSC360M			Credits :	00
Hours/Week (L:T:P:S) : 0:0:2:0			CIE Marks :	100
Total Hours Per Semester : 26hrs			SEE Marks :	00
Course Outcomes: At the end of the course, the student will be able to				
1.	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness			
2.	Familiarization of health- related Exercises, Sports for overall growth and development			
3.	Create a foundation for the professionals in Physical Education and Sports			
4.	Participate in the competition at regional/state/national/international levels.			
5.	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.			
6.	Understand and practice of Traditional Games			
Module I: Orientation			04 Hours	
A.	Lifestyle			
B.	Health & Wellness			
C.	Pre-Fitness test.			
Module II: General Fitness & Components of Fitness			04 Hours	
A. Warming up (Free Hand exercises)				
B. Strength–Push-up/ Pull-ups				
C. Speed–30Mtr Dash				
Module III: Specific games (Any one to be selected by the student)			16 Hours	
1. Kabaddi–Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus.				
2. Kho-Kho–GivingKho,Single Chain,Pole dive,Pole turning,3-6Up.				
Module IV: Orientation			04 Hours	
A.	Postural deformities.			
B.	Stress management			
Module V : Specific Games (Any one to be selected by the student)			16 Hours	
A.	Throw ball			
B.	Table Tennis			
C.	Athletics (Field Events-Jumps)–Any event as per availability of Ground.			
Module VI: Aerobics			04 Hours	
Scheme and Assessment for auditing the course and Grades:				
Sl.No.	Activity		Marks	
1.	Participation of student in all the modules		20	
2.	Quizzes–2,each of 15marks		30	
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students		50	
	Total		100	

Course Outcomes:	
CO1: Identify and Understand common postural deformities and apply stress management techniques in the context of sports and athletics CO2: Participate Confidently in competitions at regional, state, national, and international levels CO3: Demonstrate Proficiency in specific games and athletic jumping events through regular practice and skill development. CO4: Understand and Perform various Aerobic exercises for fitness and endurance enhancement. CO5: Acquire Skills and Practice specific games and athletic throwing events with proper techniques and strategies	
Module I: Ethics and Moral Values	
A.	Ethics in Sports
B.	Moral Values in Sports and Games
Module II: Specific Games (Any one to be selected by the student)	
16 Hours	
A.	Volley ball–Attack, Block, Service, Upper Hand Pass and Lower hand Pass.
B.	Athletics (TrackEvents) –Any event as per availability of Ground
Module III: Role of Organisation and administration	
4 Hours	

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	0	0	1	0	0	1	2	0	0	0	0	1	0	0	0
CO2	0	0	1	0	0	1	2	0	0	0	0	1	0	0	0
CO3	0	0	1	0	0	1	2	0	0	0	0	1	0	0	0
CO4	0	0	1	0	0	1	2	0	0	0	0	1	0	0	0
CO5	0	0	1	0	0	1	2	0	0	0	0	1	0	0	0

IV Semester Syllabus

Course Code: BECA401C	Signals and Systems	Credits: 03
L:T:P:S—3:2:0:2		CIE Marks:50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
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Introduction to Continuous-time and Discrete-time Signals and Systems: Definition of signals and systems, sampling, classification of signals, elementary signals, basic operations on signals, interconnection of systems and operations, classification of systems and properties of systems.

Self Study Component: Introduction to time variant systems.

UNIT-II	10 Hrs
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Time domain representation of LTI systems: Convolution sum, convolution integral, impulse response representation of systems, properties of impulse response.

Self Study Component: Introduction to fast convolution- Winograd Algorithm.

UNIT-III		10 Hrs
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Fourier and inverse Fourier transformation of signals: Introduction to complex sinusoidal signals and their use in Fourier representation of periodic signals, continuous time Fourier series (CTFS), discrete time Fourier series (DTFS), continuous time Fourier transform (CTFT), discrete time Fourier transform (DTFT), inverse discrete Fourier transformation (IDTFT), properties of DTFT,

Self Study Component: Basics of discrete Cosine transform

UNIT-IV		10 Hrs.
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Z -Transforms: Introduction, properties of ROC, properties of Z-transform, relation between Z - transform and Fourier transform. Inverse Z-transform, transform domain analysis of LTI systems, transfer function, stability and causality, solution of difference equations using Z-transform.

Self Study Component: Basics of Hilbert transform

Reference Books*

1. Simon Haykin and Barry VanVeen, "Signals and systems", Edition2, John Wiley Indian Ed, 2008.
2. Alan V. Oppenheim, Alan S. Willsky and Syed Hamid Nawab, "Signals and Systems", Edition2, PHI, 2014.

Web links and Video Lectures (e-Resources):

1. <https://nptel.ac.in/courses/117101055>
2. <https://www.digimat.in/nptel/courses/video/108104100/L02.html>
3. <https://nptel.ac.in/courses/117104074>

Course Outcomes**

After completion of the course student will be able to

CO1: Perform different operations on signals and systems.

CO2: Characterize different class of signals and systems in time and transform domain

CO3: Compute system response to arbitrary inputs using time and frequency domain tools.

CO4: Explore the concepts of signals and systems through implementation using MATLAB/ SCILAB/ Python.

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	0	0	0	0	0	0	0	0	3	0	0
CO2	3	3	1	0	0	0	0	0	0	0	0	3	0	0
CO3	3	3	1	0	0	0	0	0	0	0	0	3	0	0
CO4	3	2	1	0	0	0	0	0	0	0	0	3	0	0

Course Code: BECA402C	Analog and Digital Communication	Credits: 03
L:T:P - 3 : 0: 0		CIE Marks: 50
Total Hours/Week: 40		SEE Marks: 50
UNIT-I		10 Hrs.
Random Variables and Processes: Introduction, probability, conditional probability. Random variables: Continuous and discrete random variable, statistical averages, distribution and density functions, central limit theorem. Random processes: Mean, correlation and covariance function, properties of autocorrelation function, cross-correlation function, Gaussian process.		
UNIT-II		10 Hrs.
Amplitude Modulation (AM) Fundamentals: AM concepts, time domain and frequency domain description, generation and detection of AM waves, Generation of DSB-SC, SSB, VSB modulation, superheterodyne receiver. Angle modulation: Concept of angle modulation, relation between frequency and phase modulation, bandwidth of angle modulated wave. Generation of FM: Direct and indirect methods, PLL, demodulation of FM, pre-emphasis and de-emphasis, FM radio.		
UNIT-III		10 Hrs.
Digital Representation of Analog Signals: Introduction, sampling process, pulse amplitude modulation, time-division multiplexing. Pulse Position Modulation (PPM): Generation and detection of PPM wave, the quantization process. Pulse Code Modulation: Sampling, quantization, encoding, line codes, differential encoding.		
UNIT-IV		10 Hrs.
Digital Modulation Techniques: Digital Modulation formats, Coherent binary modulation techniques (ASK,PSK, FSK), Probability of error for each ASK, PSK, FSK. Coherent quadrature modulation techniques: Minimum Shift Keying. Non-coherent binary modulation techniques: Frequency Shift Keying and Differential Phase Shift Keying		
Reference Books *		
1. Lathi B.P., Zhi Ding (2010), “Modern Digital and Analog Communication Systems” (4), Oxford University Press 2. Louis E Frenzel (2016), “Principles of Electronic Communication Systems” (3), Mc Graw Hill Education (India) Private Limited 3. Simon Haykin & Michael Moher (2010), “Communication Systems” (5), John Wiley, India Pvt. Ltd, 2010, 4. John. G. Proakis, &Masoulsalehi (2014), “Fundamental of Communication System” Pearson Education, 5. Sam Shanmugan K. (2006), “Digital and Analog Communication Systems”, John Wiley & Sons		
Course Outcomes**		
After completion of the course student will be able to CO1: Apply the basics of probability to random variables and random processes for communication systems CO2: Generate and detect AM/FM waves using electronic circuits CO3: Design PCM systems through the processes sampling, quantization and encoding CO4: Apply various digital modulation techniques for signal transmission		

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	1	1	0	0	0	0	0	0	3	2	1
CO2	3	0	1	1	1	0	0	0	0	0	0	3	2	1
CO3	3	2	2	1	1	0	0	0	0	0	0	3	2	1
CO4	3	3	3	1	1	0	0	0	0	0	0	3	2	1

Course Code: BECA403C	Linear Integrated Circuits	Credits: 03
L:T:P –3:0:0		CIEMarks:50
Total Hours: 40		SEEMarks:50
UNIT-I		10 Hrs.
Differential Amplifiers: Introduction, differential amplifier, differential amplifier circuit configurations, dual-input balanced output differential amplifier, dual- input unbalanced output differential amplifier, single input balanced output differential amplifier, single input unbalanced output differential amplifier, constant current bias, current mirror, cascaded differential amplifier stages, level translator. Introduction to operational amplifiers: Introduction, block diagram representation of a typical op-amp, the ideal op-amp, equivalent circuit of an op-amp, ideal voltage transfer curve, open loop op-amp configurations.		
UNIT–II		10 Hrs.
An op-amp with negative feedback: Block diagram representation of feedback configuration, voltage series feedback amplifier, voltage shunt feedback amplifier, differential amplifier. The practical op-amp: Input offset voltage, input bias current, input offset current, total output offset voltage, common mode configuration and common mode rejection ratio.		
UNIT–III		10 Hrs.
General applications: The peaking amplifier, summing, scaling and averaging amplifiers, integrator, differentiator. Active filters: First order and second order low pass butter worth filter, first order and second order high pass butter worth filter, higher order filters, band pass filter, band reject filters, all pass filters.		
UNIT–IV		10 Hrs.
Oscillators and waveform generator: Introduction, phase shift oscillator, wien bridge oscillator, square wave generator, triangular wave generator, voltage-controlled oscillator. Comparators and converters: Basic comparator, zero crossing detector, Schmitt trigger, DAC with R-2R ladder network, ADC using successive approximation type, peak detector, sample and hold circuit.		
Reference Books *		
1. Ramakanth A Gayakwad, “Operational Amplifiers and Linear Integrated Circuits”, 3 rd & 4 th Edition, PHI. 2. James M. Fiore, “Op-amps and linear integrated circuits: Concepts and applications”, CENGAGE Learning 2009. 3. D. Roy Choudary, “Linear Integrated Circuits”, 2 nd Edition.		
Course Outcomes**		
After completion of the course student will be able to		
CO1: Identify and analyse the different configurations of differential amplifier.		
CO2: Analyse the different feedback amplifiers and various parameters of practical op-amp.		
CO3: Design of the op amp circuits to performs mathematical operations and active filters.		
CO4: Design different types of waveform generators, data converters, Precision rectifier, comparators and converters.		

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	1	0	0	0	0	0	0	0	3	1	0
CO2	3	3	1	0	0	0	0	0	0	0	0	3	2	0
CO3	3	3	2	2	0	1	1	0	0	0	0	3	2	0
CO4	3	2	2	1	0	1	1	0	0	0	0	3	2	0

SUBJECT CODE: BECA404C	ARM Microcontroller	Credits: 03
L: T; P:- 3:0:0		CIEMarks:50
Total Hours: 03		SEEMarks:50
UNIT-I		10 Hrs.
The ARM7 TDMI Programmer’s Model :Introduction, data types, processor modes, registers, program status registers: the control bits, the mode bits, the vector table. first programs. Introduction : Program 1: Shifting data, running the code, examining register and memory contents Program 2: Factorial calculation, Program 3: Swapping register contents Assembler Rules and Directives: Introduction, structure of assembly language modules, predefined register names.		
UNIT–II		10 Hrs.
Frequently Used Directives: AREA, RN, EQU, ENTRY, DCB, DCW, DCD, ALIGN SPACE, LTORG, END. Macros miscellaneous assembler features, assembler operators, literals. Loads, Stores, and Addressing: Introduction, Memory.		
UNIT–III		10 Hrs.
Loads, Stores: The instructions, operand addressing: pre-indexed addressing, post-indexed addressing endianness: changing endianness, defining memory areas. Constants and Literal Pools: Introduction, The ARM rotation scheme, loading constants into registers, loading addresses into registers. Logic and Arithmetic: Introduction, Flags and their use, The N Flag, The V Flag, The Z Flag, The C Flag. Comparison Instructions.		
UNIT–IV		10 Hrs.
Data Processing Operations: Boolean Operations, shifts and rotates addition/subtraction, multiplication, multiplication by a constant, division, fractional notation. Loops and Branches: Introduction, branching, looping, while loops, for loops do-while loops, Tables: Introduction, Lookup Tables, Jump Tables, Binary Searches.		
Reference Books *		
1. William Hohl, “ARM Assembly Language(Fundamentals and Techniques (1 st edition)”, Publisher CRC Press, 2009. 2. Steve Furber, “ARM System on Chip Architecture”, Edition 2, Pearson Education Limited, 2000.		
Course Outcomes**		
After completion of the course student will be able to CO1: Demonstrate proficiency in utilizing ARM development tools to write and debug assembly language programs, showing a deep comprehension of the ARM programmer's model. CO2: Exhibit competence in writing and executing simple ARM assembly language programs, incorporating data processing, data transfer, and control flow instructions effectively. CO3: Demonstrate skill in using the ARM instruction set to perform various operations, including branching, data processing, and coprocessor instructions.		

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	1	3	1	1	1	2	1	0	1	0	3	0
CO2	3	3	3	1	3	1	1	1	2	1	0	1	0	3	0
CO3	3	3	3	1	3	1	1	1	2	1	2	1	0	3	0

Course Code: BBTA405C	BIOLOGY FOR ENGINEERS	Credits : 03
L: T; P:- 3:0:0		CIE Marks: 50
Total Hours: 03 Hrs/Week		SEE Marks: 50
Exam Hours: 03		Total Marks: 100
UNIT-I		10 Hrs.
Introduction to Biology: The cell: Structure, and functions of a cell. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, Proteins and Lipids. Importance of special biomolecules: Enzymes, vitamins and hormones -properties and functions.		
Biomolecules and their Applications: Carbohydrates in cellulose-based water filters production, PHA and PLA in bioplastics production, Nucleic acids in vaccines and diagnosis, Proteins in food production, Lipids in biodiesel, Enzymes in biosensor fabrication, food processing, detergent formulation and textile processing.		
UNIT-II		10 Hrs.
Bio Inspiration Models Used In Engineering: Bio inspiration - Introduction, Alliance between Engineering and Biology, Biomimicry - Science mimicking nature. Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Gecko Feet, Plant burrs (Velcro), Shark skin (Friction reducing swimsuits), Kingfisher beak (Bullet train), Fire fly LED.		
Nature Bioinspired Materials And Mechanisms: BioEcholocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf), Respiration (MFCs) Human Blood substitutes-hemoglobin based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).		
UNIT-III		10 Hrs.
Human Organ Systems And Bio Designs: Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson’s disease). Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification system gas exchange mechanisms, spirometry, Ventilators, Heart-lung machine). Eye as a Camera system, bionic eye. Kidney as a filtration system - dialysis systems.		
UNIT-IV		10 Hrs.
Trends In Bioengineering: Bioprinting techniques and materials, 3D printing of ear, bone and skin, electrical tongue and electrical nose in food science, Self-healing bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes), Biomining via microbial surface adsorption. Artificial Intelligence for disease diagnosis. Biochips & their applications. Biosensors & their applications.		
Web links and Video Lectures (e-Resources) • https://nptel.ac.in/courses/121106008 • https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists • https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009 • https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006 • https://www.coursera.org/courses?query=biology • https://onlinecourses.nptel.ac.in/noc19_ge31/preview • https://www.classcentral.com/subject/biology • https://www.futurelearn.com/courses/biology-basic-concepts		
Reference Books 1. Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N, “Biology for Engineers”, Publishing, Bengaluru, 2023.		

2. Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., "Biology for Engineers", Tata McGraw-Hill, New Delhi, 2012.
3. Arthur T. Johnson, "Biology for Engineers", CRC Press, Taylor and Francis, 2011
4. Leslie Cromwell, "Biomedical Instrumentation", Prentice Hall 2011.
5. Sohini Singh and Tanu Allen, "Biology for Engineers", Vayu Education of India, New Delhi, 2014.
6. Yoseph Bar-Cohen, "Biomimetics: Nature-Based Innovation", 1st edition, 2012, CRC Press.
7. Ibrahim Ozbolat, "3D Bioprinting: Fundamentals, Principles and Applications", Academic Press, 2016.
8. Maria Rodriguez Mende, "Electronic Noses and Tongues in Food Science", Academic Press, 2016

Course Outcomes:

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

CO1: Elucidate the basic biological concepts required for engineering applications.

CO2: Use nature inspired concepts for domain specific applications.

CO3: Analyze and apply the principles of bioengineering in developing biomedical devices.

