

RN SHETTY TRUST ®



ESTD.: 2001
An Institute with a Difference

RNS INSTITUTE OF TECHNOLOGY

Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi

Approved By AICTE, New Delhi. Accredited by NAAC 'A+' Grade

RR Nagar, Dr. Vishnuvardhan Road, Bengaluru - 560 098

Ph: (080) 28611880, 28611881 URL: www.rnsit.ac.in



Dr. R N Shetty
Founder



DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

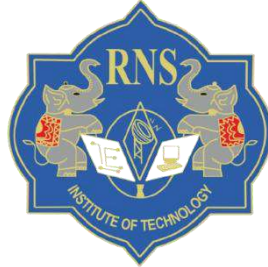
BACHELOR OF ENGINEERING

Scheme and Syllabus of V - VIII Semesters

2024 SCHEME



www.rnsit.ac.in



ESTD.: 2001

An Institute with a Difference

Scheme and Syllabus Batch 2024 – 2028

5th to 8th Semester

(As per NEP - 2020)

(Effective from the academic year 2024 – 25)

ESTD : 2001

An Institute with a Difference



RNSIT (RNS Institute of Technology)

RNS Institute of Technology, familiar as RNSIT was established in the year 2001. It is the brainchild of Dr. R. N. Shetty, well known industrialist, and a great philanthropist. The institution was established with a sole purpose of imparting quality education in Engineering, Technology and Management. Being one of the premier engineering colleges in the country RNSIT is marching towards placing itself in the global map by excelling in academics and placements. Lush green campus, state of the art infrastructure, well equipped laboratories, hundreds of activities, numerous new initiatives, consistent VTU ranks, path breaking placements, cultural extravaganza, Sports events, 5600 + students and 300 + faculty – with all these RNSIT has become dream destination for engineering aspirants across the country.

Vision

Building RNSIT into a World Class Institution

Mission

To impart high quality education in Engineering, Technology and Management with a difference, enabling students to excel in their career by

- Attracting quality Students and preparing them with a strong foundation in fundamentals so as to achieve distinctions in various walks of life leading to outstanding contributions
- Imparting value based, need based, choice based and skill based professional education to the aspiring youth and carving them into disciplined, World class Professionals with social responsibility
- Promoting excellence in Teaching, Research and Consultancy that galvanizes academic consciousness among Faculty and Students
- Exposing Students to emerging frontiers of knowledge in various domains and make them suitable for Industry, Entrepreneurship, Higher studies, and Research and Development
- Providing freedom of action and choice for all the Stakeholders with better visibility

ECE (Electronics and Communication Engineering)

The department of Electronics and Communication Engineering was started in 2001 and is currently running BE and Research programs. The Department has well qualified, committed and experienced Faculty members, in various domains of ECE, like Communication, Signal Processing, Image Processing, VLSI, Optical Communication, Antenna Design. The course covers the fundamental theoretical aspects as well as design level topics of all the above areas. The department has well structural labs to give students a practical exposure in the field of Analog Electronics, Analog Communication, Digital Signal Processing, Embedded Systems, Antennas and VLSI.

Vision

Conquering technical frontiers in the field of Electronics and Communication

Mission

The Department of Electronics and communication Engineering promotes an intellectual and ethical environment in which the strengths and skills of Electronics Professionals will flourish by:

- Achieving and fostering excellence in core Electronics and Communication engineering with focus on hardware, simulation and design.
- Pursuing Research, development and consultancy to achieve self-sustenance.
- Preparing industry ready graduates by providing skill training and nurturing innovation and creativity.

Programme Educational objectives (PEOs)

ECE Graduates, within three-five years of graduation should be able to:

- **PEO1:** Apply fundamental concepts obtained from mathematics, basic sciences and engineering subjects to solve challenging problems in Electronics, Communication and allied disciplines.
- **PEO2:** Exhibit technical and analytical skills for the design and development of innovative and cost-effective solutions.
- **PEO3:** Pursue higher education and participate in Lifelong learning to emerge as good human beings and responsible citizens.

- **PEO4:** Adapt to rapid changes in tools and technology and work in multidisciplinary fields to come up with new sustainable technologies catering to societal needs.
- **PEO5:** Cultivate skills which helps in building leadership qualities, entrepreneurship, effective communication and ethics needed for a successful professional career.

Program Outcomes (Revised)

- **PO1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- **PO2: Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK2).
- **PO3: Design/Development of solutions:** Design creative solutions for complex engineering problems and design/develop system/components or processes to meet the identified needs with consideration for the public health and safety, whole – life cost, net zero carbon, culture, society and environment as required. (WK5)
- **PO4: Conduct Investigations of Complex Problems:** Conduct investigation of complex engineering problems using research – based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
- **PO5: Engineering tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- **PO6: The engineer and world:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
- **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national and international laws. (WK9)
- **PO8: Individual and Collaborative Teamwork:** Function effectively as an individual, and as a member or leader in diverse/multi – disciplinary teams.
- **PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentation considering cultural, language, and learning differences.
- **PO10: Project management and finance:** Apply knowledge and understanding of engineering management principles and economic decision – making and apply these

to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

- **PO11: Life-long learning:** Recognize the need for and have the preparation and ability
 - i) independent and life – long learning
 - ii) adaptability to new and emerging technologies and
 - iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

The graduates of the department will be able to:

- **PSO1:** Apply knowledge of Electronic circuits and Communication systems in the design, development and analysis of integrated electronic systems to enhance human life.
- **PSO2:** Demonstrate competence in using Modern hardware languages, IT tools and create innovative electronic technologies as per industry standards.

ESTD : 2001

An Institute with a Difference

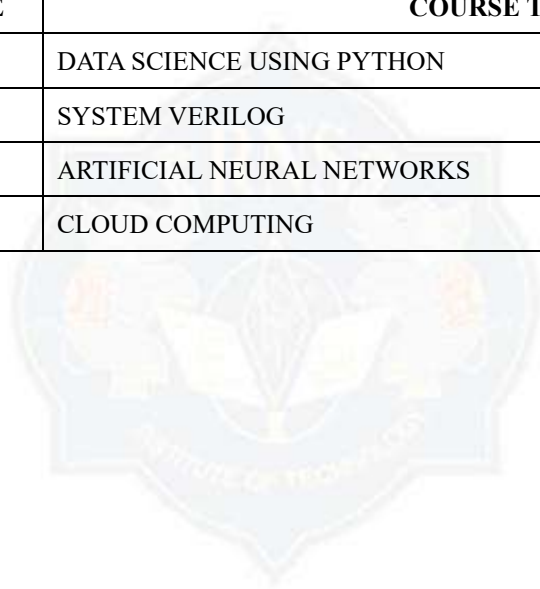
BE in Electronics and Communication Engineering (Autonomous Scheme – 2024)
5th Semester

Sl. No.	Course	Course Code	Course Title	TD/PSB	Teaching Hours per week			(TW+SL) /Sem	Examination				Credits
					Theory Lecture (L)	Tutorial (T)	Practical (P)		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	HSMS	BEC501	TECHNOLOGICAL INNOVATION AND MANAGEMENT ENTREPRENEURSHIP	ECE	3	2	0	45	3	50	50	100	4
2	IPCC	BEC502	DIGITAL SIGNAL PROCESSING	ECE	3	0	2	45	3	50	50	100	4
3	PCC	BEC503	VLSI DESIGN	ECE	3	2	0	45	3	50	50	100	4
4	PCCL	BECL504	VLSI LAB	ECE	0	0	2	0	3	50	50	100	1
5	PEC	BEC515X	PROFESSIONAL ELECTIVE COURSE (BUCKET LIST - E)	ECE / CSE	3	0	0	45	3	50	50	100	3
6	PROJ	BEC586	MINI PROJECT	ECE	0	0	2	30	3	100	0	100	2
7	BSC	BENS407/507	ENVIRONMENTAL STUDIES	ECE / CHE	2	0	0	30	2	50	50	100	2
		BBOE407/507	BIOLOGY FOR ENGINEERS	ECE / CHE									
8	AEC	BRMK558	RESEARCH METHODOLOGY AND IPR	ANY	2	0	0	30	2	50	50	100	2
9	MC	BNSK559	NATIONAL SERVICE SCHEME (NSS)	PED	0	0	2	0	-	100	0	100	0
		BPEK559	PHYSICAL EDUCATION (SPORTS AND ATHLETICS)	PED									
		BYOK559	YOGA	PED									
Total										550	350	900	22

NOTE: I SEMESTER CHEMISTRY CYCLE SECTIONS WILL STUDY “ENVIRONMENTAL STUDIES” IN IV SEMESTER AND “BIOLOGY FOR ENGINEERS” IN V SEMESTER

NOTE: I SEMESTER PHYSICS CYCLE SECTIONS WILL STUDY “BIOLOGY FOR ENGINEERS” IN IV SEMESTER AND “ENVIRONMENTAL STUDIES” IN V SEMESTER

(BUCKET LIST - E) - PROFESSIONAL ELECTIVE COURSE – BEC515X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC515A	DATA SCIENCE USING PYTHON
2	BEC515B	SYSTEM VERILOG
3	BEC515C	ARTIFICIAL NEURAL NETWORKS
4	BEC515D	CLOUD COMPUTING



ESTD : 2001

An Institute with a Difference

BE in Electronics and Communication Engineering (Autonomous Scheme – 2024)
6th Semester

Sl. No.	Course	Course Code	Course Title	TD/PSB	Teaching Hours per week			(TW+SL) /Sem	Examination				Credits
					Theory Lecture (L)	Tutorial (T)	Practical (P)		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BEC601	ARM CORTEX M3 AND EMBEDDED SYSTEMS	ECE	3	0	2	45	3	50	50	100	4
2	PCC	BEC602	DIGITAL COMMUNICATION	ECE	3	2	0	45	3	50	50	100	4
3	PEC	BEC613X	PROFESSIONAL ELECTIVE COURSE (BUCKET LIST - F)	ECE	3	0	0	45	3	50	50	100	3
4	OEC	BEC654X	OPEN ELECTIVE COURSE (BUCKET LIST - G)	ECE	3	0	0	45	3	50	50	100	3
5	PROJ	BEC685	MAJOR PROJECT PHASE-1	ECE	0	0	4	0	3	100	0	100	2
6	PCCL	BECL606	ADVANCED COMMUNICATION LAB	ECE	0	0	2	0	3	50	50	100	1
7	AEC / SEC	BECT657X	ABILITY ENHANCEMENT COURSE / SKILL ENHANCEMENT COURSE (BUCKET LIST - H)	ECE	IF COURSE IS RUN AS LAB				2	50	50	100	1
		1			0	0	15						
		BECL657X			IF COURSE IS RUN AS THEORY				3				
					0	0	2	0					
8	MC	BIKS608	INDIAN KNOWLEDGE SYSTEM	ANY	1	0	0	15	-	100	0	100	0
9	MC	BNSK659	NATIONAL SERVICE SCHEME (NSS)	PED	0	0	2	0	-	100	0	100	0
		BPEK659	PHYSICAL EDUCATION (SPORTS AND ATHLETICS)	PED									
		BYOK659	YOGA	PED									
Total										600	300	900	18

(BUCKET LIST - F) - PROFESSIONAL ELECTIVE COURSE – BEC613X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC613A	VLSI TESTING AND VERIFICATION
2	BEC613B	SATELLITE COMMUNICATION
3	BEC613C	DIGITAL IMAGE PROCESSING
4	BEC613D	CRYPTOGRAPHY

(BUCKET LIST - G) - OPEN ELECTIVE COURSE – BEC654X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC654A	INTERNET OF THINGS
2	BEC654B	INTRODUCTION TO QUANTUM COMPUTING
3	BEC654C	VERILOG HDL
4	BEC654D	BASIC VLSI DESIGN

(BUCKET LIST - H) – ABILITY ENHANCEMENT COURSE OR SKILL ENHANCEMENT COURSE - BECT657X / BECL657X		
Sl. No	COURSE CODE	COURSE TITLE
1	BECT657A	TOOLS FOR TECHNICAL WRITING AND PATENTING
2	BECT657B	INTRODUCTION TO PHOTONICS
3	BECL657C	ADVANCED IOT
4	BECL657D	DATA ANALYTICS LAB USING PYTHON

BE in Electronics and Communication Engineering (Autonomous Scheme – 2024)
7th Semester

Sl. No.	Course	Course Code	Course Title	TD/PSB	Teaching Hours per week			(TW+SL) /Sem	Examination				Credits
					Theory Lecture (L)	Tutorial (T)	Practical (P)		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BEC701	COMPUTER NETWORKS	ECE	3	0	2	45	3	50	50	100	4
3	IPCC	BEC702	MICROWAVE AND ANTENNAS	ECE	3	0	2	45	3	50	50	100	4
2	PCC	BEC703	5G WIRELESS COMMUNICATION	ECE	3	2	0	45	3	50	50	100	4
4	PEC	BEC714X	PROFESSIONAL ELECTIVE COURSE (BUCKET LIST - I)	ECE	3	0	0	45	3	50	50	100	3
5	OEC	BEC755X	OPEN ELECTIVE COURSE (BUCKET LIST - J)	ECE	3	0	0	45	3	50	50	100	3
6	PROJ	BEC786	MAJOR PROJECT PHASE-2	ECE	0	0	12	0	3	100	100	200	6
Total										350	350	700	24

(BUCKET LIST - I) - PROFESSIONAL ELECTIVE COURSE – BEC714X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC714A	WIRELESS SENSOR NETWORK
2	BEC714B	ANALOG AND MIXED SIGNAL CIRCUIT DESIGN
3	BEC714C	MACHINE LEARNING WITH PYTHON
4	BEC714D	OPTICAL FIBER COMMUNICATION

(BUCKET LIST - J) - OPEN ELECTIVE COURSE – BEC755X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC755A	ELECTROMAGNETIC COMPATIBILITY
2	BEC755B	MICRO ELECTROMECHANICAL SYSTEMS
3	BEC755C	SMART AND WEARABLE SENSOR
4	BEC755D	ROBOTICS AND APPLICATIONS

BE in Electronics and Communication Engineering (Autonomous Scheme – 2024)
8th Semester

Sl. No.	Course	Course Code	Course Title	TD/PSB	Teaching Hours per week			(TW+SL) /Sem	Examination				Credits
					Theory Lecture (L)	Tutorial (T)	Practical (P)		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PEC	BEC811X	PROFESSIONAL ELECTIVE COURSE (BUCKET LIST - K)	ONLINE	3	0	0	45	3	50	50	100	3
3	OEC	BEC852X	OPEN ELECTIVE COURSE (BUCKET LIST - L)	ONLINE	3	0	0	45	3	50	50	100	3
2	INT	BEC803	INTERNSHIP (INDUSTRY/RESEARCH-MINIMUM 14 WEEKS)	ECE	0	0	20	0	3	100	100	200	10
Total										200	200	400	16

(BUCKET LIST - K) - PROFESSIONAL ELECTIVE COURSE – BEC811X (ONLINE)		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC811X	BOS WILL PUBLISH COURSES BASED ON THE AVAILABILITY

(BUCKET LIST - L) - OPEN ELECTIVE COURSE – BEC852X (ONLINE)		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC852X	BOS WILL PUBLISH COURSES BASED ON THE AVAILABILITY

BE in Electronics and Communication Engineering (Autonomous Scheme – 2024)
7th Semester
SCHEME – A – VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No.	Course	Course Code	Course Title	TD/PSB	Teaching Hours per week			(TW+SL) /Sem	Examination				Credits
					Theory Lecture (L)	Tutorial (T)	Practical (P)		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BEC701	COMPUTER NETWORKS	ECE	3	0	2	45	3	50	50	100	4
3	IPCC	BEC702	MICROWAVE AND ANTENNAS	ECE	3	0	2	45	3	50	50	100	4
2	PCC	BEC703	5G WIRELESS COMMUNICATION	ECE	3	2	0	45	3	50	50	100	4
4	PEC	BEC714X	PROFESSIONAL ELECTIVE COURSE (BUCKET LIST - I)	ECE	3	0	0	45	3	50	50	100	3
5	OEC	BEC755X	OPEN ELECTIVE COURSE (BUCKET LIST - J)	ECE	3	0	0	45	3	50	50	100	3
6	PROJ	BEC786	MAJOR PROJECT PHASE-2	ECE	0	0	12	0	3	100	100	200	6
Total										350	350	700	24

ESTD : 2001
 An Institute with a Difference

(BUCKET LIST - I) - PROFESSIONAL ELECTIVE COURSE – BEC714X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC714A	WIRELESS SENSOR NETWORK
2	BEC714B	ANALOG AND MIXED SIGNAL CIRCUIT DESIGN
3	BEC714C	MACHINE LEARNING WITH PYTHON
4	BEC714D	OPTICAL FIBER COMMUNICATION

(BUCKET LIST - J) - OPEN ELECTIVE COURSE – BEC755X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC755A	ELECTROMAGNETIC COMPATIBILITY
2	BEC755B	MICRO ELECTROMECHANICAL SYSTEMS
3	BEC755C	SMART AND WEARABLE SENSOR
4	BEC755D	ROBOTICS AND AUTOMATION

Note: VII and VIII Semesters of IV Year of the Program

1. Institutions can swap the VII and VIII semester Schemes of Teaching and Examinations to accommodate research internships/industry internships after the VI semester.
2. Credits earned for the courses of VII and VIII semester Schemes of Teaching and Examinations shall be counted against the corresponding semesters, whether the VII or VIII semester is completed during the beginning of the IV year or the later part of the IV year of the program.

BE in Electronics and Communication Engineering (Autonomous Scheme – 2024)
8th Semester
SCHEME – A – VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No.	Course	Course Code	Course Title	TD/PSB	Teaching Hours per week			(TW+SL) /Sem	Examination				Credits
					Theory Lecture (L)	Tutorial (T)	Practical (P)		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PEC	BEC811X	PROFESSIONAL ELECTIVE COURSE (BUCKET LIST - K)	ONLINE	3	0	0	45	3	50	50	100	3
3	OEC	BEC852X	OPEN ELECTIVE COURSE (BUCKET LIST - L)	ONLINE	3	0	0	45	3	50	50	100	3
2	INT	BEC803	INTERNSHIP (INDUSTRY/RESEARCH-MINIMUM 14 WEEKS)	ECE	0	0	20	0	3	100	100	200	10
Total										200	200	400	16

(BUCKET LIST - K) - PROFESSIONAL ELECTIVE COURSE – BEC811X (ONLINE)		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC811X	BOS WILL PUBLISH COURSES BASED ON THE AVAILABILITY

(BUCKET LIST - L) - OPEN ELECTIVE COURSE – BEC852X (ONLINE)		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC852X	BOS WILL PUBLISH COURSES BASED ON THE AVAILABILITY

BE in Electronics and Communication Engineering (Autonomous Scheme – 2024)

6th Semester

Scheme – B – VI SEMESTER for the candidates who seek a two – semester internship with project work / Start-up

Sl. No.	Course	Course Code	Course Title	TD/PSB	Teaching Hours per week			(TW+SL) /Sem	Examination				Credits
					Theory Lecture (L)	Tutorial (T)	Practical (P)		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BEC601	ARM CORTEX M3 AND EMBEDDED SYSTEMS	ECE	3	0	2	45	3	50	50	100	4
2	PCC	BEC602	DIGITAL COMMUNICATION	ECE	3	2	0	45	3	50	50	100	4
3	PEC	BEC613X	PROFESSIONAL ELECTIVE COURSE (BUCKET LIST - F)	ECE	3	0	0	45	3	50	50	100	3
4	OEC	BEC654X	OPEN ELECTIVE COURSE (BUCKET LIST - G)	ECE	3	0	0	45	3	50	50	100	3
5	PROJ	BEC685	MAJOR PROJECT PHASE-1	ECE	0	0	4	0	3	100	0	100	2
6	PCCL	BECL606	ADVANCED COMMUNICATION LAB	ECE	0	0	2	0	3	50	50	100	1
7	AEC / SEC	BECT657X	ABILITY ENHANCEMENT COURSE / SKILL ENHANCEMENT COURSE (BUCKET LIST - H)	ECE	IF COURSE IS RUN AS LAB				2	50	50	100	1
					1	0	0	15					
		BECL657X			IF COURSE IS RUN AS THEORY				3				
					0	0	2	0					
8	MC	BIKS608	INDIAN KNOWLEDGE SYSTEM	ANY	1	0	0	15	-	100	0	100	0
9	MC	BNSK659	NATIONAL SERVICE SCHEME (NSS)	PED	0	0	2	0	-	100	0	100	0
		BPEK659	PHYSICAL EDUCATION (SPORTS AND ATHLETICS)	PED									
		BYOK659	YOGA	PED									
Total										600	300	900	18