CO4: Apply the innovative biobased solutions for eco-friendly and socially relevant problems.

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	2	0	0	0	0	0	3	3	2	2
CO2	3	3	2	2	3	0	0	0	0	0	3	3	2	2
CO3	3	3	2	2	3	0	0	0	0	0	3	3	2	2
CO4	3	3	2	2	3	0	0	0	0	0	3	3	2	2

Course Code: BHSA424C	Universal Human Values (UHV) (Common to all Branches)	Credits: 01
Hours/Week (L:T:P: S): 1:0:0:0		CIE Marks: 50
Total Hours of Pedagogy (Theory + Lab) 15		SEE Marks: 50
UNIT-I		3 Hrs.
Introduction to Value Education: Right understanding, relationship and physical facility (holistic development and the role of education) understanding value education, self-exploration as the process for value education, continuous happiness and prosperity – the basic human aspirations, happiness and prosperity – current scenario, method to fulfill the basic human aspirations		
UNIT-II		4 Hrs.
Harmony in the Human Being: Understanding human being as the co-existence of the self and the body, distinguishing between the needs of the self and the body, the body as an instrument of the self, understanding harmony in the self, harmony of the self with the body, programme to ensure self-regulation and health		
UNIT-III		4 Hrs.
Harmony in the Family and Society : Harmony in the Family – the basic unit of human interaction, 'trust' – the foundational value in relationship, 'respect' – as the right evaluation, other feelings, justice in human-to- human relationship, understanding harmony in the society, vision for the universal human order.		
UNIT-IV		4 Hrs.
Harmony in the Nature/Existence Implications of the Holistic Understanding – a Look at Professional Ethics : Understanding harmony in the nature, interconnectedness, self-regulation and mutual fulfillment among the four orders of nature, realizing existence as co-existence at all levels, the holistic perception of harmony in existence. Natural acceptance of human values, definitiveness of (ethical) human conduct, a basis for humanistic education, humanistic constitution and universal human order, competence in professional ethics holistic technologies, production systems and management models-typical case studies, strategies for transition towards value-based life and profession		
Reference Books		
1. Gaur R R, Asthana, R.G, Bagaria G P, “A Foundation Course in Human Values and Professional Ethics”, 2 nd Revised Edition, Excel Books, New Delhi, 2019. 2. R R Gaur, R Asthana, G, “The Teacher’s Manual for A Foundation Course in Human Values and Professional Ethics”. 3. A Nagaraj, Jeevan Vidya Prakashan, Amar kantik, “Jeevan Vidya: Ek Parichaya”, 1999. 4. A.N. Tripathi, “Human Values”, New Age Intl. Publishers, New Delhi, 2004. 5. The Story of Stuff (Book). 6. Mohandas Karamchand Gandhi, “The Story of My Experiments with Truth”. 7. E. F Schumacher, “Small is Beautiful”. 8. Andrews Cecile, “Slow is Beautiful”. 9. Kumarappa J C, “Economy of Permanence”. 10. Pandit Sunderlal, “Bharat Mein Angreji Raj”. 11. Dharampa I, “Rediscovering India”. 12. Gandhi Mohandas K, “Hind Swaraj or Indian Home Rule”. 13. Maulana Abdul Kalam Azad, “India Wins Freedom”. 14. Romain Rolland (English) Vivekananda 15. Romain Rolland (English), Gandhi		

16. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
17. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, 'Limits to Growth – Club of Rome's report', Universe Books.
18. A Nagraj, Divya Path Sansthan, Amarkantak, "Jeevan Vidya Ek Parichay", 1998.
19. P L Dhar, RR Gaur, "Science and Humanism, Commonwealth Publishers" 1990.
20. A N Tripathy, "Human Values", New Age International Publishers 2003.
21. Subhas Palekar, "How to practice Natural Farming", Pracheen (Vaidik) Krishi Tantra Shodh, Amravati, 2000.
22. E G Seebauer & Robert L. Berry, "Fundamentals of Ethics for Scientists & Engineers", Oxford University Press, 2000.
23. M Govindrajran, S Natrajan & V.S. Senthil Kumar, "Engineering Ethics (including Human Values)", Eastern Economy Edition, Prentice Hall of India Ltd, 2000.
24. B P Banerjee, "Foundations of Ethics and Management", Excel Books, 2005.
25. B L Bajpai, "Indian Ethos and Modern Management", New Royal Book Co., Lucknow. Reprinted 2008.

Suggested Web Links:

1. Value Education websites,
2. <https://www.uhv.org.in/uhv-ii>,
3. <http://uhv.ac.in>,
4. <http://www.uptu.ac.in>
5. Story of Stuff,
6. <http://www.storyofstuff.com>
7. Al Gore, An Inconvenient Truth, Paramount Classics, USA
8. Charlie Chaplin, Modern Times, United Artists, USA
9. IIT Delhi, Modern Technology – the Untold Story
10. Gandhi A., Right Here Right Now, Cyclewala Productions
11. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw
12. https://fdp-si.aicte-india.org/8dayUHV_download.php
13. <https://www.youtube.com/watch?v=8ovkLRYXlJE>
14. <https://www.youtube.com/watch?v=OgdNx0X923I>
15. <https://www.youtube.com/watch?v=nGRcbRpvGoU>
16. <https://www.youtube.com/watch?v=sDxGXOGYEKM>

Course Outcomes:

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

CO1: Understand the need and role of value education for holistic development

CO2: Differentiate between self and body needs, and practice harmony within the human being.

CO3: Analyze relationship dynamics based on trust, respect, and justice within families and society.

CO4: Recognize harmony in nature and existence, and apply these ideas to sustainable living

CO5: Explore ethical practices and professional conduct within personal and professional contexts

Course Code: BECA405L		Communication Engineering Laboratory	Credits: 01
L:T:P - 0 : 0 : 2			CIE Marks:50
Total Hours/Week: 02			SEE Marks:50
List of Experiments			
Sl. No	Title of the Experiment		
1.	Design and verification of amplitude modulation and demodulation circuit.		
2.	Design and verification of frequency modulation and demodulation circuit.		
3.	Verification of sampling theorem for $f_s=2f_m$, $f_s>2f_m$, $f_s<2f_m$.		
4.	Design and verification of pulse amplitude modulation and demodulation circuit.		
5.	Design and verification of amplitude shift keying modulation and demodulation circuit.		
6.	Design and verification of frequency shift keying modulation and demodulation circuit.		
7.	Design and verification of phase shift keying modulation and demodulation circuit.		
8.	Design and verification of pulse width modulation and demodulation circuit.		
9.	Design and verification of pulse position modulation and demodulation circuit.		
10.	Design and verification of voltage controlled oscillator circuit using phase locked loop.		
11.	Design and verification of sample and hold circuit.		
12.	Design and verification BJT mixer circuit.		
Course Outcomes			
After completion of the course students will be able to			
CO1: Design and verify analog modulation and demodulation circuits.			
CO2: Design and verify pulse modulation and demodulation circuits.			
CO3: Design and verify sampling circuit.			
CO4: Design and verify mixer circuit.			

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	2	3	0	0	0	0	0	2	3	1	0
CO2	3	3	3	2	3	0	0	0	0	0	2	3	1	0
CO3	3	3	3	2	3	0	0	0	0	0	2	3	1	0
CO4	3	3	3	2	3	0	0	0	0	0	2	3	1	0

Course Code: BECA406L		Linear Integrated Circuits Laboratory	Credits: 01
L:T:P – 0:0:2			CIEMarks:50
Total Hours/Week(L:T:P:S): 0:0:2:0			SEEMarks:50
List of Experiments			
Sl. No.	Title of Experiment		
1.	To realize using op-amp an Inverting Amplifier and Non-Inverting Amplifier		
2.	To realize using op-amps i) Summing Amplifier ii)Difference amplifier		
3.	To realize using op-amps an Instrumentation Amplifier		
4.	To realize using op-amps i) Differentiator ii) Integrator		
5.	To realize using op-amps a Full wave Precision Rectifier		
6.	To realize using op-amps: • Inverting and Non-Inverting Zero Crossing Detectors • Positive and Negative Voltage level detectors		
7.	To realize using op-amp an Inverting Schmitt Trigger		
8.	To realize using op-amp an Astable Multivibrator		
9.	To design and implement using op-amps • Butterworth I & II order Low Pass Filter • Butterworth I & II order High Pass Filter		
10.	To design and implement using op-amp a RC Phase Shift Oscillator		
11.	To design and implement Mono-stable Multivibrator using 555 timer		
12.	To design and implement 4 - bit R-2R Digital to Analog Converter		
Course Outcomes**			
After studying this course, students will be able to			
CO1: Sketch/draw circuit schematics, construct circuits, analyze and troubleshoot circuits containing op-amps, resistors, diodes, capacitors and independent sources.			
CO2: Relate to the manufacturer's data sheets of IC 555 timer and IC μ a741 op-amp.			
CO3: Realize and verify the operation of analog integrated circuits like Amplifiers, Precision Rectifiers, Comparators and Waveform generators.			
CO4: Design and implement analog integrated circuits like Oscillators, Active filters, Timer circuits, Data converters and compare the experimental results with theoretical values.			

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	2	3	2	2	2	3	1	3	0	2	0
CO2	3	2	2	2	3	2	2	2	3	1	3	0	2	0
CO3	3	2	2	2	3	2	2	2	3	1	3	0	2	0
CO4	3	2	2	2	3	2	2	2	3	1	3	0	2	0

Course Code: BECA407L	ARM Microcontroller Laboratory	Credits: 01
L:T:P – 0:0:2		CIEMarks:50
Total Hours/Week(L:T:P:S): 0:0:2:0		SEEMarks:50
Name of Experiments		
Suggested Simulation/ Modelling/ Design/ Verification/ Hardware Boards/etc. (preferably open sources):		
- Develop and test Program using ARM7TDMI/LPC2148. - Conduct the experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler.		
Sl. No.	Title of Experiment	
PART- A		
1.	Write a program to multiply two 16 bit binary numbers.	
2.	Write a program to find the sum of first 10 integer numbers.	
3.	Write a program to find factorial of a number.	
4.	Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM	
5.	Write a program to find the square of a number (1 to 10) using look-up table.	
6.	Write a program to find the largest/smallest number in an array of 32 numbers.	
7.	Write a program to arrange a series of 32 bit numbers in ascending/descending order.	
8.	Write a program to count the number of ones and zeros in two consecutive memory locations.	
PART-B		
9.	Display “Hello World” message using Internal UART.	
10.	Interface and Control a DC Motor.	
11.	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.	
12.	Determine Digital output for a given Analog input using Internal ADC of ARM controller.	
13.	Interface a DAC and generate Triangular and Square waveforms.	
14.	Interface a 4x4 keyboard and display the key code on an LCD.	
15.	Demonstrate the use of an external interrupt to toggle an LED On/Off.	
16.	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.	
Course Outcomes**		
After studying this course, students will be able to		
CO1: Able to get fundamental concepts of ARM7TDMI/LPC2148. microcontroller from practical point of view.		
CO2: Able to write efficient programs in assembly level language of the RM7TDMI/LPC2148. microcontroller.		
CO3: Able to carry out interface between the ARM7TDMI/LPC2148.microcontroller and peripheral devices so that they can design and develop a complete microcontroller based systems (projects).		
CO4: Able to develop the ability to use embedded C language to perform a defined task. Sketch/draw circuit schematics, construct circuits, analyze and troubleshoot circuits containing op-amps, resistors, diodes, capacitors and independent sources.		

Course Articulation Matrix

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	1	3	1	1	1	2	1	0	0	3	0
CO2	3	3	3	1	3	1	1	1	2	1	0	0	3	0
CO3	3	3	3	1	3	1	1	1	2	1	2	0	3	0
CO4	3	2	3	1	3	1	1	1	2	1	2	0	3	0

V Semester Syllabus

Course Code :		BECA501C	Digital Signal Processing	Semester :	V
L:T:P* :		3:0 :0		Course Type :	PCC
Hours/Sem.	Teaching :	42 Hrs.		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs.		SEE Marks :	50
	Exam :	06 Hrs.		Total Marks :	100
	Total Hrs. :	90 Hrs.		Credits :	03

Professional Competency:

Highly skilled in the design, analysis, and implementation of Digital Signal Processing algorithms for real-time systems. Adept at transforming complex mathematical concepts into optimized software and hardware architectures, specializing in noise reduction, filtering, and spectral analysis for audio, wireless communications, or sensor systems.

UNIT-I	11 Hrs.
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Discrete Fourier Transform: Frequency domain sampling and reconstruction of discrete time signals, DFT as a linear transformation, DFT relationship with other transforms, properties of DFT, multiplication of two DFTs, circular convolution and additional properties of DFT. Application of DFT in linear filtering: overlap add and overlap save method.

UNIT –II	10 Hrs.
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Fast Fourier Transform (FFT) Algorithms: Need for efficient computation of DFT, Radix 2 FFT algorithms for computation of DFT and IDFT: Decimation in time and decimation in frequency algorithms. Goertzel algorithm and chirp-Z transform algorithm.

UNIT –III	11 Hrs.
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IIR filter design: Characteristics of analog filters – Butterworth and Chebyshev filters. Design of IIR filters from analog filters (i.e. Butterworth and Chebyshev), Transformation techniques: Impulse invariance method, Approximation of derivative (Backward difference and Forward difference) method. Bilinear transformation method.

UNIT –IV	10 Hrs.
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FIR filter design: Introduction to FIR filters, Design of FIR filters using windowing (Rectangular, Hamming, Hanning and Bartlet) method, FIR filter design using frequency sampling method. Implementation of discrete time systems - Structures for IIR and FIR systems: Direct form I, Direct form II, cascade and parallel realization.

Reference Books:

1. John G. Proakis and Manolakis, "Digital Signal Processing-Principles Algorithms and Applications" PHI Publication, III Edition, 1997.
2. Oppenheim and Schaffer, "Discrete Time Signal Processing" PHI Publication, III Edition, 2003.

Course Outcomes:

After completion of the course student will be able to

CO1: Compute and analyze DFT and IDFT of given functions.

CO2: Calculate DFT and IDFT of given signals using FFT algorithms.

CO3: Design and realize IIR digital filters using Butterworth and Chebyshev approximations.

CO4: Design and realize FIR digital filters using windowing and frequency sampling techniques.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1,WK2,WK3,WK4)	2 (WK1,WK2,WK3)	1 (WK5)	1 (WK8)	1 (WK2, WK6)	- -	- -	1 (WK8)	- -	--	--	3	--	0
CO2	3 (WK1,WK2,WK3,WK4)	3 (WK1, WK2, WK3, WK4)	1 (WK5)	1 (WK8)	1 (WK2 , WK6)	--	--	1 (WK8)	--	--	--	3	--	0
CO3	3 (WK1,WK2,WK3,WK4)	2 (WK1,WK2,WK3)	2 (WK5)	1 (WK8)	2 (WK2 , WK6)	--	--	1 (WK8)	--	--	--	3	--	0
CO4	3 (WK1,WK2,WK3,WK4)	3 (WK1, WK2, WK3, WK4)	1 (WK5)	1 (WK8)	1 (WK2 , WK6)	--	--	1 (WK8)	--	--	--	3	--	0

Course Code		:	BECA502C	Computer Networks	Semester	:	V
L:T:P		:	3:0:0		Course Type	:	Theory (PCC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
Total Hrs.			:	90 Hrs	Credits	:	03
Professional Competency:							
Apply the principles of data communication and computer networking to design, implement, and manage reliable network infrastructures using appropriate protocols, addressing mechanisms, and network services.							
UNIT-I						11 Hrs.	
Layered tasks, OSI Model, Layers in OSI model, TCP/IP Suite, Addressing, Data Link Control: Framing, Flow and error control, Protocols, Noiseless channels and noisy channels, HDLC, PPP.							
UNIT-II						10Hrs.	
Multiple Accesses: Random access, Controlled access, Channelization, Wired LAN, Ethernet, IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet, Connecting LANs, Backbone and Virtual LANs							
UNIT-III						11 Hrs.	
Network Layer, Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6 Transition from Ipv4 to Ipv6, Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing protocols.							
UNIT-IV						10 Hrs.	
Transport layer Process to process Delivery, UDP, TCP, Application Layer: Domain name system, Name Space, Domain Name Space, Distribution of Name Space, DNS in the Internet, Resolution, DNS messages, Types of Records, Registrars, Dynamic Domain Name System, Encapsulation.							
Text Books							
1. Data Communication and Networking, “Behrouz A. Forouzan”, 4 th Edition, TMH, India, 2006.							
Reference Books							
1. Andrew S. Tanenbaum, “Computer networks”, Prentice-Hall, 2010.							
2. William Stallings, “Data and Computer Communications”, Prentice-Hall, 2007.							
Course Outcomes:							
After completion of the course student will be able to:							
CO1: Explain the layered architecture of computer networks, including the OSI and TCP/IP models, and analyse data link layer functions such as framing, flow control, and error control.							
CO2: Evaluate multiple access techniques and Ethernet technologies, and demonstrate the operation of wired LANs, IEEE standards, and Virtual LANs (VLANs).							
CO3: Apply IPv4 and IPv6 addressing schemes, packet forwarding, and routing protocols to solve network layer communication problems.							
CO4: Analyse the operation of transport layer protocols (TCP and UDP) and explain the role of application layer services, particularly the Domain Name System (DNS), in Internet communication.							

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1,W K2,WK3 WK4)	2 (WK2, WK3,W K4)	3 (WK4, WK5)	2 (WK8)	1 (WK5, WK8)	1 (WK2 , WK6)	1(WK7)	1 (WK9)	--	--	--	1	--	3
CO2	3 (WK1,W K2,WK3 WK4)	3 (WK2, WK3,W K4)	3 (WK4, WK5)	2 (WK8)	1 (WK5, WK8)	1 (WK2 , WK6)	1(WK7)	1 (WK9)	--	--	--	1	--	3
CO3	3 (WK1,W K2,WK3 WK4)	3 (WK2, WK3,W K4)	3(WK4, WK5)	2 (WK8)	1 (WK5, WK8)	1 (WK2 , WK6)	1(WK7)	1 (WK9)	--	--	--	1	--	3
CO4	3 (WK1,W K2,WK3 WK4)	3 (WK2, WK3,W K4)	3 (WK4, WK5)	2 (WK8)	1 (WK5, WK8)	1(WK 2, WK6)	1 (WK7)	1 (WK9)	--	--	--	1	--	3

Course Code :		BECA503E	JAVA Programming	Semester :	V
L:T:P :		3:0:0		Course Type :	PEC
Hours/Sem.	Teaching :	42 Hrs		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs		SEE Marks :	50
	Exam :	06 Hrs		Total Marks :	100
	Total Hrs. :	90 Hrs		Credits :	03

Professional Competency:

Professional competency in Java Programming involves learning object-oriented concepts and implementing them in practical applications. Developing efficient, reliable, and object-oriented software applications using Java. It includes coding, debugging, testing, and maintaining programs while following industry standards and best practices. Test Java programs effectively to solve engineering problems and develop software solutions.

UNIT-I

11 Hrs.

Introducing classes, Objects and Methods: Introducing Classes, Class Fundamentals, The General Form of a Class, A Simple Class, Declaring Objects, A Closer Look at new, Assigning Object Reference Variables, Introducing Methods, Adding a Method to the Box Class, Returning a Value, Adding a Method That Takes Parameter , Constructors, Parameterized Constructors, The this Keyword, The finalize() Method.

UNIT-II

10Hrs.

A Closer Look at Methods and Classes : Overloading methods , overloading constructors, using objects as parameters, a closer look at argument passing, returning objects, recursion, introducing access control, understanding static, introducing final, arrays revisited, introducing nested and inner classes.

Inheritance: Inheritance, inheritance basics, member access and inheritance, example, a superclass variable can reference a subclass object, using super, using super to call superclass constructors second use for super, creating a multilevel hierarchy, when constructors are called, method overriding, dynamic method dispatch, why overridden methods?, applying method overriding. using abstract classes, using final with inheritance, using final to prevent overriding, using final to prevent inheritance.

UNIT-III

11 Hrs.

Packages and Interfaces: Packages, defining a package, finding packages and classpath, a short package example, access protection, an access example, importing packages, interface, defining an interface, implementing interfaces, nested interfaces.

Exception Handling: Exception-handling fundamentals, exception types, uncaught exceptions, using try and catch, displaying a description of an exception, multiple catch clauses, nested try statements, throw, throws, finally.

UNIT-IV

10 Hrs.

Multithreaded Programming : The Java thread model, thread priorities, synchronization, messaging, the thread class and the runnable interface, the main thread, creating a thread, implementing runnable, extending thread, creating multiple threads, using isalive() and join(). Thread priorities, interthread communication, deadlock, suspending, resuming, and stopping threads, suspending, resuming, and stopping threads.

Text Books

1. From Complete Reference, "The Complete Reference" 7th edition .
2. E. Balagurusamy, "Program with JAVA" 4th edition.

Reference Books

Herbert Schildt, Dale Skrien, "Java Fundamentals A Comprehensive Introduction" McGraw Hill The JAVA tutorials, 4th Edition by SUN Microsystems.

Course Outcomes:

After completion of the course student will be able to:

CO1: Understand the fundamentals of Java programming, including data types, operators, control structures, and basic input/output operations.

CO2: Develop Java programs using object-oriented programming concepts such as classes, objects, inheritance, polymorphism, and encapsulation.

CO3: Apply exception handling, arrays, strings, and collections to create robust and efficient Java applications.

CO4: Design, implement, test, and debug simple Java applications to solve basic engineering and real-world problems.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	1	1 (w4)	1 (w4)	1 (WK1, WK4 and WK6)	1	1	1	0		2
CO2	(WK1, WK2, WK3)	2 (WK1, WK2, WK3, and WK4)	3 (WK4)		3 (WK6)	1 (WK1, WK4 and WK7)	1 (WK6)	1	1		1 (WK6)		2
CO3	(WK1, WK2, WK3)	2 (WK1, WK2, WK3, and WK4)	3 (WK6)		3 (WK6)	1 (WK1, WK6 and WK7)		1	1		1 (WK6)		2
CO4		2 (WK1, WK2, WK3, and WK4)	2 (WK6)			1 (WK1, WK6 and WK7)		1	1		1 (WK8)		2

Course Code :		BECB503E	Mobile Communication	Semester :	V
L:T:P* :		0:0 :3		Course Type :	PEC
Hours/Sem.	Teaching	: 40 Hrs.		CIE Marks :	50
	Learning (TW+SL)	: Hrs.		SEE Marks :	50
	Exam	: 3 Hrs.		Total Marks :	100
	Total Hrs.	: 40 Hrs.		Credits :	03

Professional Competency:

Analyze, design, and evaluate mobile communication systems and wireless networking solutions using cellular technologies, wireless protocols, mobility management techniques, and contemporary communication standards for modern communication applications.

UNIT-I

10 Hrs.

Introduction: Evolution and Deployment of Cellular Telephone Systems, Different generations of wireless cellular networks, 1G, 2G, 2.5G, 3G, 4G cellular systems and beyond, wireless standard organizations. Wireless transmission: Frequencies for radio communication, signals, antennas, signal propagation. Medium access control: Motivation for specialized MAC, SDMA, FDMA, TDMA, CDMA.

UNIT-II

10 Hrs.

Telecommunication systems: GSM, UMTS and IMT2000, 4G LTE networks, 5G networks overview. Satellite systems: History, applications, basics, routing, localization and handover. Broadcast system: Overview, cyclical repetition of data, digital audio broadcasting, and digital video broadcasting.

UNIT-III

10 Hrs.

Wireless LAN: IEEE 802.11- system architecture, protocol architecture, physical layer, medium access control layer, MAC management, 802.11b, and 802.11a, HIPERLAN, Bluetooth: user scenarios, architecture, radio layer. Mobile network layer: Mobile IP.

UNIT -IV

10 Hrs.

Dynamic host configuration protocol, mobile Ad hoc network. Mobile transport layer: Traditional TCP, classical TCP improvement, TCP over 2.5/3G wireless network, performance enhancing proxies. Support for mobility: world wide web, wireless application protocol.

Text Books:

1. Jochen Schiller, "Mobile Communications", second edition Pearson Education, 2003.
2. Gary J Mullett, "Introduction to wireless telecommunication systems and networks", Cengage learning, 2006.

Reference Books:

1. Dr. Sunilkumar S Manvi and Dr. Mahabaleshwar S Kakkasageri, "Wireless and Mobile Networks," second edition, Wiley, 2016
2. William Stallings, "Wireless Communication and Networks", Pearson Education, 2002.

Web Links and Video Lectures (e-Resources):

Recommended Video Lectures

NPTEL Video Courses

1. Wireless Communication
Instructor: Prof. Aditya K. Jagannatham (IIT Kanpur)
2. Mobile Computing
NPTEL Course covering GSM, UMTS, Mobile IP and Wireless Internet
3. Computer Networks and Internet Protocols
Instructor: Prof. Bhaskaran Raman (IIT Bombay)
4. 5G Wireless Communication Technologies
NPTEL
5. Internet of Things
NPTEL

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

CO1: Understand the evolution, architecture, and working principles of cellular and wireless communication systems from 1G to 5G technologies.

CO2: Analyze wireless transmission mechanisms, multiple access techniques, telecommunication systems, satellite communication, and digital broadcasting technologies.

CO3: Explain the architecture, protocols, and functionalities of wireless LANs, Bluetooth, HIPERLAN, and Mobile IP for supporting wireless connectivity and mobility

CO4: Evaluate mobility management techniques, ad hoc networks, wireless transport protocols, and web-based mobility support mechanisms for efficient wireless communication.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1:	3 (WK1, WK2)	2 (WK2, WK3)	1(WK4)	1(WK5)	1 (WK5)	-	-	-	-	-	1(WK5)	3	-	2
CO2:	2 (WK1, WK2)	3 (WK3, WK4)	1 (WK5)	1 (WK4)	2 (WK5)	-	-	-	-	-	1(WK4)	3	1	2
CO3:	2 (WK1, WK2)	3 (WK3, WK4)	2 (WK5)	1 (WK4)	3 (WK5)	-	-	-		1	1(WK4)	2	-	3
CO4:	2 (WK1, WK2)	2 (WK3, WK4)	1 (WK5)	2 (WK4)	3 (WK5)	1(WK4)	-	-	-	-	1(WK5)	2	1	3

Course Code :		BECC503E	Speech Processing (Elective)	Semester :	V
L:T:P* :		3 : 0 : 0		Course Type :	PEC
Hours/Sem.	Teaching :	42 Hrs.		CIE Marks :	50
	Learning (TW+SL) :	84 Hrs.		SEE Marks :	50
	Exam :	3 Hrs.		Total Marks :	100
	Total Hrs. :	129 Hrs.		Credits :	03

Professional Competency:

Develop and apply speech signal processing techniques for analysis, representation, and interpretation of speech using modern digital signal processing concepts.

UNIT-I

10 Hrs.

Digital representation of speech signals, waveform representation and parametric representation, sampling rate conversion. Introduction to speech production and classification, basics of phonetics, perception and phonemes, acoustic theory of speech production, digital models for speech including vocal tract, radiation, and excitation components.

UNIT -II

10 Hrs.

Introduction to time-dependent processing of speech, short-time energy and average magnitude, short-time average zero crossing rate, voiced/unvoiced/silence detection, pitch period estimation, short-time autocorrelation function, short-time average magnitude difference function, LPC speech silence detection.

UNIT -III

10 Hrs.

Introduction to Short-Time Fourier Transform (STFT), definition and properties of STFT, Fourier transform interpretation, linear filtering interpretation, sampling of STFT, speech analysis and synthesis systems, Fourier phase spectrum, cepstrum.

UNIT -IV

10 Hrs.

Introduction to homomorphic transformation, frequency domain representation of harmonic systems, impulse response transformation, complex cepstrum of speech, spectrum model, and speech processing applications.

Text Books:

1. L. R. Rabiner and R. W. Schafer, "Digital Processing of Speech Signals", Pearson Education (Asia) Pvt. Ltd., 2004.

Reference Books:

1. D. O'Shaughnessy, "Speech Communication: Human and Machine", Universities Press, 2000.
2. Gold and Morgan, "Speech and Audio Signal Processing", Wiley.
3. L. R. Rabiner and B. H. Juang, "Fundamentals of Speech Recognition", Pearson Education.

Course Outcomes:

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

CO1: Explain the speech production and perception mechanism.

CO2: Characterize and analyze speech signals in the time domain.

CO3: Characterize and analyze speech signals in the frequency domain.

CO4: Analyze speech signals using homomorphic transformation and Linear Predictive Coding (LPC).

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 WK1, WK2	2 WK2	–	–	1 WK5	–	–	–	–	–	1 WK9	3 WK1, WK2	–	–
CO2	3 WK2, WK3	3 WK3	1 WK3	2 WK)	1 WK5	–	–	–	–	–	1 WK9	3 WK2, WK3	1 WK5	–
CO3	3 WK2, WK3	3 WK3, WK4	2 WK4	2 WK4	2 WK5	–	–	–	–	–	1 WK9	3 WK2, WK3, WK4)	2 WK5	1 WK9
CO4	3 WK2, WK3	3 WK3, WK4	2 WK4	2 WK4	2 WK5	–	–	–	–	–	1 WK9	3 WK3, WK4	2 WK5	1 WK9

Course Code :		BECD503E	CMOS Analog VLSI Design	Semester :	V
L:T:P :		3:0:0		Course Type :	PEC
Hours/Sem.	Teaching :	42Hrs		CIE Marks :	50
	Learning (TW+SL) :	42Hrs		SEE Marks :	50
	Exam :	06 Hrs		Total Marks :	100
	Total Hrs. :	90Hrs		Credits :	03

Professional Competency:

Ability to analyze and design single-ended and differential CMOS amplifiers, current mirrors, and operational amplifiers with understanding of device-circuit-system relationships and design trade-offs.

UNIT-I

12Hrs

MOS device models and short channel effects: MOSFET level 1 and level 2 models, threshold voltage model, capacitance model, mobility model, MOSFET basics, small-signal model derivation for a single transistor amplifier Process, voltage, temperature (PVT) dependency and analog layout design essential considerations.

Single stage amplifiers: Basic concept, Common source stage: with resistive load, with diode connected load, with current source load, with triode load, with source degeneration Source follower (common-drain) and common gate with various loads

UNIT-II

10Hrs

CMOS Differential amplifiers: Single ended differential operation, basic differential pair (qualitative and quantitative analysis), common mode response, differential pair with MOS loads and Gilbert cell multiplier Concept of matching transistors for analog layout, analog layout techniques for differential amplifier.

CMOS Current mirrors: basic current mirrors, cascode current mirrors and active current mirrors with large and small signal analysis Understanding of common-mode properties Analog layout making techniques for current mirrors

UNIT-III

10Hrs

CMOS amplifier Frequency response: Miller effect, common source (CS), common gate (CG), common drain (CD) stages and cascode stage Analog layout techniques for MIM, MOM and fringe capacitor Noise analysis of the CMOS amplifier circuits: Types of noise, significance of flicker and thermal. Analysis and representation of noise in single stage amplifiers: CG, CS, CD (source follower) and cascode stage and noise in differential pairs. Feedback Feedback topologies (voltage-voltage, current-voltage, voltage-current, current-voltage) and the noise and the loading effect analysis.

UNIT-IV

10Hrs

Design of the CMOS operational amplifiers: One-stage opamps and two stage opamps, Gain boosting techniques, folded cascode, telescopic amplifier and common mode feedback (CMFB) amplifier Three stage opamp architectures, opamp specifications analysis, Design of high speed and high gain amplifiers.

Text Books:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill, Second Edition, 2017.
2. David Johns and Ken Martin, "Analog Integrated Circuit Design", John Wiley & Sons, Inc., Second Edition, 2012.

Reference Books*

1. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, UK, Second Edition, 2010.
2. R. Jacob Baker, "CMOS Circuit Design, Layout and Simulation", IEEE Press Series on Microelectronic Systems, Wiley Publications, Third Edition, 2010.
3. Yannis Tsividis, "Operation and Modeling of the MOS Transistor", Oxford University Press; 2 edition, June 26, 2003.
4. A. S. Sedra and K. C. Smith, "Microelectronic Circuits-Theory & Applications", Adapted by A.N. Chandorkar, 6th Edition, Oxford, 2013.

Course Outcomes:

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

CO1: Understand and analyze MOSFET device models.

CO2: Design and evaluate single-stage amplifiers, differential amplifiers, and current mirrors.

CO3: Analyze the frequency response of CMOS amplifier stages.

CO4: Design and implement CMOS operational amplifiers.

Matrix to describe the mapping of COs with POs (considering WKs) andPSOs

Course Outcome s (COs)	Program Outcomes and (WKs)											Program Specific Outcome s (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1,WK2)	3 (WK1,WK2,WK3)	1 (WK3)	1 (WK4)	–	–	–	–	–	–	–	3	1	–
CO2	3 (WK1,WK2)	3 (WK1,WK2,WK3)	3 (WK3,WK4)	2 (WK4)	2 (WK5)	–	–	–	–	–	–	3	3	–
CO3	3 (WK1,WK2)	3 (WK1,WK2,WK3)	2 (WK3,WK4)	3 (WK4)	2 (WK5)	–	–	–	–	–	–	3	2	–
CO4	3 (WK1,WK2)	2 (WK1,WK2,WK3)	3 (WK3,WK4)	2 (WK4)	3 (WK5)	–	–	–	–	–	–	3	3	1

Course Code :		BECE503E	Advanced Python Programming	Semester :	05
L:T:P :		3:0:0		Course Type :	Theory (PEC)
Hours/Sem.	Teaching :	42 Hrs		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs		SEE Marks :	50
	Exam :	06 Hrs		Total Marks :	100
	Total Hrs. :	90 Hrs		Credits :	03

Professional Competency:

Professional competency in Advanced Python Programming by creating efficient and scalable programs using advanced language features and libraries.