(BUCKET LIST - F) - PROFESSIONAL ELECTIVE COURSE – BEC613X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC613A	VLSI TESTING AND VERIFICATION
2	BEC613B	SATELLITE COMMUNICATION
3	BEC613C	DIGITAL IMAGE PROCESSING
4	BEC613D	CRYPTOGRAPHY

(BUCKET LIST - G) - OPEN ELECTIVE COURSE – BEC654X		
Sl. No	COURSE CODE	COURSE TITLE
1	BEC654A	INTERNET OF THINGS
2	BEC654B	INTRODUCTION TO QUANTUM COMPUTING
3	BEC654C	VERILOG HDL
4	BEC654D	BASIC VLSI DESIGN

(BUCKET LIST - H) – ABILITY ENHANCEMENT COURSE OR SKILL ENHANCEMENT COURSE - BECT657X / BECL657X		
Sl. No	COURSE CODE	COURSE TITLE
1	BECT657A	TOOLS FOR TECHNICAL WRITING
2	BECT657B	INTRODUCTION TO PHOTONICS
3	BECL657C	ADVANCED IOT
4	BECL657D	DATA ANALYTICS LAB USING PYTHON

BE in Electronics and Communication Engineering (Autonomous Scheme – 2024)

7th Semester

Scheme – B – VI SEMESTER for the candidates who seek a two – semester internship with project work / Start-up

Sl. No.	Course	Course Code	Course Title	TD/PSB	Teaching Hours per week			(TW+SL) /Sem	Examination				Credits
					Theory Lecture (L)	Tutorial (T)	Practical (P)		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BEC701	TO BE COMPLETED IN 5TH/6TH SEMESTER	ECE	3	0	2	45	3	50	50	100	4
3	IPCC	BEC702	TO BE COMPLETED IN 5TH/6TH SEMESTER	ECE	3	0	2	45	3	50	50	100	4
2	PCC	BEC703	TO BE COMPLETED IN 5TH/6TH SEMESTER	ECE	3	2	0	45	3	50	50	100	4
4	PEC	BEC714X	PROFESSIONAL ELECTIVE COURSE (MOOC COURSES)	ECE	3	0	0	45	3	50	50	100	3
5	OEC	BEC755X	OPEN ELECTIVE COURSES (MOOC COURSES)	ECE	3	0	0	45	3	50	50	100	3
1	PEC	BEC811X	PROFESSIONAL ELECTIVE COURSE (MOOC COURSES)	ECE	3	0	0	45	3	50	50	100	3
2	OEC	BEC852X	OPEN ELECTIVE COURSES (MOOC COURSES)	ECE	3	0	0	45	3	50	50	100	3
3	PROJ	BEC883	PROJECT – OUTCOME TRAINING	ECE	0	0	12	0	3	100	100	200	9
4	INT	BEC803	INTERNSHIP (INDUSTRY/RESEARCH-MINIMUM 14 WEEKS)	ECE	0	0	20	0	3	100	100	200	10
Total										350	350	700	42

PROFESSIONAL ELECTIVE COURSE – BEC714X (MOOC COURSE)	
BEC714X	BOS WILL PUBLISH COURSES BASED ON THE AVAILABILITY

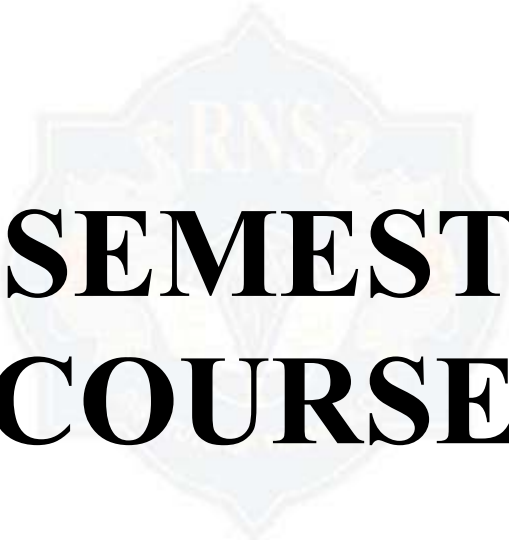
OPEN ELECTIVE COURSE – BEC755X (MOOC COURSE)	
BEC755X	BOS WILL PUBLISH COURSES BASED ON THE AVAILABILITY

PROFESSIONAL ELECTIVE COURSE – BEC811X (MOOC COURSE)	
BEC811X	BOS WILL PUBLISH COURSES BASED ON THE AVAILABILITY

OPEN ELECTIVE COURSE – BEC852X (MOOC COURSE)	
BEC852X	BOS WILL PUBLISH COURSES BASED ON THE AVAILABILITY

Abbreviations:

IPCC: Integrated Professional Core Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course Laboratory, **PEC:** Professional Elective Course, **OEC:** Open Elective Course, **HSMS:** Health and Safety Management System, **AEC:** Ability Enhancement Course, **MC:** Mandatory Course, **PROJ:** Project Work, **INT:** Internship, **L:** Lecture, **T:** Tutorial, **P:** Practical, **SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation, **TD:** Teaching Department, **PSB:** Paper Setting Department, **BOS:** Board of Studies, **MOOC:** Massive Open Online Course.



V SEMESTER COURSES

ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Technological Innovation and Management Entrepreneurship		
Course Code	BEC501	CIE Marks	50
(L: T: P) + SL	(3: 2: 0) + 45 Hours/Sem	SEE Marks	50
Credits	4	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand basic skills of Management. 2. Understand the need for Entrepreneurs and their skills. 3. Identify the Management functions and social responsibilities. 4. Understand economic development, creativity and Innovation. 5. Understand the Ideation Process, creation of Business Model, Feasibility Study and sources of funding.			
Module-1	Fundamentals of Management and Planning	9 hrs	
Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Time, a key resource: Making it work, The productivity gain, First steps towards effective time management: Your work mix, Assessing your current working practice, Where time goes now, Plan the work and work the plan, Dealing with the uncontrollable, What kind of system?, Setting clear objectives. (Selected topics of Chapter 1, Text1, Selected topics from Chapter 1 & 2, Text 3). Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types of Decisions. (Selected topics from Chapters 4 & 5, Text 1).			
Module-2	Organizing, Staffing, Directing and Controlling	9 hrs	
Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization, Committees-Meaning, Types of Committees; Decentralization of Authority; Staffing -Need and Importance, Recruitment and Selection Process. (Selected topics from Chapters 7, 8, & 11, Text 1). Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow’s Need-Hierarchy Theory and Herzberg’s Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning,			

Characteristics, Behavioural Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process.

(Selected topics from Chapters 15 to 18 and 9, Text 1).

Module-3	Business Social Responsibility and Entrepreneurship	9 hrs
-----------------	--	--------------

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance **(Selected topics from Chapter 3, Text 1).**

Entrepreneurship: Introduction, Entrepreneurship Today, Types of Entrepreneurs, Intrapreneurship, Entrepreneurial Competencies, Capacity building for Entrepreneurs, Entrepreneurial Motivation, Entrepreneurship Training Methods, The process of Entrepreneurial Development, The story of Silicon Valley **(Selected topics from Chapter 1 and 2, Text 2).**

Module-4	MSME and Women Entrepreneurs	9 hrs
-----------------	-------------------------------------	--------------

Micro, Small, and Medium Enterprises: Role and Importance of Micro, Small, and Medium Enterprises, Concepts and definitions of MSME, The MSMED Act, 2006, Government Policy Initiatives Since 1948, Growth and Development of MSME in India, Current schemes for MSME. **(Selected topics from Chapter 5, Text 2).**

Women Entrepreneurs: Introduction, Women's Entrepreneurship in Asia, Women's Entrepreneurship in India, Challenges faced by Women Entrepreneurs, Strategies for the Development of Women, Institutions supporting Women Entrepreneurs in India, Women Entrepreneurs from Around the World, Women Entrepreneurs in India. **(Selected topics from Chapter 3, Text 2).**

Module-5	New Venture Creation	9 hrs
-----------------	-----------------------------	--------------

Identification of Business Opportunities: Introduction, What defines a Good Business Opportunity, When is an Idea and opportunity, How to generate Business Ideas, What Leads to the Creation of Opportunities, How to Identify a Business Opportunity.

(Text 2: Chapter 6).