UNIT-I

12 Hrs

Basic of python data structure - Dictionary, Tuple and Set: Introduction to strings, lists, set, sets in python, create a set, accessing python sets, delete from sets, update sets, python set operations, tuple, tuples in python, creating tuples, accessing tuple, iterate over tuples, slicing tuples, tuples are immutable, python tuple operations, built-in tuple functions and methods, dictionary, dictionaries in python, creating dictionaries, accessing items in python dictionaries, add, update, remove in dictionaries, properties of dictionary keys built-in dictionary methods and functions.

UNIT-II

10 Hrs

Modules and Packages: Introduction to module, creating user defined module, importing a module in python, normal import, from import, from import with *, module search path, introduction to packages, creating user defined package, importing a package in python, normal import, from import, from import with *, intra-package references, installing pip, installing/uninstalling python packages.

UNIT-III

10 Hrs

Exception handling: Introduction to exception, types of exceptions, built-in exceptions, user defined exceptions, raising exceptions, handling exceptions, try clause, except clause, finally clause.

UNIT-IV

10 Hrs

Files Handling: Introduction to files and its types, binary files, text files, opening and closing text file, reading and writing files, setting offsets in file, object serialization - pickle module.

Text Books:

1. Cody Jackson , Learn Programming in Python with Cody Jackson , Packt Publishing, 2018, ISBN : 9781789531947
2. David Amos, Dan Bader et. al. , Python Basics: A Practical Introduction to Python 3 , Real Python, 2021 ISBN : 9781775093329
3. E. Balagurusamy , Introduction to Problem Solving with Python ,Mc Graw Hill India, New Delhi, 2017 ISBN: 9789352602582

Reference Books*

1. James Payne , Beginning Python , Wiley, 2010 ISBN: 9780470414637
2. Allen Downey , Think Python , O'Reilly, USA, 2016, ISBN : 978-9352134755

Course Outcomes:

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

CO1: Apply advanced Python programming concepts, including functions, modules, packages, decorators, and object-oriented programming, to develop efficient applications.

CO2: Utilize Python libraries for file handling, data processing, visualization, and automation to solve engineering and real-world problems.

CO3: Design and implement programs using exception handling, File handling techniques.

CO4: Develop, test, debug, and optimize Python applications by following coding standards and best programming practices.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	1	1 (w4)	1 (w4)	1 (WK1, WK4 and WK6)	1	1	1	0		2
CO2	(WK1, WK2, WK3)	2 (WK1, WK2, WK3, and WK4)	3 (WK4)		3 (WK6)	1 (WK1, WK4 and WK7)	1 (WK6)	1	1		1 (WK6)		2
CO3	(WK1, WK2, WK3)	2 (WK1, WK2, WK3, and WK4)	3 (WK6)		3 (WK6)	1 (WK1, WK6 and WK7)		1	1		1 (WK6)		2
CO4		2 (WK1, WK2, WK3, and WK4)	2 (WK6)			1 (WK1, WK6 and WK7)		1	1		1 (WK8)		2

1. T L Singal, "Analog and Digital Communications", McGraw Hill Education (India) Private Limited, 2012, ISBN: 0-07-107269-1.
2. T L Singal, "Wireless Communications", McGraw Hill Education (India) Private Limited, 2016, ISBN: 0-07-068178-3.

Reference Books:

1. Simon Haykin & Michael Moher, "Communication Systems", 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN: 978-81-265-2151-7.
2. Herbert Taub, Donald L Schilling, Goutam Saha, "Principles of Communication systems", 4th Edition, McGraw Hill Education (India) Private Limited, 2016, ISBN: 978-1-25-902985-1.
3. Simon Haykin, "Digital Communication Systems", John Wiley & sons, 2014, ISBN 978-81-265-4231-4.

Web Links and Video Lectures (e-Resources):

1. Communication Engineering, NPTEL: <https://nptel.ac.in/courses/117102059>

Course Outcomes:

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

CO1: Describe the scheme and concepts of radiation and propagation of communication signals through air.

CO2: Understand the AM and FM modulation techniques and represent the signal in time and frequency domain relations.

CO3: Understand the process of sampling and quantization of signals and describe different methods to generate digital signals.

CO4: Describe the basic digital modulation techniques, channel capacity, source coding technique and the channel coding.

CO5: Compare the different wireless communication systems and describe the structure of cellular communication.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2 (WK1)	2 (WK2)	1 (WK3)	1 (WK4)	-	-	-	-	-	-	-	1	1
CO2	3 (WK1)	3 (WK2, WK3)	2 (WK3)	2 (WK4)	1 (WK5)	-	-	-	-	-	-	2	1
CO3	2 (WK2)	3 (WK3)	2 (WK3)	2 (WK4)	2 (WK5)	-	-	-	1	-	-	2	2
CO4	2 (WK2)	3 (WK3)	3 (WK4)	2 (WK4)	2 (WK5)	-	-	-	-	-	-	2	2
CO5	2 (WK2)	2 (WK3)	2 (WK4)	1 (WK4)	1 (WK5)	1	1	-	-	1	-	2	2

Course Code :			Fuzzy Logic	Semester :	V
L:T:P :		3:0:0		Course Type :	OEC
Hours/Sem.	Teaching :	42 Hrs		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs		SEE Marks :	50
	Exam :	06 Hrs		Total Marks :	100
	Total Hrs. :	90 Hrs		Credits :	03

Professional Competency:

The ability to design, analyze, and implement intelligent fuzzy rule-based inference and decision-making systems capable of modeling non-random uncertainty and translating human linguistic knowledge into precise engineering solutions.

UNIT-I

12 Hrs

Classical sets: Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets. **Classical and Fuzzy relations:** Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation.

UNIT-II

10 Hrs

Fuzzification and Defuzzification: Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, Other forms of the implication operation.

UNIT-III

10 Hrs

Fuzzy Systems: Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories.

UNIT-IV

10 Hrs

Fuzzy decision making: Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi objective decision making, Fuzzy Bayesian, Decision method, Decision making under Fuzzy states and fuzzy actions.

Text Books:

1. Timothy J.Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley,2010.
2. George J.KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995.

Reference Book:

Guanrong Chen and Trung Tat Pham- Introduction to Fuzzy Sets, Fuzzy Logic, and Fuzzy Control Systems, CRC Press, 2000.

Course Outcomes:

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

CO1: Apply and analyze classical and fuzzy sets and relations to model systems with uncertainty using appropriate operations and properties.

CO2: Analyze fuzzification process and defuzzification of membership functions to transform fuzzy information into crisp outputs.

CO3: Design fuzzy rule based system and inference techniques to solve problems involving approximate reasoning.

CO4: Apply fuzzy decision making techniques to analyze multi-objective problems under uncertainty.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcome s (COs)	Program Outcomes and (WKs)											Program Specific Outcome s (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1WK2 , WK3, andWK4)	2(WK1 WK2, and WK3)	2 (WK1, WK2, WK3, and WK4)	-	1 (WK4)	1 (WK4)	1 (WK1, WK4 and WK6)	-	-	-	1 (WK8)	2	2	-
CO2	3 (WK1, WK2, WK3, and WK4)	2(WK1 WK2, and WK3)	2(WK4)	-	1(WK6)	1 (WK1 , WK4 and WK7)	1 (WK6)	-	-	-	1 (WK8)	2	2	-
CO3	3 (WK1, WK2, WK3)	3(WK1 , WK2, WK3, and WK4)	1(WK6)	-	1(WK6)	1 (WK1 , WK6 and WK7)	1 (WK4 and WK6)	-	-	-	1 (WK8)	2	2	-
CO4	2 (WK1, WK2, andWK3)	2 (WK1 WK2, WK3, and WK4)	1(WK6)	-	1 (WK2)	1 (WK1 , WK6 and WK7)	2 (WK1, WK2, andWK3)	-	-	-	1 (WK8)	2	2	-

Course Code :			Micro Electro Mechanical Systems	Semester :	V
L:T:P* :		3: 0: 0		Course Type :	OEC
Hours/Sem.	Teaching :	40 Hrs.		CIE Marks :	50
	Learning (TW+SL) :	Hrs.		SEE Marks :	50
	Exam :	3 Hrs.		Total Marks :	100
	Total Hrs. :	Hrs.		Credits :	03

Professional Competency:

Demonstrate strong understanding of Micro Electro Mechanical Systems (MEMS) concepts, including microsensors, microactuators, and fabrication techniques for advanced engineering applications.

Possesses the ability to analyze, design, and apply MEMS technology in interdisciplinary fields such as electronics, biomedical systems, and automation.

UNIT-I

10 Hrs.

Introduction to MEMS Technology: Basic definitions, history and evolution of MEMS. Feynman's vision, Microelectronics and MEMS, Micro sensors microactuators and microsystems, Types of MEMS, Applications of MEMS in various disciplines. Commercial MEMS products.

Scaling issues in micro systems: Examples and numerical problems based on scaling laws.

Multiphysics- Multiengineering aspects of MEMS: Introduction to design, modeling and simulation, optimization, fabrication, reliability and packaging of MEMS.

UNIT -II

10 Hrs.

Working Principles of MEMS:

Mechanical sensors and actuators – beams and cantilevers, accelerometers

Electrostatic sensors and actuators – parallel plate capacitors, comb drive sensor and actuator

Piezoelectric sensors and actuators – cantilever based piezoelectric sensor and actuator

Thermal actuators – single and bimorph thermal actuators

Optical MEMS – DLP mirror; construction and working

Bio/Chemical sensors – DNA sensor

UNIT -III

10 Hrs.

Modeling and Simulation of MEMS: Electronic circuits and Control for MEMS: MOSFET, OpAmp, ADC, Control theory and controllers (instrumentation amplifier, PLL, Airbag trigger system), MEMS system modeling, Need for Simulation tools, FEM. MEMS design and Realization Tools – ANSYS/Multiphysics, CoventorWare, COMSOL. AFM as a measurement tool in microsystems.

Case Studies: Microcantilever based sensor, Electrothermal actuator, Electrostatic actuator.

UNIT -IV

10 Hrs.

Microfabrication/Micromachining: Introduction to microfabrication, Materials used in microfabrication, Lithography, thin film deposition, diffusion, oxidation, doping, CVD, PVD, etching, bonding. Surface, bulk and LIGA micromachining techniques.

Text Books:

1. Tai, Ran Hsu, "MEMS and Microsystems: Design and Manufacture" TMH, 2002.

2. G K Ananthasuresh, K J Vinoy, S Gopalkrishnan, K N Bhat, V K Atre, "Micro and Smart Systems" Wiley India, 2010.

Reference Books:

1. N. P. Mahalik, "MEMS" Tata McGraw-Hill, 2007.
2. James J. Allen, "Micro Electro Mechanical System Design" CRC Press, Taylor & Francis Group, 2005.
3. Chang Liu, "Foundations of MEMS", Pearson Education International, 2007.
4. Stephen D. Senturia, "Microsystem Design", Springer International Edition, 2001.

Course Outcomes:

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

CO1: To apply the scaling laws for the design on devices at micro domain.

CO2: To design sensors and actuators using the transduction principles covered in the syllabus.

CO3: To analyze performance using the CAD tools for, capacitive, Piezoresistive, thermal, mechanical and bio/chemical transducers.

CO4: To develop a set of process steps and specs to obtain a desired microfabricated device.

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcomes (COs)	Program Outcomes and (Wks)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	1	-	-	1	-	-	2
CO2	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	1 (WK9)	1	1	-	1 (WK8)	-	-	2
CO3	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-	-	2
CO4	-	2 (WK1, WK2, WK3, and WK4)	2 (WK5)	-	-	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-	-	2

Course Code :		BECA505L	Computer Networks Laboratory	Semester :	V
L:T:P :		0 :0: 2		Course Type :	Practical (PCCL)
Hours/Sem.	Teaching	: 28 Hrs		CIE Marks :	50
	Learning (TW+SL)	: 00		SEE Marks :	50
	Exam	: 04 Hrs		Total Marks :	100
	Total Hrs.	: 32Hrs		Credits :	1.0

Professional Competency:

Develop the ability to design, configure, implement, and troubleshoot computer networks using networking hardware and simulation tools, while applying industry-standard protocols, routing techniques, and network services for efficient communication.

Sl. No.	Title of Experiment
1.	Study of different types of network cables and practically implement the cross-wired cable and straight through cable using clamping tool
2.	Study of network components/devices: i)NIC ii)Hub iii)Switch
3.	Connecting computers on Local Area Network(LAN) using HUB
4.	Connecting computers on Local Area Network(LAN) using SWITCH
5.	Study of packet tracer
6.	Configuration of different network topologies using packet tracer
7.	Configuration of switch and establishing LAN using packet tracer
8.	Creation of Virtual LAN (VLAN) using packet tracer
9.	Configuration of Basic Routing using Packet Tracer
10.	Configuration of a network using Routing Information Protocol(RIP)using packet Tracer
11.	Configuration of a network using Open Shortest path First (OSPF)using packet tracer
12.	Configuration of DHCP using packet tracer
13.	Configuration of NAT using CISCO packet tracer
14.	FTP configuration using CISCO packet tracer
15.	DNS server configuration using CISCO packet tracer

Course Outcomes:

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

CO1: Identify networking components, prepare network cables, and establish basic LAN connectivity using networking devices and tools.

CO2: Design and implement different network topologies, switch configurations, and Virtual LANs (VLANs) using Cisco Packet Tracer.

CO3: Configure and analyze routing protocols and IP addressing services including static routing, RIP, OSPF, DHCP, and NAT in computer networks.

CO4: Simulate and evaluate network application services such as FTP and DNS, and troubleshoot network connectivity issues using simulation tools.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes (POs) and WKs											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1,WK2,WK3,WK4)	3 (WK2,WK3,WK4)	1 (WK5)	1 (WK8)	3 (WK2)	--	--	1 (WK9)	1 (WK9)	--	1 (WK8)	--	--	3
CO2	2 (WK2,WK3,WK4)	3 (WK2,WK3,WK4)	3 (WK5)	2 (WK8)	3 (WK2,WK6)	--	--	2 (WK9)	1 (WK9)	1 (WK9)	1 (WK8)	--	--	3
CO3	2 (WK2,WK3,WK4)	3 (WK2,WK3,WK4)	3 (WK5)	3 (WK8)	3 (WK2,WK6)	--	--	1 (WK9)	1 (WK9)	1 (WK9)	1 (WK8)	--	--	3
CO4	2 (WK2,WK3,WK4)	3 (WK2,WK3,WK4)	2 (WK5)	3 (WK8)	3 (WK2,WK6)	--	--	2 (WK9)	2 (WK9)	1 (WK9)	2 (WK8)	--	--	3

Course Code		:	BECA506L	Digital Signal Processing Laboratory	Semester	:	V
L:T:P		:	0 :0: 2		Course Type	:	Practical (PCCL)
Hours/Sem.	Teaching	:	28 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	00		SEE Marks	:	50
	Exam	:	04 Hrs		Total Marks	:	100
	Total Hrs.	:	32 Hrs		Credits	:	01

Professional Competency:

Competent in real-time hardware-in-the-loop implementation of digital filters and spectral analysis tools on embedded DSP targets; highly proficient in utilizing oscilloscopes and spectrum analyzers to measure latency and signal integrity."

Sl. No.	Title of the Experiment
1.	Generation of different analog and digital signals (impulse, step, ramp, sine, cosine, square, rectangular and triangular) with given amplitude, frequency, phase and duration.
2.	Verification of sampling theorem.
3.	Implementation of amplitude scaling, time scaling, time reversal and time shift operations on given continuous time and discrete time signal.
4.	Response of continuous time and discrete time LTI systems to a given input.
5.	Fourier series of given continuous time and discrete time periodic signals.
6.	Fourier transform of given continuous time and discrete time aperiodic signals.
7.	N point DFT of a given sequence of length L when (a) $N < L$ (b) $N = L$ and (c) $N > L$, corresponding IDFT and analysis of the result.
8.	Verification of time shift, conjugate symmetry and convolution property of DFT.
9.	Implementation of linear convolution and circular convolution using DFT and IDFT.
10.	Design and frequency response analysis of IIR filter to meet given specifications using different $S \rightarrow Z$ transformation techniques.
11.	Design and frequency response analysis of FIR filter to meet given specifications using different windows.
12.	Implementation of linear and circular convolution using DSP processor.

Course Outcomes:

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

CO1: Analyze algorithms implemented to generate different functions of time and frequency.

CO2: Analyze algorithms implemented to perform various operations on signal.

CO3: Design, implement and analyze IIR and FIR filters to meet given specifications.

CO4: Implement and analyze convolution algorithms implemented using DSP processor.

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcomes (COs)	Program Outcomes (POs) and Wks											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, WK4)	3 (WK2, WK3, WK4)	--	--	1 (WK2)	1 (WK5, WK7)	--	1 (WK9)	1 (WK9)	1 (WK9)	--	3	--	--
CO2	3 (WK2, WK3, WK4)	2 (WK2, WK3, WK4)	3 (WK5)	2 (WK8)	3 (WK2, WK6)	1 (WK5, WK7)	--	1 (WK9)	1 (WK9)	1 (WK9)	--	3	--	--
CO3	3 (WK2, WK3, WK4)	3 (WK2, WK3, WK4)	1 (WK5)	2 (WK8)	2 (WK2, WK6)	1 (WK5, WK7)	--	1 (WK9)	1 (WK9)	1 (WK9)	--	3	--	--
CO4	2 (WK2, WK3, WK4)	3 (WK2, WK3, WK4)	1 (WK5)	2 (WK8)	3 (WK2, WK6)	1 (WK5, WK7)	--	1 (WK9)	1 (WK9)	1 (WK9)	--	3	--	--

Course Code :		BECA507L	Data Structure Using C++ Laboratory	Semester :	V
L:T:P* :		0:0:02		Course Type :	PCCL
Hours/Sem.	Teaching :	1Hrs.		CIE Marks :	50
	Learning (TW+SL) :	1Hrs.		SEE Marks :	50
	Exam :	2Hrs.		Total Marks :	100
	Total Hrs. :	4Hrs.		Credits :	2

Professional Competency:

Professional competency in Data Structures using C++ by implementing linear and non-linear data structures to solve computational problems efficiently.

List of Experiments OR Programs List

1. Write a C++ Program to create a Student record structure to store, N-records, each record having the structure shown below: USN, Student Name and Semester. Write necessary functions
a. To display all the records in the file. b. To search for a specific record based on the USN. In case there record is not found, suitable message should be displayed. Both the options in this case must be demonstrated. (Use pointer to structure for dynamic memory allocation)
2. Write a C++ Program to construct a stack of integers and to perform the following operations on it: **Push b. Pop c. Display** . The program should print appropriate messages for stack overflow, stack underflow, and stack empty.
3. Write a C++ Program to convert and print a given valid parenthesized infix- arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide).
4. Write a C++ Program to simulate the work in queue of integers using an array. Provide the following operations: **a. Insert b. Delete c. Display.**
5. Write a C++ Program using dynamic variables and pointers to construct a stack of integers using singly linked list and to perform the following operations: **a. Push b. Pop c. Display** The program should print appropriate messages for stack overflow and stack empty.
6. Write a C++ Program to support the following operations on a doubly linked list where each node consists of integers: **a. Create a doubly linked list by adding each node at the front. b. Insert a new node to the left of the node whose key value is read as an input c. Delete the node of a given data, if it is found, otherwise display appropriate message. d. Display** the contents of the list. (Note: Only either (a,b and d) or (a, c and d) may be asked in the examination).
7. Write a C++ Program **a. To construct a binary search tree of integers. b. To traverse the tree using all the methods i.e., inorder, preorder and postorder. c. To display the elements in the tree.**
8. Write recursive C++ Programs for **a. Searching an element on a given list of integers using the Binary Search method. b. Solving the Towers of Hanoi problem.**

Open Ended Experiment(s) OR Open Ended Program(s)

1. **Student Record Management System Using Linked Lists**
Design and implement a system to store, search, update, and delete student records using singly or doubly linked lists.
2. **Expression Evaluation and Conversion Using Stacks**

Develop a program to convert and evaluate arithmetic expressions .(Postfix) using stack data structures.

Text Books:

1. D. S. Malik, *"Data Structures Using C++"*, 2nd Edition, Cengage Learning. A beginner-friendly book covering arrays, linked lists, stacks, queues, trees, graphs, and sorting techniques with C++ implementations.
2. Adam Drozdek, *"Data Structures and Algorithms in C++"*, 4th Edition, Cengage Learning. Provides a thorough treatment of data structures, algorithms, and problem-solving using C++.
3. Mark Allen Weiss, *"Data Structures and Algorithm Analysis in C++"*, 4th Edition, Pearson Education. Focuses on algorithm analysis and efficient implementation of data structures.
4. Michael T. Goodrich, Roberto Tamassia, and David M. Mount, *"Data Structures and Algorithms in C++"*, 2nd Edition, Wiley. Covers fundamental and advanced data structures with practical examples and applications.
5. Sartaj Sahni, *"Data Structures, Algorithms, and Applications in C++"*, 2nd Edition, Universities Press. Widely used in engineering curricula for learning data structures and algorithm design.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, and Dinesh Mehta, *"Fundamentals of Data Structures in C++"*, Universities Press.
2. Narasimha Karumanchi, *"Data Structures and Algorithms Made Easy"*, Career Monk Publications.
3. Yedidyah Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, *"Data Structures Using C and C++"*, PHI Learning.

Web Links and Video Lectures (e-Resources):

1. GeeksforGeeks – Data Structures and Algorithms
2. Programiz – Data Structures Tutorials
3. cplusplus.com – C++ Reference and Tutorials
4. TutorialsPoint – Data Structures Tutorial
5. NPTEL Courses

Course Outcomes:

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

CO1: To understand the fundamentals of data structures and their implementation using C++ programming concepts.

CO2: To develop problem-solving skills by applying linear and non-linear data structures such as arrays, linked lists, stacks, queues, trees.s

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcomes (COs)	Program Outcomes and (Wks)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	1	1 (w4)	1 (w4)	1 (WK1, WK4 and WK6)	1	1	1	0		2
CO2	(WK1, WK2, WK3)	2 (WK1, WK2, WK3, and WK4)	3 (WK4)		3 (WK6)	1 (WK1, WK4 and WK7)	1 (WK6)	1	1		1 (WK6)		2

Rubrics for Mini-project in BE Program

Semester V

Code: BECA504P

Rubrics for	Phase	Period (Duration)	Rubric#	Marks	Evaluation by
CIE	Evaluation -I	Within ONE MONTH from the start of 5 th /6 th semester of BE Program	R1	15	Committee consisting of HoD/ Nominee + Coordinator + Guide(s)
	Review	Before 15 days from the end of 5 th /6 th semester of BE Program	R2	15	
	Evaluation by guide	Before one week from the end of 5 th /6 th semester of BE Program	R3	20	
SEE	Semester End Examination	During SEE of 5 th /6 th semester of BE Program	R4	50	External + Internal Examiners

R1: Rubrics to evaluate mini-project in the beginning of semester: Within ONE MONTH from the start of 5th semester BE

Evaluation Criteria	Needs improvements (Poor) (2)	Acceptable (Average) (3)	Satisfactory (Good) (4)	Proficient (Very good) (5)	Total marks	Evaluated by
Articulate problem statements and identify objectives	Problem statement and objectives are not clear	Problem statement is clear and objectives are not in line with problem statement	Problem statement is clear and objectives are not completely defined.	Problem statement is clear and objectives are completely defined	15	Committee consisting of (s), HoD, Mini-project coordinator and guide Each will evaluate for 15 marks and average of all the three is the marks awarded
Identify existing processes/ solution methods for solving the problem, including forming justified approximations and assumptions	Not able to identify existing solution for solving the problem. The assumptions, approximations and justifications are identified but not clear	Not able to identify existing solution for solving the problem. But assumptions and approximations are aligned to the objectives.	Able to identify existing solution for solving the problem. Assumptions, and approximations are clear	Able to identify existing solution for solving the problem. and assumptions, approximations and justifications are clear		
Compare and contrast alternative solution processes to select the best process-	Not able to compare alternative solution processes	Able to compare alternative solution processes but could not contrast clearly	Able to compare alternative solution processes and contrast clearly but not able to select best process	Able to compare alternative solution processes, contrast it and also able to select best process		

R2: Rubrics to review mini-project: Before 15 days from the end of 5th semester of B.E.

Evaluation Criteria	Needs improvements (Poor) (2)	Acceptable (Average) (3)	Satisfactory (Good) (4)	Proficient (Very good) (5)	Total marks	Evaluated by
Apply formal idea generation tools to develop multiple engineering design solutions and Identify suitable criteria for evaluation of alternate design solutions	• Able to identify but not able to use it effectively • Able to identify criteria but not able to use them	• Able to use the tool but not able to generate engineering designs • Able to use criteria but not able to compare alternatives	• Able to generate engineering designs but not able to justify • Not able to justify the comparison with criteria	• Able to generate engineering designs with justification • Able to justify the comparison with criteria	15	Committee consisting of (s), HoD, Mini-project coordinator and guide Each will evaluate for 15 marks and average of all the three is the marks awarded
Apply formal decision- making tools to select optimal engineering design solutions for further development	• Able to identify but not able to choose optimum one	• Able to identify optimum one but not able to use it	• Able to use optimum one but not able to justify	• Able to use optimum one with justification		
Build models/ prototypes to develop diverse set of design solutions and develop drawings	• Able to choose the tool but not able to use it effectively	• Able to use the tool but not able to generate alternatives	• Able to generate alternatives but not able to justify the best solution	• Able to generate and justify the best solution		

R3: Rubrics for evaluation by the guide(s): Before one week from the end of 5th semester of B.E.

Evaluation Criteria	Score/Marks				Total Marks	Evaluated by
	Needs improvement (Poor) (2)	Acceptable (Average) (3)	Satisfactory (Good) (4)	Proficient (Excellent) (5)		
Identify engineering systems, variables, and parameters to solve the problems	• Engineering systems are identified but not clear. Variables, and parameters to solve the problems are not defined	• Engineering systems are clear. Variables, and parameters to solve the problems are not defined	• Engineering systems are identified. Variables, and parameters to solve the problems are partially defined	• Engineering systems are identified. Variables, and parameters to solve the problems are completely defined	20	Guide(s)
Technical Knowledge and Awareness related to the Project	• Poor knowledge and no awareness related to project	• Lacks sufficient knowledge and Awareness	• Fair knowledge and awareness related to the project	• Extensive knowledge and awareness related to the project		
Regularity and Attendance	• Irregular and inconsistent in work	• Reports to the guide but lacks consistency	• Reports to the guide very often but not very consistent	• Reports to the guide regularly and consistent in work		
Read, understand	• Able to identify non-technical	• Able to read technical and	• Able to read, understand	• Able to read, understand and		

interpret technical and non-technical information	information	non-technical information, but could not understand and interpret	technical and non-technical information, but could not interpret	interpret technical and non-technical information		
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R4: Rubrics for SEE evaluation

Evaluation Criteria	Very poor (2)	Poor (4)	Average (6)	Good (8)	Very good (10)	Total marks	Evaluated by
Generate information through appropriate tests to improve or revise design	Not able to identify suitable tests to be done	Able to identify but not able to follow testing procedure	Able to follow testing procedures but not able to collect information	Able to collect information but not able to apply it for improvement	Able to apply information for the improvement	50	External + Internal Examiners
Use appropriate procedures, tools and techniques to conduct experiments and collect data	Not able to identify tools, techniques and procedures	Able to identify but not able to conduct experiments	Able to conduct experiments but not able to follow procedure	Able to follow procedure but not able to collect data	Able to collect data as per the standards		
Analyze data for trends and correlations, stating possible errors and limitations	Not able to understand data	Able to understand but not able to analyze data	Able to analyze data but not able to correlate them	Able to correlate but not able to identify errors and limitations	Able to identify errors and limitations		
Deliver effective oral presentations to technical and non-technical audiences	Could not deliver effective presentations.	Could not deliver presentation, but presentation was prepared and attempted.	Able to deliver fair presentation but not able to answer to the audiences	Deliver effective presentations but able to answer partially to the audience queries.	Deliver effective presentation and able to answer all queries of the audience.		
Present results as a team, with smooth integration of contributions from all individual efforts	No Contribution from an individual to a team	Contributions from an individual to a team is minimal	Contributions from an individual to a team is moderate	A contribution from an individual to a team is good but not well groomed in team.	Contribution from an individual to a team is good and results in an integrated team presentation.		

VI Semester Syllabus

Course Code : BECA601C			Electromagnetic Theory	Semester : VI
L:T:P : 3:0:0				Course Type : PEC
Hours/Sem.	Teaching : 42 Hrs			CIE Marks : 50
	Learning (TW+SL) : 42 Hrs			SEE Marks : 50
	Exam : 6 Hrs			Total Marks : 100
	Total Hrs. : 90Hrs			Credits : 03
Professional Competency:				
Apply the principles of electrostatics, magnetostatics, electromagnetic waves, and transmission lines to analyze and solve engineering problems related to electromagnetic fields and wave propagation in electrical, electronics, and communication systems				
UNIT-I				11 Hrs.
Coulomb's Law and electric field intensity: Introduction to coulomb's law, Electric filed intensity, Field arising from a continuous volume charge distribution, Filed of line charge, Filed of sheet charge, Electric flux density Gauss law and divergence: Electric flux density, Gauss law, Application of Gauss law for symmetrical charge distribution (Point charge, Coaxial cable) and Differential volume element, Divergence, Maxwell's first equation, Vector operator dell and Divergence theorem.				
UNIT –II				11 Hrs.
Energy and potential: Energy expended in moving a point charge in an electric filed, The line integral, Definition of potential difference and potential, The potential field of a point charge, Potential field of system of charges, Potential gradient, Energy density in the Electrostatics filed. Conductors, dielectrics and capacitance: Current and current density, Continuity of current, Conductor properties and Boundary conditions, Boundary conditions for perfect dielectrics, Capacitance and examples (Parallel plate capacitor, Dielectric boundary normal to plates).				
UNIT –III				10 Hrs.
Poisson's and Laplace's equations: Poisson's and Laplace's equations. Uniqueness theorem The steady magnetic field: Biot-savart's law, Ampere's circuital law, Curl, Stokes theorem, Magnetic flux density, Scalar and vector magnetic potentials. Magnetic forces: Force on a moving charge and differential current element. Force between differential current elements. Force and torque on a closed circuit.				
UNIT –IV				10 Hrs.
Magnetic Materials and Magnetism: Nature of magnetic materials, Magnetization and permeability. Magnetic boundary conditions. Magnetic circuit, Inductance and mutual inductance. Time varying fields and Maxwell's equations: Faraday's law, Displacement current, Maxwell's equation in point and integral form. Uniform plane wave: Wave propagation in free space and dielectrics, Poynting's theorem and wave power.				
Text Books:				
1. William H HaytJr, John A Buck, "Engineering Electronics", Tata McGraw-Hill, 7 th edition, 2006				
2. Matthew N. O. Sadiku "Principles of Electromagnetics" Oxford 6 th Edition, 2015.				

Reference Books:

1. David K. Cheng, "Fundamentals of Engineering Electromagnetics" Pearson 2014
2. Ashutosh Pramanik, "Electromagnetism -Theory (Volume -1) -Applications (Volume-2)" PHI Learning 2014
3. Bhag Guru et al, "Electromagnetic Field Theory Fundamentals" Cambridge 2005
4. Rohit Khurana, "Electromagnetic Field Theory" Vikas Publishing 1 st Edition, 2014
5. J. A. Edminister, "Electromagnetics" McGraw Hill 3 rd Edition, 2010
6. Gottapu Sasibhushana Rao, "Electromagnetic Field Theory and Transmission Lines" Wiley 1st Edition, 2013

Course Outcomes:

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

CO1: Apply the concepts of vector calculus, Coulomb's law, Gauss's law, electric field intensity, and electric flux density to analyze electrostatic field problems.

CO2: Analyze electric potential, potential gradient, current continuity, boundary conditions, and capacitance in conductors and dielectric media.

CO3: Apply Poisson's and Laplace's equations, Biot-Savart law, Ampere's circuital law, magnetic potentials, and magnetic force relations to solve magnetostatic field problems.