Project Management and Financing: Introduction, Project Manager, Project Life Cycle, Project Scheduling, Gantt Charts, Network Techniques. **(Text 2: Chapters 7).**

Business Plans: Introduction, Purpose of Business Plan, Contents of Business Plan, Presenting a Business Plan, why do some Business plans Fail? **(Text 2: Chapters 8).**

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business.
------------	---

CO2	Analyse the functions of Managers, Entrepreneurs and their social responsibilities.
CO3	Analyse the components in developing a business plan, along with the integration of CSR-Corporate Social Responsibility.
CO4	Evaluate the significance of Micro, Small, and Medium Enterprises and Women Entrepreneurs.
CO5	Develop awareness about various venture creation schemes.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	P.C Tripathi, P.N Reddy, “Principles of Management”, McGraw Hill Education, 6 th Edition, 2017. ISBN-13:978-93-5260-535-4
2.	Poornima M Charantimath, “Entrepreneurship Development Small Business Enterprises”, Pearson Education 2008, ISBN 978-81-7758-260-4

3.	Patrick Forsyth, “Successful Time Management”, Kogan Page Limited Fifth edition 2019, ISBN - 978-0-7494-8619-8.
----	---

Reference Books:

1.	Vasant Desai, “Dynamics of Entrepreneurial Development and Management”, HPH 2007, ISBN: 978-81-8488-801-2
2.	Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, “Entrepreneurship”, 8th Edition, Tata Mc-graw Hill Publishing Co.ltd.-New Delhi, 2012
3.	Harold Koontz, Heinz Weihrich, “Essentials of Management: An International, Innovation and Leadership perspective”, McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4

Weblinks and Video Lectures:

1.	nptel.ac.in/courses/110105146
2.	VideoLectures.NET

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Digital Signal Processing		
Course Code	BEC502	CIE Marks	50
(L: T: P) + SL	(3: 0: 2) + 45 Hours / Sem	SEE Marks	50
Credits	4	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> - Understand frequency-domain analysis of discrete-time signals using the Discrete Fourier - Transform (DFT) and its fundamental properties for signal representation and reconstruction. - Apply efficient computational techniques such as Fast Fourier Transform (FFT) algorithms for analyzing and processing discrete-time signals. - Design and analyze FIR (Finite Impulse Response) filters using windowing techniques and understand their structures for practical signal processing applications. - Develop IIR (Infinite Impulse Response) filters using methods like Bilinear Transformation and analog-to-digital filter conversion techniques. - Explore multi-rate signal processing concepts and real-world DSP applications, particularly in areas such as biomedical signal processing and voice processing.			
Module-1	Discrete Fourier Transforms	9 hrs	
Frequency domain sampling and Reconstruction of Discrete Time Signals, The Discrete Fourier Transform, DFT as a linear transformation, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution. Text 1			
Module-2	Additional DFT Properties, Linear filtering, and FFT	9 hrs	
Additional DFT Properties, Linear filtering methods based on the DFT: Use of DFT in Linear Filtering, Filtering of Long data Sequences. Fast-Fourier-Transform (FFT) algorithms: Efficient Computation of the DFT: Radix-2 DIT-FFT algorithm for the computation of DFT and IDFT. Text 1			
Module-3	Design of FIR Filters	9 hrs	
Characteristics of practical frequency-selective filters, Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR (low pass and High pass) filters using windows - Rectangular, Hamming, Hanning, Bartlett windows. Structure for FIR Systems: Direct form, Cascade form and Lattice structures. Text 1			

Module-4	IIR Filter Design	9 hrs
Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Analog Filters using Low pass prototype transformation, Normalized Butterworth Functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Digital Butterworth (Lowpass and Highpass) Filter Design using BLT. Realization of IIR Filters in Direct form I and II. Text 1		
Module-5	Multi-rate Signal Processing and Applications	9 hrs
Introduction, Sampling, Sampling rate conversion, Signal flow graphs, Applications of DSP in biomedical Engineering, voice processing. Text 2		

Practical component of IPCC:

List of Programs to be implemented and executed using any programming languages like C++/Python/Java/Scilab/MATLAB/CC Studio (but not limited to):

Exp. No.	Programs
1	Computation of N-point DFT of a given sequence and to plot magnitude and phase spectra.
2	Computation of circular convolution of two given sequences using DFT and IDFT method.
3	Verification of Linearity property, circular time shift property and circular frequency shift property of DFT.
4	Verification of Conjugate properties and Parseval's theorem applicable to DFT.
5	Implement Radix-2 DIT-FFT algorithm for the computation of DFT.
6	Design and implementation of IIR (Butterworth) low pass filter to meet given specifications.
7	Design and implementation of IIR (Butterworth) high pass filter to meet given specifications.
8	Design and implementation of low pass FIR filter to meet given specifications.
9	Design and implementation of high pass FIR filter to meet given specifications.
10	Design and implementation of band pass FIR filter to meet given specifications.
11	Design and implementation of band reject FIR filter to meet given specifications.
12	Implementation of decimation- interpolation operation on Discrete time signals.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply direct method and DFT properties to determine DFT of real and complex discrete-time signals.
CO2	Develop the DITFFT algorithm for computation of DFT, apply FFT algorithm and use the method of DFT-IDFT for linear filtering.
CO3	Design FIR and IIR filters.
CO4	Analyse multi-rate signal processing operations and DSP Applications.
CO5	Implement various signal processing operations using simulation tool.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CIE Theory (A+B)	30	12	Marks of Tests and Assignments awarded for a maximum of 30.
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	20	8	Marks of Experiments, Record and Test awarded for a maximum of 20 marks.
CIE: Theory + Practical (A+B+C)	50	20	CIE Evaluation is done for a maximum of 50 marks.

SEE (D)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be before 3 hours.
CIE+SEE (A+B+C+D)	100	40	Final marks shall be the sum of marks scored in Components A, B, C and D
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.			

Text Books:

1.	Proakis and Manolakis, “Digital Signal Processing–Principles, Algorithms and Applications”, 4 th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2.	Shalivahanan S, Gnanapriya C, “Digital Signal Processing”, 2nd Edition, 2000, Tata McGraw-Hill Publication.

Reference Books:

1.	Sanjit K Mitra, “Digital Signal Processing, A Computer Based Approach”, 4th Edition. McGraw Hill Education, 2013.
2.	Oppenheim and Schaffer, “Discrete Time Signal Processing”, PHI, 2003.
3.	D Ganesh Rao and Vineeth P Gejji, “Digital Signal Processing” Cengage India Private Limited, 2017, ISBN: 9386858231.
4.	Li Tan, Jean Jiang, “Digital Signal processing - Fundamentals and Applications”, Academic Press, 2013, ISBN: 978-0-12-415893.

Weblinks and Video Lectures (e-Resources):

1.	https://onlinecourses.nptel.ac.in/noc21_ee20/preview
2.	https://onlinecourses.nptel.ac.in/noc26_ee50/preview

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	VLSI Design		
Course Code	BEC503	CIE Marks	50
(L: T: P) + SL	(3: 2: 0) + 45 Hours / Sem	SEE Marks	50
Credits	4	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. This course deals with analysis and design of digital CMOS integrated circuits. 2. The course emphasizes on basic theory of digital circuits, design principles and techniques for digital design blocks implemented in CMOS technology. 3. This course will also cover switching characteristics of digital circuits along with delay and power estimation. 4. Understanding the CMOS sequential circuits and memory design concepts.			
Module-1	Introduction to CMOS Circuits	9 hrs	
Introduction, A brief History, MOS Transistors, MOS Transistor switches, CMOS Logic, Circuit and System Representation. Text 1: Chapter 1			
Module-2	MOS Transistor Theory	9 hrs	
n-MOS enhancement transistor, p-MOS transistor, Threshold Voltage, Threshold voltage adjustment, Body effect, MOS device design equations, Second Order Effects, V-I characteristics, CMOS inverter DC characteristics, Influence of β_n / β_p ratio on transfer characteristics, Noise margin, Alternate CMOS inverters. Transmission gate Tristate Inverter. Text 1: Chapter 2			
Module-3	CMOS Process Technology	9 hrs	
Silicon Semiconductor Technology: An overview, Basic CMOS Technology, Layout Design Rules. Scaling of MOS transistor Dimensions. Text 1: Chapter 3			
Module-4	CMOS Circuit and Logic Design	9 hrs	
Introduction, CMOS Logic Gate design, Basic Physical Design of simple Logic Gates- Inverter, NAND and NOR gates. CMOS Logic structures, CMOS Complementary logic, BiCMOS Logic, Pseudo n-MOS logic, Dynamic CMOS logic, Clocked CMOS Logic, Cascade Voltage Switch logic, Pass transistor Logic, CMOS Domino Logic. Text 1: Chapter 5			
Module-5	Sequential MOS Logic Circuits	9 hrs	
Introduction, Behaviour of Bistable Elements (Excluding Mathematical analysis) SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, Clocked SR Latch, Clocked JK Latch.			

Text 2: Chapter 8

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the fundamental knowledge of MOS transistors to the design of digital CMOS integrated circuits.
CO2	Apply the basic theory of MOS transistors to analyze the DC characteristics of CMOS logic circuits.
CO3	Evaluate CMOS process technology, layout design rules, and scaling concepts to determine their impact on circuit performance.
CO4	Analyze and design other CMOS logic circuits.
CO5	Apply sequential CMOS logic concepts to design and evaluate basic memory elements.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Neil H. E. Weste and Kamran Eshraghian, “Principles of CMOS VLSI Design, A Systems Perspective”, 2 nd Edition, Pearson Education
2.	Sung Mo Kang and Yosuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, 3 rd Edition, Tata McGraw-Hill.

Reference Books:

1.	Neil H E Weste, and David Money Harris “CMOS VLSI Design- A Circuits and Systems Perspective”, 4th Edition, Pearson Education.
2.	Douglas A Pucknell, Kamran Eshraghian, “Basic VLSI Design”, 3rd Edition, Prentice Hall of India publication, 2005.