CO4: Analyze magnetic materials, Maxwell's equations, electromagnetic wave propagation, Poynting theorem, reflection of plane waves, and Standing Wave Ratio (SWR) in time-varying electromagnetic fields.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, WK4)	2 (WK2, WK4)	1	1 (WK8)	1 (WK6)	-		-	-	-	-	2	-	-
CO2	3 (WK1, WK2, WK3, WK4)	3 (WK2, WK3, WK4)	2 (WK5)	2 (WK8)	1 (WK6)	-	-	-	-	-	-	3	-	-
CO3	3 (WK1, WK2, WK3 and, WK4)	3 (WK2, WK4)	2 (WK5)	2 (WK8)	2 (WK6)	-	-	-	-	-	-	3	-	-
CO4	3 (WK1, WK2, WK3 and, WK4)	3 (WK2, WK4)	3 (WK5)	2 (WK8)	2 (WK6)	1	-	-	-	-	-	3	1	1

Course Code :			BECA602C	Control Systems	Semester :	VI
L:T:P* :			3: 0: 0		Course Type :	PCC
Hours/Sem.	Teaching	:	40 Hrs.		CIE Marks :	50
	Learning (TW+SL)	:	Hrs.		SEE Marks :	50
	Exam	:	3 Hrs.		Total Marks :	100
	Total Hrs.	:	Hrs.		Credits :	03
Professional Competency:						
Demonstrated proficiency in analyzing and designing control systems using stability analysis, transfer functions, and feedback control techniques for engineering applications. Skilled in applying control system principles to analyse the stability of a control system using various techniques like Bode plot, Nyquist plot, etc.						
UNIT –I					10 Hrs.	
System modeling: Definition of control system, Concept of feedback and its significance, open loop and closed loop systems, Modeling of Electrical, Mechanical and Electromechanical systems, Differential equations of physical system. Transfer function, Block diagram representation and Reduction technique, Signal flow graph representation and reduction using Mason’s gain formula						
UNIT –II					10 Hrs.	
Time domain analysis of control systems: Introduction, standard test signals, Unit step response of a second order system, Steady state error analysis, time domain specifications. Stability analysis technique: Concept of stability, Location of Roots in the s-plane for stability, methods of determining stability, Routh-Hurwitz stability criterion.						
UNIT –III					10 Hrs.	
Root-Locus Technique: Introduction, Procedure for constructing Root-locus. Stability analysis using root locus. Frequency Domain Analysis: Introduction, Bode plots, Gain and Phase cross over frequency, gain margin, phase margin, Frequency domain specifications-resonant peak, resonant frequency, and bandwidth.						
UNIT –IV					10 Hrs.	
Polar plots, Nyquist stability criterion: Principle of argument, mapping, Nyquist path, Nyquist criterion, Nyquist Plot and stability analysis. State Space Analysis: Introduction, concept of state and variables, state model, Non-homogeneous solution of a state equation.						
Text Books:						
1. Nagrath and Gopal, “Control System Engineering”, New Age publication.						
Reference Books:						
1. K. Ogata, “Modern control engineering”, Person education, Asia/PHI 4 th edition, 2002. 2. Benjamin C. Kuo, “Automatic Control Systems”, PHI 7 th edition. 3. Richard C. Dorf and Robert. H. Bishop, “Modern Control Systems”, Person Education, 8th Edition, 2002. 4. M. Gopal, “Control Systems-Principles and Design”, TMH, 2nd Edition, 2002. 5. David. K. Chng, “Analysis of Linear systems”, Narosa publishing house, 1996.						

Course Outcomes:**After completion of the course, student will be able to:****CO1:** Mathematically model electrical, mechanical and electromechanical control systems.**CO2:** Characterize the control systems in time domain.**CO3:** Analyze stability of a control system using root locus technique and frequency domain analysis using Bode plotting techniques.**CO4:** Determine the stability of control systems using polar and Nyquist plotting technique and represent the control systems using state space techniques.**Matrix to describe the mapping of COs with POs (considering Wks) and PSOs**

Course Outcomes (COs)	Program Outcomes and (Wks)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, andWK4)	3(WK1, WK2, WK3, and WK4)	3 (WK5)	-	-	-	1 (WK9)	-	-	-	1 (WK8)	3	2	-
CO2	3 (WK1, WK2, WK3, andWK4)	3(WK1, WK2, WK3, and WK4)	1(WK5)	-	-	-	2 (WK9)	-	-	-	-	3	-	-
CO3	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	2(WK5)	-	1(WK6)	-	-	-	-	-	1 (WK8)	3	-	-
CO4	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	2 (WK5)	-	1 (WK6)	-	-	-	-	-	1 (WK8)	3	-	-

Course Code : BECA603C			CMOS Digital VLSI Design	Semester : VI
L:T:P : 3:0:0				Course Type : PCC
Hours/Sem.	Teaching : 42 Hrs			CIE Marks : 50
	Learning : 42 Hrs			SEE Marks : 50
	(TW+SL)			
	Exam : 6 Hrs			Total Marks : 100
	Total Hrs. : 90Hrs			Credits : 03
Professional Competency:				
Ability to understand CMOS technology, fabrication methods, transistor-level design, delay and power analysis, interconnects, combinational and sequential circuit design, and memory subsystem implementation in VLSI systems				
UNIT-I				11 Hrs.
Introduction: A Brief History, Preview, MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning. MOS Transistor Theory: Introduction, Long- Channel I-V Characteristics, C-V Characteristics (simple MOS capacitance models), Nonideal I-V Effects, DC Transfer Characteristics. CMOS Processing Technology: Introduction, CMOS Technologies.				
UNIT –II				11 Hrs.
R Delay: Introduction, Transient Response, RC Delay Model, Linear Delay Model (Logical effort, parasitic delay, delay in logic gate, drive), Logical Effort of Paths. Power: Introduction, Dynamic Power, Static Power.				
UNIT –III				10 Hrs.
Interconnect: Introduction (wire Geometry), Interconnect Modeling, Interconnect Impact (Delay, Energy, Cross talk). Combinational Circuit Design: Introduction, Circuit families, Silicon-On-Insulator Circuit Design.				
UNIT –IV				10 Hrs.
Sequential Circuit Design: Introduction, Circuit Design of Latches and Flip Flops (conventional CMOS latches, conventional CMOS flip flops, pulsed latches, resettable latches and flip flops, enabled latches and flip flops, incorporating logic into latches, dual edge triggered flip flops. Array Subsystems: Introduction, SRAM (SRAM cells, ROW circuitry, column circuitry), Read-Only Memory, Serial Access Memories, Content Addressable Memory, Programmable Logic Arrays.				
Text Books:				
1. Neil H.E. Weste, David Harris “CMOS VLSI Design: A Circuits and Systems Perspective” Pearson Education Publisher, Fourth Edition, 2015.				
Reference Books:				
1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits A Design Perspective”, Pearson Education Publisher, Second Edition, 2010. 2. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, Wiley Publication 2002. 3. R. Jacob Baker, CMOS Circuit Design, Layout and Simulation, IEEE Press Series on Microelectronic Systems, Wiley Publications, Third Edition, 2010				
Course Outcomes:				
After completion of the course, student will be able to:				
CO1: Draw the layout of CMOS circuits; apply the knowledge of fabrication processes and				

CO4: Design basic buildings of sequential and memory blocks using MOSFET transistors.

Program Outcomes and (WKs)

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2)	2 (WK1, WK2)	1 (WK3)	–	1 (WK5)	–	–	–	–	–	–	3	1	–
CO2	3 (WK1, WK2)	3 (WK1, WK2, WK3)	2 (WK3)	1 (WK4)	2 (WK5)	–	–	–	–	–	–	3	2	–
CO3	2 (WK1)	3 (WK1, WK2, WK3)	3 (WK3, WK4)	1 (WK4)	3 (WK5)	–	–	–	–	–	–	3	3	–
CO4	2 (WK1)	2 (WK1, WK2)	3 (WK3, WK4)	2 (WK4)	2 (WK5)	–	–	–	–	–	–	3	3	1

Course Code :		BECA604C	Multimedia Communication	Semester :	VI
L:T:P* :		3: 0: 0		Course Type :	PCC
Hours/Sem.	Teaching	: 40 Hrs.		CIE Marks :	50
	Learning (TW+SL)	: Hrs.		SEE Marks :	50
	Exam	: 3 Hrs.		Total Marks :	100
	Total Hrs.	: Hrs.		Credits :	03

Professional Competency:

Analyze and develop wireless communication and networking solutions by applying concepts of wireless transmission, mobility management, routing, multicast communication, and energy-efficient protocols in cellular and ad hoc network environments.

UNIT –I

10 Hrs.

Introduction, Multimedia information representation, Multimedia networks, Multimedia applications. Introduction, Digitization principles, Text, Images, Audio, Video

UNIT –II

10 Hrs.

Text and Image Compression: Introduction, Compression principles, Text compression, image compression

UNIT –III

10 Hrs.

Audio and Video Compression: Introduction, Audio compression, Video compression.

UNIT –IV

10 Hrs.

Multimedia Network Communications: Multimedia over IP, Multimedia over ATM Networks, Transport of MPEG-4, Media-on-demand, Multimedia over Wireless Networks.

Text Books:

1. Fred Halsall "Multimedia Communications", Pearson Education, 2001, ISBN - 9788131709948.
2. Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia", Pearson Education (Pearson Prentice Hall), New Delhi, 2004.
3. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson Education, 2004.

Reference Books:

1. John F. Koegel Buford, "Multimedia Systems", Addison-Wesley, 2000.
2. Tay Vaughan, "Multimedia: Making It Work", 8th Edition, McGraw-Hill Education, 2011.
3. Ralf Steinmetz and Klara Nahrstedt, "Multimedia Fundamentals", Vol. 1: Media Coding and Content Processing", 2nd Edition, Pearson Education, 2004.
4. Ralf Steinmetz and Klara Nahrstedt, "Multimedia Applications", Services and Techniques", Springer, 2004.
5. K. R. Rao and J. J. Hwang, "Techniques and Standards for Image, Video and Audio Coding", Prentice Hall, 1996.

Web Links and Video Lectures (e-Resources):

Recommended Video Lectures

🔗 NPTEL Online Courses

- <https://nptel.ac.in/>
- Provides free video lectures and course materials on Multimedia Systems, Digital Image Processing, Computer Networks and Communication Systems.

🔗 SWAYAM Portal

- <https://swayam.gov.in/>
- Online courses on Multimedia Systems, Computer Networks and Digital Signal Processing.

🔗 MIT Open Course Ware

- <https://ocw.mit.edu/>
- Course materials related to multimedia communication, signal processing and networking.

🔗 IEEE Xplore Digital Library

- <https://ieeexplore.ieee.org/>
- Research papers and standards related to multimedia communication systems and networking.

🔗 RFC Editor

- <https://www.rfc-editor.org/>
- Standards and protocols for multimedia over IP, RTP, RTCP, and Internet communication.

🔗 MPEG Standards

- <https://mpeg.chiariglione.org/>
- Information on MPEG-1, MPEG-2, MPEG-4 and multimedia coding standards.

🔗 IETF (Internet Engineering Task Force)

- <https://www.ietf.org/>
- Protocol standards for multimedia communication over IP networks.

🔗 ITU-T Multimedia Standards

- <https://www.itu.int/en/ITU-T/>

International standards for multimedia systems, coding and communication networks.

Course Outcomes:

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

CO1: Explain multimedia information representation, digitization principles, multimedia networks, and applications.

CO2: Analyze text, image, audio, and video data and apply suitable compression techniques.

CO3: Evaluate multimedia communication protocols and transport mechanisms over IP, ATM, and wireless networks.

CO4: Analyze and design multimedia communication systems for media-on-demand and emerging multimedia applications.

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcomes (COs)	Program Outcomes and (Wks)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, WK4))	2 (WK1, WK2, WK3, WK4)	-	-	-	-	-	1	-	-	1	-	2	2
CO2	2 (WK1, WK2, WK3)	3 (WK2, WK3, WK4)	2 (WK5)	1 (WK4)	2 (WK6)	1 (WK1, WK5, WK7)	1 (WK9)	1	1	-	1 (WK8)	-	2	²
CO3	2 (WK1, WK2, WK3)	3 (WK4)	3 (WK5)	2 (WK4)	3 (WK6)	1 (WK1, WK5, WK7)	-	1	1	-	1 (WK8)	-	2	1
CO4	2 (WK1, WK2)	2 (WK3, WK4)	3 (WK5)	2 (WK4)	3 (WK6)	1 (WK1, WK5, WK7)	1 (WK9)	1	1	-	1 (WK8)	-	2	1

Course Code		:	BECA605E	Robotics and Automation	Semester	:	VI
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	6 Hrs		Total Marks	:	100
Total Hrs.		:	90Hrs	Credits	:	03	
Professional Competency:							
Apply engineering knowledge and modern tools to design, implement, and manage robotic and automation systems for industrial, commercial, and societal applications.							
UNIT-I						11 Hrs.	
Fundamentals of Robotics: Introduction to Robotics: Definition, History and Evolution of Robots, Classification of Robots, Components of Robotic Systems, Robot Anatomy and Degrees of Freedom, Robot Configurations, Robot Workspace, Robot Applications in Manufacturing, Healthcare, Agriculture, and Service Industries, Robot Performance Parameters.							
UNIT –II						11 Hrs.	
R Robot Kinematics: Coordinate Systems and Transformations, Position and Orientation Representation, Homogeneous Transformation Matrices, Forward Kinematics, Denavit-Hartenberg (D-H) Representation, Inverse Kinematics Concept, Kinematic Analysis of Simple Manipulators, Jacobian Matrix and Velocity Analysis.							
UNIT –III						10 Hrs.	
R Robot Dynamics, Actuators and Sensors: Introduction to Robot Dynamics, Equations of Motion, Actuation Systems: Electric, Hydraulic and Pneumatic Drives, DC and Servo Motors, Stepper Motors, End Effectors and Grippers, Sensors in Robotics: Position, Velocity, Force/Torque, Proximity and Vision Sensors, Sensor Integration.							
UNIT –IV						10 Hrs.	
Robot Control and Applications: Robot Control Systems, Open-loop and Closed-loop Control, PID Control Basics, Robot Programming Concepts, Programming Methods: Lead-through and Off-line Programming, Industrial Robot Applications, Mobile Robots, Collaborative Robots (Cobots), Autonomous Robots, Introduction to Artificial Intelligence in Robotics, Emerging Trends and Future Directions.							
Text Books:							
1. S. K. Saha, “Introduction to Robotics”, 3 rd Edition, McGraw-Hill Education. 2. M. P. Groover, M. Weiss, R. N. Nagel, and N. G. Odrey, “Industrial Robotics: Technology, Programming, and Applications”, 1st ed. New York, NY, USA: McGraw-Hill, 1986. 3. Imran and K. Gopalakrishnan, “AI for Robotics: Toward Embodied and General Intelligence in the Physical World”, Berkeley, CA, USA: Apress, 2025.							
Reference Books:							
1. N.P. Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press. 2. Saeed B. Niku, “Introduction to Robotics: Analysis, Control, Applications”, Wiley. 3. Peter Corke, “Robotics, Vision and Control”, Springer. 4. Russell & Norvig. “Artificial Intelligence: A Modern Approach”. Pearson.							

5. Rajiv Kapoor, “Robotics and Industrial Automation”, Khanna Publishers.

Course Outcomes:

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

CO1: Explain robot fundamentals, classification, anatomy and applications.

CO2: Apply coordinate transformations and kinematic analysis techniques to robotic manipulators.

CO3: Analyze robot actuators, sensors and dynamic behavior.

CO4: Describe robot control strategies, programming methods and emerging robotic technologies.

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, WK4)	1	1	2 (WK8)	2 (WK2, WK6)	1	-	-	-	-	-	2	2	-
CO2	3 (WK1, WK2, WK3, WK4)	3 (WK2, WK3, WK4)	2 (WK5)	2 WK8	2 (WK2 and WK6)	-	-	-	-	-	-	2	3	-
CO3	3 (WK1, WK2 WK3 and, WK4)	2	1	3 WK8	2 (WK2, WK6)	-	-	-	-	-	-	3	3	-
CO4	3 (WK1, WK2 WK3 and, WK4)	2	3 WK5	2 WK8	3(WK2 and WK6)	1	-	-	-	-	-	2	3	1

Course Code :		BECB605E	Digital Image Processing	Semester :	VI
L:T:P* :		3:0 :0		Course Type :	PEC
Hours/Sem.	Teaching :	42 Hrs.		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs.		SEE Marks :	50
	Exam :	06 Hrs.		Total Marks :	100
	Total Hrs. :	90 Hrs.		Credits :	03

Professional Competency:

Apply digital image processing techniques and tools to analyze, enhance, and interpret images for engineering applications.

UNIT-I	11 Hrs.
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Introduction- Digital Image, its Representation & point operations: Image Representation and Image Processing Paradigm - Elements of digital image processing, Image model. Sampling and quantization-Relationships between pixels- Connectivity, Distance Measures between pixels.