Weblinks and Video Lectures (e-Resources):

1.	https://www.youtube.com/watch?v=oL8SKNxEaHs&list=PLLy_2iUCG87Bdulp9brz9AcvW_TnFCUmM
2.	https://www.youtube.com/watch?v=lRpt1fCHd8Y&list=PLCmoXVuSEVHIEJi3SwdyJ4EICffuyqijk
3.	https://www.youtube.com/watch?v=yLqLD8Y4-Qc

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

1.	Model displayed for clear understanding of fabrication process of MOS transistor
2.	Practise session can be held to understand the significance of various layers in MOS process, with the help of coloured layouts

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	VLSI Lab		
Course Code	BECL504	CIE Marks	50
L: T: P	0: 0: 2	SEE Marks	50
Credits	1	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Design, model, simulate and verify digital circuits. 2. Design layouts and perform physical verification of CMOS digital circuits. 3. Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist. 4. Perform RTL-GDSII flow and understand the stages in ASIC.			
Sl. No	Experiments		
	Part 1: ASIC Analog Design		
1	Construct the schematic of CMOS inverter with load capacitance of 0.1pF and set the widths of inverter with $W_n = W_p$, $W_n = 2W_p$, $W_n = W_p/2$ and length at selected technology. Carry out the following: 1. Set the input signal to a pulse with rise time, fall time of 1ns and pulse width of 10ns and the time period of 20ns and plot the input voltage and output voltage of designed inverter? 2. From the simulation result compute TP_{HL}, TP_{LH} and T_d for all three geometrical settings of width? 3. Tabulate the results of delay and find the best geometry for minimum delay for CMOS inverter. Draw layout of the inverter using optimum layout methods. Verify for DRC and LVS, extract parasitic. Record the observations.		
2	Capture the schematic of 2-input CMOS NAND gate having a similar delay as that of CMOS inverter computed in the experiment above. Verify the functionality of the NAND gate and also find out the delay t_d for all four possible combinations of input vectors. Tabulate the results. Increase the drive strength to 2X and 4X and tabulate the results. Draw the layout of NAND, using optimum layout methods. Verify for DRC and LVS, extract parasitic. Record the observations		

3	Construct the schematic of the Boolean Expression $Y = AB + CD + E$ using CMOS Logic. Verify the functionality of the expression, find out the 1. delay T_d for some combination of input vectors. Tabulate the results.
4	Construct the schematic of Common Source Amplifier with PMOS Current Mirror Load and find its transient response, DC response and AC response? Measure the Unit Gain Bandwidth (UGB). Draw a layout of common source amplifier, using optimum layout methods. Verify for DRC. LVS & extract parasitic elements. Record the observations.
5	Construct the schematic of a two-stage operational amplifier and find its transient response, DC response & AC response. measure the following: 1. Unity gain Bandwidth 2. dB Bandwidth 3. Gain Margin and phase margin with and without coupling capacitance 4. Use the op-amp in the inverting and non-inverting configurations and verify its functionality. Draw a layout of a common source amplifier, using optimum layout methods. Verify for DRC, LVS & extract parasitic elements. Record the observations.
Part 2: ASIC Digital Design	
6	Design a 4-Bit Adder 1. Write a Verilog description 2. Verify the Functionality using Test-bench 3. Synthesize the design by setting proper constraints and generate the gate level netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
7	4-Bit Shift and add Multiplier 1. Write Verilog Code 2. Verify the Functionality using Test-bench 3. Synthesize the design by setting proper constraints and obtain the gate level netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
8	32-Bit ALU Supporting 4-Logical and 4-Arithmetic operations, using case and if statement for ALU Behavioural Modeling 1. Write Verilog description 2. Verify functionality using Test-bench 3. Synthesize the design targeting suitable library and by setting area and timing constraints

	4. Tabulate the Area, Power and Delay for the Synthesized netlist Identify Critical path
9	Flip-Flops (D, SR and JK) 1. Write the Verilog description 2. Verify the Functionality using Test-bench 3. Synthesize the design by setting proper constraints and obtain the gate level netlist. From the report gate level netlist identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required. Verify the functionality using Gate level netlist and compare the results at RTL and gate level netlist.
10	Four-bit Synchronous MOD-N counter with Asynchronous reset 1. Write Verilog Code 2. Verify functionality using Test-bench 3. Synthesize the design targeting a suitable library by setting area and timing constraints 4. Tabulate the Area, Power and Delay for the Synthesized netlist Identify the critical path, verify the functionality using Gate level netlist and compare the results at RTL and gate-level netlist.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Design and simulate basic CMOS circuits like inverter, Nand gate, Boolean expression, common source amplifier and differential amplifiers.
CO2	Verify functionality of operational amplifier and analog/digital converters to meet desired parameters using basic amplifiers.
CO3	Interpret delay concepts using DC Analysis, AC Analysis and Transient Analysis in analog circuits.
CO4	Design and simulate combinational and sequential digital Verilog HDL.
CO5	Execute ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level net list.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
-----------------	---------------	-----------------------	--------------------

CIE – Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 20 marks.
CIE Practical Test (B)	20	-	Test conducted for part A and part B, each carries 5 marks and final IA test conducted for 20 Marks
Total CIE (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Data Science using Python		
Course Code	BEC515A	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Learn the basics of Python programming using the Spyder tool. 2. Understand Python data types, data structures, and NumPy arrays. 3. Perform data analysis and visualization using Pandas, Matplotlib, and Seaborn. 4. Gain basic knowledge of Data Science concepts and statistical methods. 5. Apply EDA and basic machine learning techniques to solve real-world problems.			
Module-1	Basics of Python Spyder		9 hrs
Introduction Spyder, setting working Directory, Creating and saving a script file, File execution, clearing console, removing variables from environment, clearing environment, Commenting script files, Variable creation, Arithmetic and logical operators Data types and associated operations, Sequence data types and associated operations: Strings, Lists, Arrays, Tuples, Dictionary, Sets, Range. NumPy: ndarray. Text 1			
Module-2	Pandas, visualization techniques, and Python control structures		9 hrs
Pandas dataframe and dataframe related operations on Toyota Corolla dataset: Reading files, Exploratory data analysis, Data preparation and preprocessing. Data visualization on Toyota Corolla dataset using matplotlib and seaborn libraries: Scatter plot. Line plot, Bar plot, Histogram, Box plot, Pair plot Control structures using Toyota Corolla dataset: if-else family, for loop, for loop with if break, while loop Functions. Text 1			
Module-3	Introduction to Data Science		9 hrs
What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets. Needed Statistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model. Text 2			
Module-4	Exploratory Data Analysis and Basic Machine Learning Techniques		9 hrs
Exploratory Data Analysis and the Data Science Process Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study:			

Real Direct (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k- NN), k-means. **Text 2**

Module-5	Advanced Feature Extraction and Selection Methods	9 hrs
-----------------	--	--------------

Feature Generation and Feature Selection Extracting Meaning from Data: Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests. Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis. **Text 2**

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply Python programming concepts and NumPy arrays to develop and execute programs.
CO2	Apply Pandas, visualization techniques, and Python control structures to analyze datasets.
CO3	Analyse basic Data Science concepts and statistical inference techniques to understand and analyze data.
CO4	Apply EDA and simple machine learning techniques to real-world datasets.
CO5	Analyse feature selection and dimensionality reduction techniques for data analysis.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down

			to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	O'Reilly, "Python for Data Analysis Data Wrangling with pandas, NumPy and Jupyter" 3 rd Edition by Wes McKinney.
2.	Cathy O'Neil and Rachel Schutt, "Doing Data Science ", O'Reilly Media, Inc O'Reilly Media, Inc, 2013.

Web links and Video Lectures (e-Resources)

1.	https://nptel.ac.in/courses/106106212
----	---

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	System Verilog		
Course Code	BEC515B	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand and apply System Verilog verification fundamentals, including verification guidelines, data types, testbench architecture, directed and constrained-random testing methodologies. 2. Apply System Verilog modeling, procedural constructs, and interfaces for digital system design and simulation. 3. Develop modular, reusable, and scalable System Verilog designs using packages, tasks, functions, and scope management techniques. 4. Generate high-quality verification results through constrained randomization and functional coverage, including coverage strategies and cross-coverage analysis to ensure thorough design validation.			
Module-1	Verification Guidelines and Data Types	9 hrs	
Verification Guidelines: The verification process, basic test bench, functionality, directed testing, methodology basics, constrained random stimulus, randomization, functional coverage, test bench components, layered testbench. (Text 1: 1.1 - 1.12). Data Types: Built in Data types, fixed and dynamic arrays, Queues, associative arrays, linked lists, array methods, choosing a storage type, creating new types with typedef, creating user defined structures, Expression width. (Text 1: Chapter 2). <i>Self-Study Components:</i> Enumerated types, constants, and strings.			
Module-2	Behavioral and Structural Modeling	9 hrs	
Procedural Constricks, Block and Statement labels, Case Statement, If Statement, Final Statement, Disable Statement, Event Control, Edge Event, Continuous Assignment, Parallel Block, Process control, Fine-Grain Process Control, Interface (Text 2: 5.1, 5.3 to 5.13, 6.2) <i>Self-Study Components: Module of Structural Modelling</i>			
Module-3	Procedural statements and routines	9 hrs	
Packages, Compilation Unit, Tasks and Functions, System Task and Functions, Alias Statement, Local and Global Variable. (Text 2: Chapter 7) <i>Self-Study Components: Assertions</i>			

Module-4	Randomization	9 hrs
Introduction, What to Randomise? Randomization in System Verilog, Constraint details, Valid constraints, pre_randomize and post_randomize, Random Number Functions. (Text 1: 6.1, 6.2, 6.3, 6.4, 6.7, 6.9, 6.10). <i>Self-Study Components: Conditional constraints</i>		
Module-5	Functional Coverage	9 hrs
Introduction, Coverage types, Functional Coverage Strategies-Gather Information, Not Data, Only Measure What You Are Going to Use, Measuring Completeness, Simple coverage example, Anatomy of a Cover Group, Cross coverage-Pass Cover Group Arguments by Value, Pass Cover Group Arguments by Reference (Text 1: 9.1 - 9.4, 9.8) <i>Self-Study Components: Excluding cross coverage bins.</i>		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply System Verilog verification guidelines and data types to develop basic testbenches using directed and constrained-random testing techniques.
CO2	Construct structured and modular testbenches by utilizing procedural statements, tasks, functions, interfaces, and proper stimulus timing mechanisms.
CO3	Design and implement object-oriented verification environments using System Verilog classes, inheritance, dynamic objects, and reusable testbench components.
CO4	Evaluate design functionality using constrained randomization and functional coverage techniques, including cross-coverage, to measure verification completeness.
CO5	Apply System Verilog verification guidelines and data types to develop basic testbenches using directed and constrained-random testing techniques.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.

Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Chris Spear, “System Verilog for Verification – A guide to learning the Test bench language features”, Springer Publications Second Edition, 2010
2.	M Morris Mano, Micheal Ciletti, “Digital Design”,

Reference Books:

1.	Stuart Sutherland, Simon, Davidmann, Peter Flake, “System Verilog for Design- A guide to using system Verilog for Hardware design and modeling”, Springer Publications Second Edition, 2006
----	---

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Artificial Neural Networks		
Course Code	BEC515C	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the basics of ANN and comparison with human brain. 2. Acquire knowledge on Generalization and function approximation of various ANN architectures. 3. Understand reinforcement learning using neural networks 4. Acquire knowledge on unsupervised learning using neural networks.			
Module-1	Introduction	9 hrs	
Introduction: Biological Neuron- Artificial Neural Model- Types of activation functions, Architecture: Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks. Learning: Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem. Text 1: Chapter 2: 2.2, Chapter 3: 3.1, 3.2, 3.5, Chapter 4: 4.2, 4.5, 4.7, 4.8, Chapter 5: 5.5-5.10.			
Module-2	Multilayer Networks	9 hrs	
Alpha-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, Mu-LMS, Multi-layered Network Architecture, Back propagation Learning Algorithm, Practical consideration of BP algorithm. Text 1: Chapter 5: 5.14 – 5.18, Chapter 6: 6.1-6.5.			
Module-3	Convolutional Neural Networks (CNNs)	9 hrs	
Convolution operation, Pooling, Variants based on convolution functions, Applications, Structured outputs, Data types, Efficient Convolution Algorithms, Random or Supervised features, Neuro scientific basis for CNNs. Text 2: Chapter 9: 9.1- 9.10			
Module-4	Sequence Modelling, Recurrent and Recursive Nets	9 hrs	
Unfolding computational graphs, recurrent neural nets, Bidirectional RNNs, Encoder-Decoder Sequence to sequence architectures, Deep Recurrent Networks. Text 2: Chapter 10: 10.1-10.5			
Module-5	Autoencoders	9 hrs	

Autoencoders, Under complete Autoencoders, Regularised Auto encoders, Representational Power, Layer, Size and Depth, Stochastic Encoders & Decoders, Applications for Auto encoders. **Text 2: Chapter 14: 14.1- 14.4, 14.9**

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the fundamental concepts of artificial neural networks, including biological inspiration, neuron models, activation functions, and learning paradigms.
CO2	Apply learning algorithms such as perceptron learning, LMS, and backpropagation for solving linearly and non-linearly separable problems.
CO3	Analyze and design feedforward neural networks and multilayer architectures for function approximation and classification tasks.
CO4	Evaluate the performance of neural networks by tuning hyper parameters, error functions, and optimization techniques.
CO5	Implement advanced deep learning models such as Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Autoencoders for real-world applications.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.

CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Satish Kumar, “Neural Networks A Classroom Approach”, McGraw Hill Education (India) Pvt. Ltd. Second Edition.
2.	Ian Good Fellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press (3 January 2017), ISBN- 13: 978-0262035613.

Reference Books:

1.	Simon Haykin, “Neural Networks and Learning Machines”, 3 rd Edition, Pearson Prentice Hall.
2.	Nikhil Buduma, O’Reilly Publications, “Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms”, 2016 Edition, ISBN-13:978-1491925614.

Web links and Video Lectures (e-Resources)

1.	https://nptel.ac.in/courses/106106212
2.	https://www.deeplearningbook.org
3.	https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs04

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

1.	https://www.tensorflow.org/tutorials
2.	https://www.deeplearning.ai/

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Cloud Computing		
Course Code	BEC515D	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Introduce the fundamental concepts of distributed and cloud computing, including system models, cloud architecture, deployment models, and essential characteristics of cloud environments. 2. Enable students to understand virtualization concepts and technologies, including virtual machines, virtualization layers, and mechanisms for CPU, memory, and I/O virtualization. 3. Develop an understanding of the cloud computing paradigm, focusing on enterprise cloud adoption, migration strategies, and challenges in moving applications and services to the cloud. 4. Explain cloud service models such as IaaS, PaaS, and SaaS, and familiarize students with virtual machine provisioning, cloud platforms, and integration of private and public clouds. 5. Create awareness of data security and identity management in cloud computing, including security risks, current challenges, and best practices for protecting data in cloud environments.			
Module-1	Systems Modeling		9 hrs
System Models for Distributed and Cloud Computing- Cloud Computing in a Nutshell, Layers and Types of Clouds, Desired Features of a Cloud, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks. Text 1: Chapter 1			
Module-2	Virtualization		9 hrs
Virtual machines, Implementation Levels of Virtualization -Virtualization Structures/Tools and Mechanisms-Virtualization of CPU, Memory, and I/O Devices. Text 1: Chapter 3			
Module-3	Foundations		9 hrs
Introduction to Cloud Computing- Migrating into a Cloud-The Enterprise Cloud Computing Paradigm. Text 2: Chapter 1			
Module-4	Infrastructure as a Service (IAAS) and Platform as a service (PAAS)		9 hrs

Virtual machines provisioning and Migration services-On the Management of Virtual machines for Cloud Infrastructures Aneka— Integration of Private and Public Clouds.

Text 2: Chapter 4

Module-5	Software as a Service (SAAS) and Data Security in the Cloud	9 hrs
Google App Engine, An Introduction to the idea of Data Security- The Current State of Data Security in the Cloud Computing and Data Security Risk- Cloud Computing and Identity. Text 1: Chapter 6, Text 2: Chapter 9.		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply system models for distributed and cloud computing, learn cloud architecture, service layers, deployment models, desired cloud features, and associated challenges and risks.
CO2	Analyze the concept of virtualization and describe virtualization mechanisms, including virtual machines, virtualization structures, and virtualization of CPU, memory, and I/O devices.
CO3	Apply the foundations of cloud computing and evaluate strategies for migrating enterprise applications and services to cloud environments.
CO4	Analyze Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) architecture, including virtual machine provisioning, migration services, and cloud infrastructure management platforms such as Aneka.
CO5	Analyze Software as a Service (SaaS) models and evaluate data security issues in cloud computing, including identity management, risks, and security mechanisms.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.

Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C .
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Kaithwang Geoffrey C. Fox and Jack J Dongarra, “Distributed and Cloud Computing”, Elsevier India 2012.
2.	Raj Kumar Buyya, Christian Vecchiola and S. Tanurai Selvi, “Mastering Cloud Computing”, TMH, 2012.

Reference Books:

1.	Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, Que Publishing, August 2008.
----	---

Weblinks and Video Lectures (e-Resources):

1.	https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs14
2.	https://nptel.ac.in/courses/106105167

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Environmental Studies		
Course Code	BENS407 / 507	CIE Marks	50
(L: T: P) + SL	(2: 0: 0) + 30 Hours / Sem	SEE Marks	50
Credits	2	Exam Hours	2
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Introduce the basic concepts of ecology and ecosystem functioning, including biodiversity and biogeochemical cycles. 2. Understand various types of environmental pollution, their sources, impacts, and preventive measures. 3. Explore causes of environmental degradation and methods of conservation with special emphasis on Indian biodiversity. 4. Create awareness about climate change, global warming, environmental legislation, and significant environmental movements in India.			
Module-1	Ecology, Biogeochemical cycles, Sustainability	6 hrs	
Basic concepts of ecosystem. Ecosystems (structure and function)- forest, desert, wetlands, river, oceanic and lake. Biotic and Abiotic components; Food chain; Ecological pyramid. Carbon cycle, nitrogen cycle, phosphorus cycle, water cycle. 17-Sustainable Development Goals (SDG)- history, targets, implementation, capacity development.			
Module-2	Environmental Pollution, Water Chemistry	6 hrs	
Surface and ground water pollution, noise pollution, soil pollution, air pollution and marine pollution - sources, impacts on living beings, impacts on environment, preventive measures. case-study on marine pollution. Significance and effect of pH, total dissolved solids and hardness. Case study on impact of fluoride on human health.			
Module-3	Environmental Degradation, Environmental Conservation	6 hrs	
Causes and effects of deforestation, desertification, soil erosion and glacier melting. Significance and key features of national parks, wildlife sanctuaries, reserved forest and mangrove forest. Importance of western ghats as biodiversity hotspot (flora and fauna)			
Module-4	Indian Monsoon and Global Warming	6 hrs	
Climate- Impact on monsoons, significance of El Nino and La Nina on India climate. Global warming: causes, greenhouse gases, effects on environment and human health.			

Causes and effects of acid rain and ozone depletion. Air sampler and its importance in assessing pollutants.		
Module-5	Environmental Legislation, Indian Environmental Movements	6 hrs
Environmental Protection Act 1984: Definition, Significance and key features. Bishnoi Movement, Chipko and Appiko movement.		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Describe the components and functions of ecosystems and explain major biogeochemical cycles and sustainability goals.
CO2	Understand various forms of pollution and environmental degradation, along with their impacts on ecosystems and human health.
CO3	Demonstrate awareness of climate issues, Indian environmental legislation, and the role of community-based movements in environmental protection.

Assessment Details (CIE and SEE) (MCQs for Assessment):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	Question Paper having 50 MCQs with each question carrying 01 mark, and exam duration shall be for 2 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Benny Joseph, “Environmental studies”, 3 rd ed., Tata McGraw-Hill, 2017.
2.	SM Prakash, “Environmental studies”, 3 rd ed., Pristine publishing house, 2018.

Reference Books:

1.	M. Anji Reddy, “Textbook of environmental science and Technology”, revised ed., B S publications, 2014.
2.	Dr. B. S Chauhan, “Environmental studies”, 1 st ed., University of science press, 2008.



ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Biology for Engineers		
Course Code	BBOE407 / 507	CIE Marks	50
(L: T: P) + SL	(2: 0: 0) + 30 Hours / Sem	SEE Marks	50
Credits	2	Exam Hours	2
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Familiarize the students with the basic biological concepts and their engineering applications. 2. Enable the students with an understanding of bio design principles to create novel devices and structures. 3. Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems. 4. Motivate the students to develop interdisciplinary vision of biological engineering.			
Module-1	Fundamentals of Life	6 hrs	
Introduction to fundamentals of life. Structure and functions of a cell. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, Proteins, Enzymes and Lipids.			
Module-2	Applications of Biomolecules	6 hrs	
Introduction to applications of biomolecules, Carbohydrates in cellulose-based water filters production, PHA and PLA in bioplastics production, Nucleic acids in vaccines and diagnosis, Proteins in food production, Enzymes in biosensors fabrication, food processing, enzymes in biobleaching, Lipids in biodiesel and detergents production.			
Module-3	Adaptations of anatomical principles	6 hrs	
Introduction to adaptations of anatomical principles for bioengineering design, Brain as a CPU system. Eye as a Camera system. Heart as a pump system. Lungs as purification system. Kidney as a filtration system.			
Module-4	Biomaterials and mechanisms	6 hrs	
Introduction to nature inspired biomaterials and mechanisms, Echolocation, Photosynthesis. Bird flying, Lotus leaf effect, Plant burrs, Shark skin, Kingfisher beak. Artificial blood - haemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).			
Module-5	Trends in bioengineering	6 hrs	
Introduction to trends in bioengineering, Tissue engineering, stem cells and their applications, Bioprinting techniques and materials. Electrical tongue and electrical nose in			

food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Corroborate the concepts of biomimetics for specific requirements.
CO2	Understand the basic biological concepts for relevant industrial applications. adaptation.
CO3	Evaluate the principles of design and development, for exploring engineering knowledge in biological
CO4	Think critically towards exploring innovative biobased solutions for socially relevant problems.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	Question Paper having 50 MCQs with each question carrying 01 mark, and exam duration shall be for 2 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Chandra Shekara. B.M, Basavaraju B.C, “Basuchandra’s Biology for Engineers”, 2025.
2.	Rajendra Singh C and Rathnakar Rao N, “Biology for Engineers”, Publishing, Bengaluru, 2023.

Reference Books:

1.	Stuart Fox, Krista Rompolski, “Human Physiology”, McGraw-Hill eBook. 16th Edition, 2022
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.	D. Floreano and C. Mattiussi, “Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies”, MIT Press, 2008.
8.	C R Sunilkumar, N Geetha, A C Udayashankar, “Bioremediation of heavy metals: bacterial participation”, Lambert Academic Publishing, 2019.

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Research Methodology and IPR		
Course Code	BRMK558	CIE Marks	50
(L: T: P) + SL	(2: 0: 0) + 30 Hours / Sem	SEE Marks	50
Credits	2	Exam Hours	2
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the fundamental concepts of research and its various types. 2. Apply the principles of literature review, technical reading, attribution, and citation in academic research. 3. Demonstrate awareness of ethical practices in engineering research. 4. Explain the concepts and significance of Intellectual Property Rights (IPR) in engineering.			
Module-1	Introduction	6 hrs	
Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.			
Module-2	Literature Review and Technical Reading	6 hrs	
Introduction to literature review and technical reading, understanding new and existing knowledge, and techniques for analysis and synthesis of prior art. Overview of bibliographic databases such as Web of Science, Google, and Google Scholar. Effective search strategies and approaches for technical reading. Conceptualizing research through critical and creative reading practices Attributions and Citations: Importance of giving proper credit through attributions and citations. Functions and attributes of citations, and the role of titles and keywords in enhancing citation impact. Understanding knowledge flow through citations and the practice of citing datasets. Overview of citation styles, along with guidelines for acknowledgments and proper attribution in academic writing			
Module-3	Introduction to Intellectual Property and Patents	6 hrs	
Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India. Major Amendments in IP Laws and Acts in India. Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible			

for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting. Process of Patenting

Module-4	Process of Patenting	6 hrs
-----------------	-----------------------------	--------------

Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Commercialization of a Patent. Need for a Patent Attorney/Agent. Can a Worldwide Patent be Obtained? Do I Need First to File a Patent in India? Patent Related Forms. Fee Structure
Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright.

Module-5	Trademarks	6 hrs
-----------------	-------------------	--------------

Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India.

Famous Case Law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.

Industrial Designs: Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. International Treaties.

Famous Case Law: Apple Inc. vs. Samsung Electronics Co.

Geographical Indications: Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Comprehend the fundamental principles of research and its various classifications.
CO2	Analyze and apply concepts of literature review, technical reading, attribution, and citation in research contexts.
CO3	Demonstrate an understanding of ethical practices in engineering research.
CO4	Interpret and explain the role and significance of Intellectual Property Rights (IPR) in engineering and innovation.
CO5	Understanding the basic principles of design rights.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	Question Paper having 50 MCQs with each question carrying 01 mark, and exam duration shall be for 2 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Dr. Santosh M Nejekar, Dr. Harish Bendigeri “Research Methodology and Intellectual Property Rights”, ISBN 978-93-5987-928-4, Edition: 2023-24.
----	--

Reference Books:

1.	David V. Thiel “Research Methods for Engineers”, Cambridge University Press, ISBN: 978-1-107-03488-4
2.	N.K. Acharya “Intellectual Property Rights”, Asia Law House 6th Edition. ISBN: 978-93-81849-4

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	NSS-National Service Scheme		
Course Code	BNSK559	CIE Marks	100
(L: T: P)	(0: 0: 2)	SEE Marks	--
Credits	--	Exam Hours	--
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Identify the needs and problems of the community and involve in problem solving. 2. Develop a sense of social and civic responsibility and utilize knowledge in finding practical solutions to individual and community problems. 3. Develop competence required for group living and sharing of responsibilities, and gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.			
Module-1			3 hrs
Waste management– Public, Private and Govt organization, 5 R’s.			
Module-2			3 hrs
Automation of local Activities			
Module-3			3 hrs
Organic farming, Indian Agriculture (Past, Present and Future), Connectivity for marketing.			
Module-4			3 hrs
Spreading public awareness under rural outreach Programs.			
Module-5			3 hrs
Food preservation and Packaging			

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Understand the motto and concepts of NSS.
CO2	Develop overall personality of volunteers and make them responsible citizens and leaders of the nation.

CO3	Analyze environmental and societal problems and design appropriate solutions.
CO4	Communicate effectively with the community and officials.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two assessment methods as per 24RNBE4.2, scaled to 40 marks.
CIE + SEE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Text Books:

1.	NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2.	Government of Karnataka, NSS Cell, Activities Reports and its Manual.
3.	Government of India, NSS Cell, Activities Reports and its Manual.

Web links:

1.	https://nss.gov.in/
2.	https://pledge.mygov.in/

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Physical Education		
Course Code	BPEK559	CIE Marks	100
(L: T: P)	(0: 0: 2)	SEE Marks	--
Credits	--	Exam Hours	--
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness 2. Familiarization of health-related Exercises, Sports for overall growth and development 3. Participate in the competition at regional/state / national / international levels. 4. Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.			
Module-1	Athletics – Track Events		3 hrs
110 Mtrs and 400 Mtrs: Hurdling Technique: Lead leg Technique, Trail leg Technique. Crouch start (its variations) use of Starting Block.			
Module-2	Athletics - Jumps		3 hrs
High Jump • Approach Run • Take-off • Bar Clearance (Straddle) • Landing			
Module-3	Athletics - Throws		3 hrs
Discuss Throw • Holding the Discus • Initial Stance Primary Swing • Rotation • Release and Recovery (Rotation in the circle)			
Module-4	Football		3 hrs
A. Fundamental skills			

- Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.
- Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot.
- Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.
- Heading: In standing, running and jumping condition.
- Throw-in: Standing throw-in and Running throw-in.
- Tackling: Simple Tackling, Slide Tackling.
- Goal Keeping: Collection of Ball, Ball clearance- kicking, throwing and deflecting.
- Game practice with application of Rules and Regulations

B. Rules and their interpretation and duties of the officials

Module-5	Hockey	3 hrs
A. Fundamental skills • Passing: Short pass, Long pass, push pass, hit • Trapping. • Dribbling and Dozing. • Penalty stroke practice. • Penalty corner practice. • Tackling: Simple Tackling, Slide Tackling. • Goal Keeping, Ball clearance- kicking, and deflecting. • Game practice with application of Rules and Regulations B. Rules and their interpretation and duties of the officials		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Understand and demonstrate fundamental techniques of track events including 110m and 400m hurdles, with proper use of starting blocks and hurdling skills.
CO2	Apply technical knowledge of athletic jumps, particularly high jump, including approach run, take-off, bar clearance, and landing techniques.
CO3	Develop skills and perform throwing events, specifically discus throw, with correct techniques such as grip, stance, rotation, release, and recovery.
CO4	Demonstrate fundamental skills of football such as kicking, trapping, dribbling, heading, throw-in, tackling, and goalkeeping along with understanding rules and officiating.
CO5	Exhibit basic skills and techniques in hockey, including passing, trapping, dribbling, tackling, penalty strokes/corners, and understand rules and duties of officials.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two assessment methods as per 24RNBE4.2, scaled to 40 marks.
CIE + SEE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Text Books:

1.	Health and Physical Education by V.K. Sharma
2.	Introduction to Physical Education, Fitness, and Sport by Daryl Siedentop
3.	Physical Education Activities, Sports and Games: The Origin and Background, Rules of Play, Teaching Hints and Fundamentals by Louis E. Means

Reference Books:

1.	Saraswati Health and Physical Education Textbook
2.	Foundations of Physical Education, Exercise Science and Sport by Deborah A. Wuest

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – V			
Course Title	Yoga		
Course Code	BYOK559	CIE Marks	100
(L: T: P)	(0: 0: 2)	SEE Marks	--
Credits	--	Exam Hours	--
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Physical, Mental & spiritual Objectives of Yoga 2. Explain the meaning of Yoga. 3. Discuss the importance of the Yoga and its scope. 4. Describe the aims and objectives of Yoga. 5. Clarify the misconceptions on Yoga.			
Module-1	Suryanamaskara		3 hrs
Suryanamaskar 12 count 6 rounds • Suryanamaskar prayer. • Meaning, need & Importance • Benefits of Suryanamaskara			
Module-2	Yoga		3 hrs
• Meaning and definition. • Brief introduction of yogic practices for the common man • Rules and regulations • Misconceptions of Yoga			
Module-3	Asanas - Sitting and Standing		3 hrs
Need and importance of different Asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana. Sitting 1. Ardha Ushtrasana 2. Yogamudra in Padmasana Standing 1. Hastapadasana 2. Utkatasana			
Module-4	Asanas - Supine line		3 hrs
Need and importance of different Asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana. Supine line 1. Sarvangasana 2. Chakraasana			