Color image (overview, various color models)-Various image formats bmp, jpeg, tiff, png, gif, etc. Noise in Images Sources, types. Arithmetic operations, Logical operations, Spatial operations Single pixel, neighbourhood, geometric-Contrast Stretching-Intensity slicing-Bit plane slicing Power Law transforms.

UNIT -II	11 Hrs.
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Image Enhancement: Spatial and Frequency domain-Histogram processing-Spatial filtering-Smoothing spatial filters, Sharpening spatial filters; Frequency filtering-Smoothing frequency filters-Sharpening frequency filters, Selective filtering.

Image Restoration: Noise models - Degradation models-Methods to estimate the degradation-Image de-blurring Restoration in the presence of noise only spatial filtering-Periodic noise reduction by frequency domain filtering-Inverse filtering-Wiener Filtering.

UNIT -III	10 Hrs.
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Feature Extraction: Region of interest (ROI) selection - Feature extraction: Histogram based features - Intensity features-Color, Shape features-Contour extraction and representation-Homogenous region extraction and representation-Texture descriptors.

Image Segmentation: Discontinuity detection-Edge linking and boundary detection. Thresholding-Region oriented segmentation- Histogram based segmentation. Object recognition based on shape descriptors.

UNIT-IV	10 Hrs.
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Image Coding and Compression: Lossless compression versus lossy compression-Measures of the compression efficiency- Huffman coding, Bitplane coding, Arithmetic coding. **Wavelet Transform in image processing:** Wavelet Transform in one dimensions, Wavelet transforms in two dimensions. Fast Wavelet Transform , Other Applications of Wavelet in image processing.

Practical Module

Assignment: Students are required to develop programs using Matlab.

List of Programs

1. Write program to read and display digital image using MATLAB or SCILAB

- a. Become familiar with SCILAB/MATLAB Basic commands
 - b. Read and display image in SCILAB/MATLAB
 - c. Resize given image
 - d. Convert given color image into gray-scale image
 - e. Convert given color/gray-scale image into black & white image
 - f. Draw image profile
 - g. Separate color image in three R G & B planes
 - h. Create color image using R, G and B three separate planes
 - i. Write given 2-D data in image file
2. To write and execute image processing programs using point processing method
 - a. Obtain Negative image
 - b. Obtain Flip image
 - c. Thresholding
 - d. Contrast stretching
 3. To write and execute programs for image arithmetic operations
 - a. Addition of two images
 - b. Subtract one image from other image
 - c. Calculate mean value of image
 - d. Different Brightness by changing mean value
 4. To write and execute programs for image logical operations
 - a. AND operation between two images
 - b. OR operation between two images
 - c. Calculate intersection of two images
 - d. Water Marking using EX-OR operation
 - e. NOT operation (Negative image)
 5. To write a program for histogram calculation and equalization using
 - a. Standard MATLAB function
 - b. Program without using standard MATLAB functions
 6. To write and execute program for geometric transformation of image
 - a. Translation b. Scaling c. Rotation d. Shrinking e. Zooming
 7. To understand various image noise models and to write programs for
 - a. image restoration b. Remove Salt and Pepper Noise c. Minimize Gaussian noise d. Median filter and Weiner filter
 8. Write a program in MATLAB/SCILAB for edge detection using different edge detection mask

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education, 2018.
2. Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, "Digital Image Processing Using MATLAB", Pearson Education, 2020.

Reference Books:

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education.
2. Bhabatosh Chanda and Dwijesh Dutta Majumder, "Digital Image Processing and Analysis", PHI Learning.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis, and Machine Vision", Cengage Learning.

Web Links and Video Lectures (e-Resources):

- NPTEL Course on Digital Image Processing – <https://nptel.ac.in/courses/117105079>

- OpenCV Documentation – <https://docs.opencv.org>
- MATLAB Image Processing Toolbox Documentation – <https://www.mathworks.com/help/images>

Course Outcomes:

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

CO1: Explain the fundamentals of digital image processing, image representation, and mathematical transformations used in image analysis.

CO2: Apply image enhancement and restoration techniques using appropriate spatial and frequency domain methods for improving image quality.

CO3: Analyze image segmentation and feature extraction techniques for object identification and image interpretation.

CO4: Design image compression and coding schemes using transform-based techniques, including wavelet transforms, for efficient image storage and transmission.

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcomes (COs)	Program Outcomes and (Wks)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3)	2 (WK1, WK2, WK3)	-	-	1 (WK2)	-	-	-	-	-	1 (WK8)	3	1	-
CO2	3 (WK2, WK3, WK4)	3 (WK2, WK3, WK4)	2 (WK5)	1 (WK8)	3 (WK2, WK6)	-	-	-	-	-	1 (WK8)	3	1	-
CO3	3 (WK2, WK3, WK4)	3 (WK2, WK3, WK4)	1 (WK5)	2 (WK8)	3 (WK2, WK6)	-	-	-	-	-	1 (WK8)	3	1	-
CO4	2 (WK2, WK4)	2 (WK2, WK4)	3 (WK5)	1 (WK8)	2 (WK2, WK6)	-	-	-	-	-	2 (WK8)	2	1	1

Course Code :		BECC605E	Nanotechnology	Semester :	VI
L:T:P* :		3: 0: 0		Course Type :	PEC
Hours/Sem.	Teaching :	42 Hrs.		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs.		SEE Marks :	50
	Exam :	6 Hrs.		Total Marks :	100
	Total Hrs. :	90 Hrs.		Credits :	03

Professional Competency:

Demonstrate strong knowledge in nanotechnology concepts, including nanoscale materials, fabrication techniques, and characterization methods for advanced engineering applications. Skilled in applying nanotechnology principles to develop innovative solutions in electronics, biomedical devices, energy systems, and material science research.

UNIT-I

11 Hrs.

Introduction: The Canvas of nano-science and nanotechnology, Nano and nature, Evolution of various technologies of the 20th century, Beginning of Nano.

Introduction to Fullerenes: Introduction to fullerenes, Synthesis & purification of fullerenes, Conductivity & superconductivity in Fullerenes, Introduction, synthesis & purification of CNT's, filling & mechanism of growth of CNT's, Electronic structure, mechanical and physical properties of CNT's, applications of CNT's

UNIT –II

11 Hrs.

Semiconductor quantum dots: Introduction, synthesis of quantum dots, electronic structure of nano-crystals.

Nano shells: Introduction, types of nano-shells, properties and characterization.

Nano sensors: Introduction, Nano sensors, Nano sensors based on quantum size effects, electrochemical sensors, Nano biosensors and smart dust.

UNIT –III

10 Hrs.

Molecular Nano-machines: Introduction, covalent and non-conventional approaches, molecular motors and machines, molecular devices, single molecule devices.

Nano-tribology: Introduction, studying tribology at the nano-scale, nano-tribology applications.

Case study: Design and development of CNT based nano piezo-resistive pressure sensor, Silicon nano-wire-based sensors.

UNIT –IV

10 Hrs.

Investigation & characterization methods in the nano-scale: Electron Microscopes, Scanning Probe Microscopes, optical microscopes for nanotechnology, other microscopes, X-ray diffraction, AFM.

Societal implications of nano-science and nanotechnology: From first industrial revolution to the nano revolution, implications of nano-science and nanotechnology on society, nanotech and war, public perception and involvement in the nano discourse, harnessing nanotechnology for economic and social development.

Text Books:

1. T. Pradeep, "NANO: The Essentials", McGraw-Hill Education, 2007 Edition.

Reference Books:

1. Rainer Waser, "Nano-electronics and Information Technology", Wiley-VCH, 3rd Edition, 2012.

Course Outcomes:

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

CO1: Comprehend the fundamentals of nanotechnology and develop an understanding of various nano-materials and synthesis technology.

CO2: Understand quantum dots, nano shells, design and development of Nanosensors

CO3: Comprehend the knowledge of molecular nanomechanics & Nano-tribology

CO4: Analyze and characterize nanodevices, nanostructures and comprehend the societal implications of nanotechnology.

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcome s (COs)	Program Outcomes and (Wks)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	-	-	-	1	3	1	-
CO2	3 (WK1, WK2, WK3, and WK4)	-	2 (WK5)	-	-	-	-	-	1	-	1 (WK8)	3	2	-
CO3	3 (WK1, WK2, WK3, and WK4)	-	2 (WK5)	-	-	-	-	-	1	-	1 (WK8)	3	2	-
CO4	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	1 (WK5)	-	3 (WK1, WK5 and WK7)	3 (WK1, WK5 and WK7)	3 (WK1, WK5 and WK7)	3 (WK1)	1	-	1 (WK8)	3	2	-

Course Code :		BECD605E	Embedded System Design using Embedded C	Semester :	06
L:T:P :		3:0:0		Course Type :	Theory (PEC)
Hours/Sem.	Teaching :	42 Hrs		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs		SEE Marks :	50
	Exam :	06 Hrs		Total Marks :	100
Total Hrs. :		90 Hrs	Credits :	03	
Professional Competency:					
Design, develop, and interface 8051-based embedded systems by applying embedded C programming, firmware development techniques, and hardware interfacing concepts to solve real-world engineering problems.					
UNIT-I					12 Hrs
Designing Embedded Systems with 8-bit Microcontrollers: Factors to be Considered in Selecting a Controller, The 8051 Architecture, The Memory Organisation, Registers, Port 0, Port 1, Port 2, Port 3, 8051 pin configuration. Embedded Firmware Design and Development: Microprocessor and Microcontrollers, Embedded firmware design approaches, embedded firmware development languages. Text book 1: 5.1, 5.3.1, 5.3.2, 5.3.3, 5.3.5.1, 5.3.5.2, 5.3.5.3, 5.3.5.4, 9.1, 9.2					
UNIT-II					10 Hrs
Programming in embedded C: ‘C’ v/s. ‘Embedded C’, Compiler vs. Cross-Compiler. Using ‘C’ in ‘Embedded C’: Keywords and identifiers, Data types, Storage class, Arithmetic operations, Logical operations, Relational operations, Branching instructions, Looping instructions, Arrays and pointers, Characters and strings, Functions, Function pointers. Text Book 1: 9.3.1, 9.3.2, 9.3.3 (9.3.3.1 to 9.3.3.12)					
UNIT-III					10 Hrs
Programming in embedded C: Structures and unions, Pre-processors and Macros, Constant declarations, The ‘Volatile’ type qualifier, Delay generation and infinite loops, Bit manipulation operations, Coding Interrupt Service Routines (ISR), Recursive functions, Re-entrant functions, Dynamic memory allocation. Text Book1: 9.3.3.13 to 9.3.3.22					
UNIT-IV					10 Hrs
Writing embedded C code for digital I/O operations, Interfacing and programming of LEDs, switches, buzzers and LCDs, Analog Interfacing and Programming: Interfacing ADC and sensors, DAC interfacing and waveform generation using embedded C. Text Book2: Chapters 4, 8, 12, and 13 (selected topics)					
Text Books:					
1. Shibu K V, “Introduction to embedded systems”, McGraw Hill Education (India) Private Limited, Second Edition. 2. Mazidi McKinlay Mazidi, “The 8051 Microcontroller A Systems Approach”, Pearson New 113 International Edition, First edition.					
Reference Book:					
1. Frank Vahid and Tony Givargis, “Embedded System Design: A Unified Hardware/Software					

Approach”, Wiley India Pvt. Limited, 2001.

2. Michael Barr, Anthony Massa, “Programming Embedded Systems with C and GNU Development Tools”.
3. Kai Qian, David Den Haring, Li Cao, “Embedded Software Development with C”, Springer US, July 28, 2009.

Course Outcomes:

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

CO1: Analyze the 8051 microcontroller architecture and develop basic embedded system applications using appropriate firmware design approaches and development languages.

CO2: Implement basic embedded applications using Embedded C constructs like loops, functions, arrays, and pointers.

CO3: Develop optimized code using ISRs, memory management, bit manipulations, and reentrant functions for time-critical tasks.

CO4: Design interfacing solutions with 8051 for devices like LEDs, switches, LCDs, ADCs, and DACs using Embedded C.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1WK2, WK3, andWK4)	1(WK1 WK2, and WK3)	1 (WK1, WK2, WK3, and WK4)	-	-	1 (WK4)	1 (WK1, WK4 and WK6)	-	-	-	1	-	3	-
CO2	3 (WK1, WK2, WK3, andWK4)	2(WK1 WK2, and WK3)	1(WK4)	-	1(WK6)	1 (WK1, WK4 and WK7)	1 (WK6)	-	-	-	1	-	3	-
CO3	3 (WK1, WK2, WK3)	3(WK1, WK2, WK3, and WK4)	2(WK6)	-	1(WK6)	1 (WK1, WK6 and WK7)	1 (WK4 and WK6)	-	-	-	1	-	3	-
CO4	3 (WK1, WK2, andWK3)	3(WK1 WK2, WK3, and WK4)	3(WK6)	-	2 (WK2)	2 (WK1, WK6 and WK7)	1 (WK1, WK2, andWK3)	-	-	-	1	-	3	-

Course Code :		BECE605E	Micro Electro Mechanical Systems	Semester :	VI
L:T:P* :		3: 0: 0		Course Type :	PEC
Hours/Sem.	Teaching :	42 Hrs.		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs.		SEE Marks :	50
	Exam :	6 Hrs.		Total Marks :	100
	Total Hrs. :	90 Hrs.		Credits :	03

Professional Competency:

Demonstrate strong understanding of Micro Electro Mechanical Systems (MEMS) concepts, including microsensors, microactuators, and fabrication techniques for advanced engineering applications.

Possesses the ability to analyze, design, and apply MEMS technology in interdisciplinary fields such as electronics, biomedical systems, and automation.

UNIT-I

12 Hrs.

Introduction to MEMS Technology: Basic definitions, history and evolution of MEMS. Feynman's vision, Microelectronics and MEMS, Microsensors, microactuators and microsystems, Types of MEMS, Applications of MEMS in various disciplines. Commercial MEMS products.

Scaling issues in microsystems: Examples and numerical problems based on scaling laws.

Multiphysics- Multiengineering aspects of MEMS: Introduction to design, modeling and simulation, optimization, fabrication, reliability and packaging of MEMS.

UNIT -II

10 Hrs.

Working Principles of MEMS:

Mechanical sensors and actuators – beams and cantilevers, accelerometers

Electrostatic sensors and actuators – parallel plate capacitors, comb drive sensor and actuator

Piezoelectric sensors and actuators – cantilever based piezoelectric sensor and actuator

Thermal actuators – single and bimorph thermal actuators

Optical MEMS – DLP mirror; construction and working

Bio/Chemical sensors – DNA sensor

UNIT –III

10 Hrs.

Modeling and Simulation of MEMS: Electronic circuits and Control for MEMS: MOSFET, OpAmp, ADC, Control theory and controllers (instrumentation amplifier, PLL, Airbag trigger system), MEMS system modeling, Need for Simulation tools, FEM. MEMS design and Realization Tools – ANSYS/Multiphysics, CoventorWare, COMSOL. AFM as a measurement tool in microsystems.

Case Studies: Microcantilever based sensor, Electrothermal actuator, Electrostatic actuator.

UNIT –IV

10 Hrs.

Microfabrication/Micromachining: Introduction to microfabrication, Materials used in microfabrication, Lithography, thin film deposition, diffusion, oxidation, doping, CVD, PVD, etching, bonding. Surface, bulk and LIGA micromachining techniques.

Text Books:

1. Tai, Ran Hsu, "MEMS and Microsystems: Design and Manufacture" TMH, 2002.

2. G K Ananthasuresh, K J Vinoy, S Gopalkrishnan, K N Bhat, V K Atre, "Micro and Smart Systems" Wiley India, 2010.

Reference Books:

1. N. P. Mahalik, "MEMS" Tata McGraw-Hill, 2007.
2. James J. Allen, "Micro Electro Mechanical System Design" CRC Press, Taylor & Francis Group, 2005.
3. Chang Liu, "Foundations of MEMS", Pearson Education International, 2007.
4. Stephen D. Senturia, "Microsystem Design", Springer International Edition, 2001.

Course Outcomes:

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

CO1: To apply the scaling laws for the design on devices at micro domain.

CO2: To design sensors and actuators using the transduction principles covered in the syllabus.

CO3: To analyze performance using the CAD tools for, capacitive, Piezoresistive, thermal, mechanical and bio/chemical transducers.

CO4: To develop a set of process steps and specs to obtain a desired microfabricated device.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	1	-	-	1	-	-	2
CO2	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	1 (WK9)	1	1	-	1 (WK8)	-	-	2
CO3	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-	-	2
CO4	-	2 (WK1, WK2, WK3, and WK4)	2 (WK5)	-	-	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-	-	2

Course Code :		BECA606C	Indian Knowledge System	Semester :	VI
L:T:P* :		1: 0: 0		Course Type :	PCC
Hours/Sem.	Teaching :	15 Hrs.		CIE Marks :	50
	Learning (TW+SL) :	11 Hrs.		SEE Marks :	50
	Exam :	4 Hrs.		Total Marks :	100
	Total Hrs. :	30 Hrs.		Credits :	03

Professional Competency:

Demonstrate sensor fundamentals, sensing principles, sensor materials, microfabrication techniques, and modern sensor technologies such as MEMS and nanotechnology. It also includes the ability to design, interface, analyze, and apply various mechanical, electromechanical, capacitive, piezoelectric, and smart sensors for real-world measurement and control applications.

UNIT-I

03 Hrs.

Indian Knowledge Systems (IKS)

Overview, Vedic Corpus, Philosophy in Indian Knowledge system.

UNIT-II

04 Hrs.

Traditional Knowledge in Mathematics

Introduction to Indian Mathematics, Unique aspects of Indian Mathematics, Indian Mathematicians and their Contribution. Number Systems and Units of Measurement.

UNIT-III

04 Hrs.

Traditional Knowledge in Science

Measurements for time, distance and weight, Astronomy, Indian contributions in astronomy, Astrology, The celestial coordinate system, Elements of the Indian calendar, Notion of years and month, Panchanga – The Indian calendar system.

UNIT-IV

10 Hrs.

Traditional Knowledge in Professional domain

Town Planning and Architecture, Agriculture, Governance and Public Administration.

Text Books:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi (2022). Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Sampad and Vijay "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry. (2011).
3. Acarya, P.K. Indian Architecture, Munshiram Manoharlal Publishers, New Delhi. (1996).
4. Kapoor Kapil, Singh Avadhesh "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P. (2021).
5. Dasgupta, S. A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi. (1975).
6. PLofer, K. (1963). Mathematics in India, Princeton University Press, New Jersey, USA"

Suggested Links:

1. <https://www.youtube.com/watch?v=LZP1StpYEPM>
2. <http://nptel.ac.in/courses/121106003/>
3. <http://www.iitkgp.ac.in/departments/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63>
(Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4. https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5. https://unctad.org/system/files/official-document/ditcted10_en.pdf

Course Outcomes:

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

CO1: Provide an overview of the concept of the Indian Knowledge System and its importance

CO2: Appreciate the need and importance of protecting traditional knowledge.

CO3: Recognize the relevance of Traditional knowledge in different domains.

CO4: Establish the significance of Indian Knowledge systems in the contemporary world.

Course Code		:	---	Sensor Technology	Semester	:	VI
L:T:P*		:	3: 0: 0		Course Type	:	OE
Hours/Sem.	Teaching	:	42 Hrs.		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs.		SEE Marks	:	50
	Exam	:	6 Hrs.		Total Marks	:	100
	Total Hrs.	:	90 Hrs.		Credits	:	03

Professional Competency:

Demonstrate sensor fundamentals, sensing principles, sensor materials, microfabrication techniques, and modern sensor technologies such as MEMS and nanotechnology. It also includes the ability to design, interface, analyze, and apply various mechanical, electromechanical, capacitive, piezoelectric, and smart sensors for real-world measurement and control applications.

UNIT-I

10 Hrs.

Sensor Fundamentals: Introduction, Definition, Types, and Sensor characteristics

Principles of Sensing: Capacitive, Magnetic, Inductive, Resistive, Piezoelectric, Piezoresistance, Pyroelectric, Hall effect.

Interfacing Electronic Circuits: Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, A to D Converters, Bridge Circuits, Data Transmitters, Batteries for low power sensors

UNIT-II

10 Hrs.

Overview of Sensor Materials: Sensor materials and material properties, Surface Processing of materials for development of Sensors.

Sensor Technologies: Micro technology, Micro-Electro-Mechanical Systems Technology, Nanotechnology

Sensor Applications: Displacement Sensing, level & Velocity Sensors, Accelerometers, Tactile Sensors, Pressure Sensors, Temperature Sensors, Combdrive sensors

UNIT-III

10 Hrs.

Mechanical and Electromechanical sensor: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. **Strain gauge:** Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature.

Capacitive sensors: Stretched diaphragm type: microphone, response characteristics.

Piezoelectric element: piezoelectric effect

Case Study: Piezoelectric and Capacitive Pressure Sensors, Cantilever based DNA Sensor, CNT based Pressure Sensor.

UNIT-IV

10 Hrs.

Microfabrication/Micromachining of sensors: Overview of micro fabrication, silicon wafer extraction and cleaning, structural and sacrificial materials in microfabrication, lithography, deposition, doping, etching, Introduction to MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods.

Text Books:

1. Jacob Fraden, "Handbook of Modern Sensors: Physical Design & Applications", AIP Press, Springer.

Reference Books:

1. D. Patranabis, "Sensors & Transducers", PHI Publication New Delhi.
2. Frank Vahid, Tony Givargis, "Embedded system Design", John Wiley & Sons, Inc, 2002
3. H.K.P. Neubert, "Instrument transducers", Oxford University press.
4. E.A.Doebelin, "Measurement systems: application & design", Mc Graw Hill.
5. Tai Ran Hsu, "MEMS and microsystems: design and manufacture", TMH, 2002.

Course Outcomes:

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

CO1: Use concepts for converting a physical parameter into an electrical quantity.

CO2: Identify appropriate sensor materials and technology while designing sensors.

CO3: Comprehend working principle of mechanical, strain gauge and capacitive sensors.

CO4: Comprehend the fabrication of various sensor.

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcomes (COs)	Program Outcomes and (Wks)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, and WK4)	3(WK1, WK2, WK3, and WK4)	2 (WK5)	-	-	2 (WK9)	-	-	-	-	1 (WK8)	3	1	-
CO2	3 (WK1, WK2, WK3, and WK4)	1(WK1, WK2, WK3, and WK4)	2 (WK5)	-	-	3 (WK9)	-	-	-	-	-	3	2	-
CO3	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	2 (WK6)	2 (WK9)	-	-	-	-	1 (WK8)	3	2	-
CO4	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	1 (WK5)	-	3 (WK6)	3 (WK9)	3 (WK9)	-	-	-	1 (WK8)	3	3	-

Course Code :		----	Wireless Network and Mobile Network Architecture	Semester :	VI
L:T:P* :		0:0 :3		Course Type :	OEC
Hours/Sem.	Teaching :	42Hrs.		CIE Marks :	50
	Learning (TW+SL) :	42 Hrs.		SEE Marks :	50
	Exam :	06 Hrs.		Total Marks :	100
	Total Hrs. :	90 Hrs.		Credits :	03

Professional Competency:

Analyze and develop wireless communication and networking solutions by applying concepts of wireless transmission, mobility management, routing, multicast communication, and energy-efficient protocols in cellular and ad hoc network environments.

UNIT-I

10 Hrs.

PCS architecture, Cellular telephony: AMPS, GSM, IS-136, IS-95; Cordless telephony and low-tier PCS: CT2, DECT, PHS, PACS, Unlicensed systems; Third-generation wireless systems: cdma2000, W-CDMA, SCDMA; Overview of wireless technologies and protocols.

UNIT-II

10 Hrs.

Mobility management, Handoff types: inter-BS handoff, intersystem handoff; Handoff strategies: mobile-controlled, network-controlled, mobile-assisted; Handoff detection and failures; Channel assignment schemes: non-prioritized, reserved channel, queuing priority, sub rating; Radio link transfer: hard handoff, soft handoff; Roaming management and signalling with SS7.

UNIT-III

11 Hrs.

GSM system overview, GSM architecture and components, GSM radio interface and frequency planning; GSM location tracking, call setup, and security; GSM signalling protocols: MAP framework and primitives; GSM mobility management: location update, call origination and termination, VLR and HLR databases, failure restoration; GSM Short Message Service (SMS): architecture and protocol hierarchy; International roaming; Number portability in GSM.

UNIT-IV

11 Hrs.

GPRS architecture and functional groups, GPRS procedures: attach, detach, PDP context, billing; iGSM and mobile VoIP architecture and procedures; Wireless Application Protocol (WAP): protocol stack, gateways, and development toolkits; Third-generation systems: W-CDMA, cdma2000, core network improvements, QoS, field trials; Mobile prepaid services: WIN, service node, hot billing, handset-based solutions; Emerging services in 3G networks.

Text Books:

1. Yi-Bing Lin and Imrich Chlamtac, "Wireless and Mobile Network Architectures", John Wiley & Sons, 2000.
2. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, New Delhi, 2002.
3. Jochen Schiller, "Mobile Communications", 2nd Edition, Pearson Education, New Delhi, 2008.

Reference Books:

1. William Stallings, "Wireless Communications and Networks", 2nd Edition, Pearson Education, New Delhi, 2005
2. Mischa Schwartz, "Mobile Wireless Communications", 1st Edition, Cambridge University Press, Cambridge, 2005.
3. Andreas F. Molisch, "Wireless Communications", 2nd Edition, John Wiley & Sons, New York, 2011.

Web Links and Video Lectures (e-Resources):

Recommended Video Lectures

NPTEL Video Courses

1. **Wireless Communication**
 - Instructor: Prof. Aditya K. Jagannatham (IIT Kanpur)
 - Platform: NPTEL
 - Topics: Wireless channels, modulation, diversity, MIMO, OFDM, cellular systems.
2. **Wireless Ad Hoc and Sensor Networks**
 - Instructor: Prof. Sudip Misra (IIT Kharagpur)
 - Platform: NPTEL
 - Topics: Ad hoc routing, MAC protocols, energy management, security.
3. **Computer Networks and Internet Protocol**
 - Instructor: Prof. Bhaskaran Raman (IIT Bombay)
 - Platform: NPTEL
 - Topics: TCP/IP, Mobile IP, routing protocols, wireless Internet.
4. **Mobile Computing**
 - Platform: NPTEL
 - Topics: GSM, UMTS, Mobile IP, Wireless Application Protocol (WAP), mobility management.

Course Outcomes:

After completion of the course student will be able to

CO1: Describe wireless architectures, cellular systems, and low-tier PCS systems.

CO2: Analyze mobility and handoff management schemes in wireless networks.

CO3: Illustrate GSM system architecture, signaling, and mobility mechanisms.

CO4: Explain advanced wireless technologies such as GPRS, VoIP, and WAP

Matrix to describe the mapping of COs with POs (considering Wks) and PSOs

Course Outcomes (COs)	Program Outcomes and (Wks)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK2, WK3, WK4))	2 (WK1, WK2, WK3, WK4)	-	-	-	-	-	1	-	-	1	-	2
CO2	2 (WK1, WK2, WK3)	3 (WK2, WK3, WK4)	2 (WK5)	1 (WK4)	2 (WK6)	1 (WK1, WK5, WK7)	1 (WK9)	1	1	-	1 (WK8)	-	2
CO3	2 (WK1, WK2, WK3)	3 (WK4)	3 (WK5)	2 (WK4)	3 (WK6)	1 (WK1, WK5, WK7)	-	1	1	-	1 (WK8)	-	2
CO4	2 (WK1, WK2)	2 (WK3, WK4)	3 (WK5)	2 (WK4)	3 (WK6)	1 (WK1, WK5, WK7)	1 (WK9)	1	1	-	1 (WK8)	-	2

Course Code :		BECA607L	Robotics Laboratory	Semester :	VI
L:T:P :		0:0:2		Course Type :	PCC Lab
Hours/Sem.	Teaching :	26Hrs		CIE Marks :	50
	Learning (TW+SL) :	--		SEE Marks :	50
	Exam :	4 Hrs		Total Marks :	100
	Total Hrs. :	30Hrs		Credits :	01

Professional Competency:

Design and implement robotics and IoT-based solutions for real-world applications by integrating hardware, software, communication networks, and modern engineering tools.

List of Experiments

Mitsubishi 6-DOF Articulated Robot (8 Kg Payload) Experiments

1. Robot Coordinate Systems and Motion Programming.
2. Pick and Place Operation.
3. AI-Based Object Sorting
4. Name Tracing.
5. Color Sorting.

IoT PROGRAMS (ESP32, ARDUINO UNO, STM32)

6. Program to blink an LED.
7. Program to turn ON the LED when a push button is pressed.
8. Program to turn on the Relay using a Push button. Implementation of half adder and full adder.
9. Program to display temperature and humidity readings on the TFT display
10. Interfacing CAN Controller with BMP180 to transmit "BMP180 data" from Point-Point using Arduino Uno.
11. LoRaWAN OTA DHT11

Course Outcomes:

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

CO1: Design and implement basic robotic systems using sensors, actuators, and microcontrollers for automation applications.

CO2: Develop and interface IoT devices using embedded platforms to acquire, process, and transmit data over networks.

CO3: VIntegrate robotics and IoT technologies to develop smart systems for industrial, agricultural, healthcare, and home automation applications.

CO4: Demonstrate problem-solving, debugging, testing, and teamwork skills while developing robotics and IoT-based projects.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK3 , WK4, WK5)	2 (WK3 , WK4, WK5)	3 (WK3 , WK4, WK5)	1	3 (WK3 , WK4, WK5)	-	-	-	1	1	-	3	3	-
CO2	3 (WK3 , WK4, WK5)	2 (WK3 , WK4, WK5)	3 (WK3 , WK4, WK5)	2 (WK3 , WK4, WK5)	3 (WK3 , WK4, WK5)	-	-	-	1	1	-	3	3	2
CO3	3 (WK3 , WK4, WK5, WK6, WK7)	3 (WK3 , WK4, WK5, WK6, WK7)	3 (WK3 , WK4, WK5, WK6, WK7)	2 (WK3 , WK4, WK5, WK6, WK7)	3 (WK3 , WK4, WK5, WK6, WK7)	1 (WK3 , WK4, WK5, WK6, WK7)	- (WK3 , WK4, WK5, WK6, WK7)	-	1	1	-	3	3	2
CO4		3 (WK5 , WK6, WK8)	2	2 (WK5 , WK6, WK8)	2 (WK5 , WK6, WK8)	-	-	-	3 (WK5 , WK6, WK8)	2 (WK5 , WK6, WK8)	1 (WK5 , WK6, WK8)	2	2	1
Course Contribution to POs and PSOs	3	2.5	2.75	1.75	2.75	0.25	0	0	1.50	1.25	0.25	2.75	2.75	1.25

Course Code :		BECA608L	CMOS Digital VLSI Laboratory	Semester :	VI
L:T:P :		0:0:2		Course Type :	PCC Lab
Hours/Sem.	Teaching :	26 Hrs		CIE Marks :	50
	Learning (TW+SL) :	--		SEE Marks :	50
	Exam :	4 Hrs		Total Marks :	100
	Total Hrs. :	30 Hrs		Credits :	01

Professional Competency:

Ability to design, simulate, verify and implement CMOS digital circuits using industry-standard EDA tools by performing schematic design, layout generation, DRC/ERC verification, LVS checking and post-layout analysis of combinational and sequential building blocks.

List of Experiments

Design following CMOS/TG based circuits with given specifications and complete the VLSI design flow mentioned below using appropriate tool:

- a) Draw the schematic and verify the following
 - i) DC Analysis ii) Transient Analysis
- b) Draw the Layout and verify the DRC, ERC
- c) Check for LVS
- d) Extract RC and back annotate the same and verify the design.
 1. CMOS inverter
 2. CMOS two input NAND gate
 3. CMOS two input NOR gate
 4. CMOS two input OR gate
 5. CMOS two input AND gate
 6. TG based two input XOR and XNOR gates
 7. D Latch using TGs and inverters
 8. DFF using D latches
 9. T-FF using TGs and Inverters
 10. 2:1MUX using TGs and inverters
 11. 4:1 MUX using 2:1 MUX
 12. 3-Bit up counter using T-FF
 13. 3-Bit SISO shift register

Open ended experiments

1. Design a full adder using following design styles:
Standard Static CMOS
Transmission Gate (TG) Logic
2. Design a ring oscillator using an odd number (e.g., 5, 7, 9) of inverters in a loop.
3. Design a Johnson counter using an T-ff.
4. Design a full Subtractor using at least two of the following design styles:
Complementary Pass-Transistor Logic (CPL)
Dynamic Logic (optional challenge)
5. Implement 2:1 Mux using basic gates

Course Outcomes:

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

CO1: Design CMOS/TG based gates, MUX, flip flops, counters and shift register.

CO2: Draw the layout, run DC and transient analysis for designed CMOS standard cells

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Coursers Outcomes	Program Outcomes (POs)												Program Specific Outcome s (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	
CO1	3 (WK1, WK2)	2 (WK1,WK2,WK3)	3 (WK3,WK4)	–	2 (WK5)	–	–	–	–	–	–	3	2	–	
CO2	2 (WK1, WK2)	3 (WK1,WK2,WK3)	3 (WK3,WK4)	1 (WK4)	3 (WK5)	–	–	–	–	–	–	3	3	–	