Module-5	Pranayama	3 hrs
Kapalabhati - Revision of practice 40 strokes/min - 3 rounds Pranayama -- 1. Ujjayi 2. Sheetali Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Explain the meaning, definition, scope, and objectives of Yoga and its role in physical, mental, and spiritual well-being.
CO2	Demonstrate Suryanamaskara (12 counts, 6 rounds) with correct technique and understand its importance and benefits.
CO3	Apply knowledge of yogic practices, rules, and regulations while identifying and correcting common misconceptions of Yoga.
CO4	Perform sitting, standing, and supine Asanas with proper technique, precautions, and awareness of their benefits.
CO5	Practice Pranayama techniques (Kapalabhati, Ujjayi, Sheetali) to improve breathing control, concentration, and overall health.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two assessment methods as per 24RNBE4.2, scaled to 40 marks.
CIE + SEE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Text Books:

1.	The Yoga Sutras of Patanjali – Sri Swami Satchidananda.
----	---

2.	Light on Yoga — B.K.S Iyengar.
----	--------------------------------

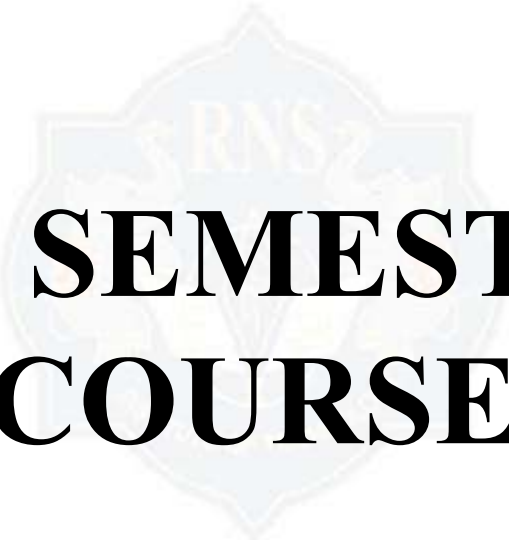
Reference Books:

1.	The Heart of Yoga — T.K.V Desikachar.
2.	Asana Pranayama Mudra Bandha by Swami Satyananda Saraswati.



ESTD : 2001

An Institute with a Difference



VI SEMESTER COURSES

ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	ARM Cortex M3 and Embedded Systems		
Course Code	BEC601	CIE Marks	50
(L: T: P) + SL	(3: 0: 2) + 45 Hours / Sem	SEE Marks	50
Credits	4	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the architectural features and instruction set of 32-bit microcontroller ARM Cortex M3. 2. Program ARM Cortex M3 using the various instructions and C language for different applications. 3. Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system. 4. Develop the hardware software co-design and firmware design approaches. 5. Explain the need of real time operating system for embedded system applications.			
Module-1	ARM-32-bit Microprocessor	9 hrs	
Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence. Text 1: Chapter: 1, 2, 3			
Module-2	ARM Cortex M3 Instruction Sets and Programming	9 hrs	
Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations. Text 1: Chapter: 4, 5, 10 (10.1, 10.2, 10.3, 10.5 only)			
Module-3	Exceptions and Interrupts	9 hrs	
Exceptions, Nested Vector interrupt controller design, SysTick Timer, Cortex-M3 Programming using assembly and C language, CMSIS. Text 1: Chapter: 7, 8, 10			
Module-4	Embedded System Components	9 hrs	
Embedded vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7-segment LED display, Optocoupler, Relay, Piezo buzzer, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components. (Text 2: All the Topics from Chapter: 1, 2, excluding 2.3.3.4 (stepper motor), 2.3.3.8 (keyboard) and 2.3.3.9 (PPI) sections.			
Module-5	Embedded System Design Concepts	9 hrs	

Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling (excluding UML), Embedded firmware design and development (excluding C language). **Text 2: Chapter: 3, 4, Chapter: 7 (Sections 7.1, 7.2 only), Chapter: 9 (Sections 9.1, 9.2, 9.3.1, 9.3.2 only)**

Practical Component of IPCC:

PART-A	
Conduct the following Study experiments to learn ALP using ARM Cortex M3 Registers using an Evaluation board and the required software tool.	
1	ALP to perform addition and subtraction of two numbers.
2	ALP to multiply two 16-bit binary numbers.
3	ALP to find the sum of first 10 integer numbers.
4	ALP to find number of 0's and 1's in a 32-bit data.
5	ALP to find whether given number is even / odd and positive/negative
6	ALP to arrange numbers in Ascending/descending order.
7	ALP to write data to RAM.
PART-B	
Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' and Keil Uvision-4 tool/compiler.	
1	Display "Hello World" message using Internal UART.
2	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
3	Interface a DAC and generate Triangular and Square waveforms.
4	Demonstrate the use of an external interrupt to toggle an LED On/Off.
5	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
6	Interface a simple Switch and display its status through Relay, Buzzer and LED.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Analyze the architectural features and instructions of 32-bit microprocessor ARM Cortex M3.
CO2	Apply the knowledge gained for Programming ARM Cortex M3 for different applications.
CO3	Apply the knowledge of interrupts and exceptions to program on chip peripherals of ARM microprocessor.
CO4	Analyze the basic hardware components and evaluate their selection method based on the characteristics and attributes of an embedded system.
CO5	Analyze the hardware /software co-design and firmware design approaches.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CIE Theory (A+B)	30	12	Marks of Tests and Assignments awarded for a maximum of 30.
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	20	8	Marks of Experiments, Record and Test awarded for a maximum of 20 marks.
CIE: Theory + Practical (A+B+C)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (D)	50	18	SEE is a theory exam, conducted for 100 marks and

			scaled down to 50 marks. Exam duration shall be before 3 hours.
CIE+SEE (A+B+C+D)	100	40	Final marks shall be the sum of marks scored in Components A, B, C and D
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.			

Text Books:

1.	Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2 nd Edition, Newnes, (Elsevier), 2010.
2.	Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2 nd Edition.

Reference Books:

1.	Andrew N Sloss, Dominic System and Chris Wright, “ARM System Developers Guide”, Elsevier, Morgan Kaufman publisher, 1 st Edition, 2008.
2.	Raj Kamal, “Embedded Systems: Architecture and Programming”, Tata McGraw Hill, 2008.

Weblinks and Video Lectures (e-Resources):

1.	https://nptel.ac.in/courses/106105193
2.	https://www.coursera.org/learn/arm-cortex-fundamentals-building-embedded-systems?utm_medium=sem&utm_source=gg&utm_campaign=b2c_india_x_multi_ft_cof_career-academy
3.	https://www.nielit.gov.in/calicut/content/nptel-lab

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Digital Communication		
Course Code	BEC602	CIE Marks	50
(L: T: P) + SL	(3: 2: 0) + 45 Hours / Sem	SEE Marks	50
Credits	4	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> - Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver. - Analyze and compute performance metrics and parameters for symbol processing and recovery under ideal and noisy channel conditions. - Understand the principles of spread spectrum communications. - Apply the fundamental concepts of information theory and implement various source coding techniques. - Study the comprehensive knowledge about various Source and Channel Coding techniques.			
Module-1	Introduction to Information Theory		9 hrs
Measure of information, Average information content of symbols in long independent sequences. Source Coding: Encoding of the Source Output, Shannon’s Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding. Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes.			
Module-2	Linear Block Codes, Convolutional Codes		9 hrs
Matrix description of Linear Block Codes, Error Detection and Correction capabilities of Linear Block Codes, Single error correction Hamming code. Convolutional Encoder, Code tree, Trellis Graph and State graph, Recursive systematic Convolutional codes, The Viterbi Algorithm, Examples.			
Module-3	Digital Modulation Techniques		9 hrs
Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM. Coherent detection: BFSK generation, detection and error probability. BFSK using Non coherent Detection, Differential Phase Shift Keying.			
Module-4	Signalling Communication through Band Limited AWGN Channels		9 hrs

Signalling over AWGN Channels- Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel (without statistical characterization), Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver. Intersymbol interference, Signal design for Zero ISI.

Module-5	Principles of Spread Spectrum	9 hrs
-----------------	--------------------------------------	--------------

Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the fundamentals of information theory and perform source coding for efficient data representation.
CO2	Design and evaluate error control coding schemes using linear block codes, Hamming codes, convolutional codes, and Viterbi decoding.
CO3	Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications
CO4	Analyze signal space representation, optimum receivers, AWGN channel models, and techniques for mitigating Intersymbol interference.
CO5	Describe the principles of spread spectrum communication systems, PN sequence generation, DSSS, and FHSS techniques.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests each of 50 marks, scaled down to 30 marks.
Alternate Assessment (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks

SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE are 20 out of allotted 50 marks to appear for SEE, with minimum 40 % scored in every component of CIE.			

Text Books:

1.	Simon Haykin, “Digital Communication Systems”, John Wiley & sons, First Edition, 2014, ISBN 978-0 471-64735-5.
----	--

Reference Books:

1.	John G Proakis and Masoud Salehi, “Fundamentals of Communication Systems”, 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
2.	K Sam Shanmugam, “Digital and analog communication systems”, Wiley India Pvt. Ltd, 2017, ISBN:978- 81-265-3680-1
3.	Hari Bhat, Ganesh Rao, “Information Theory and Coding”, Cengage, 2017.
4.	Todd K Moon, “Error Correction Coding”, Wiley Std. Edition, 2006.

Weblinks and Video Lectures (e-Resources):

1.	https://nptel.ac.in/courses/108102096
----	---

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	VLSI Testing and Verification		
Course Code	BEC613A	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours/Sem	SEE Marks	50
Credits:	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Know the various types of faults in VLSI based digital circuits. 2. Examine various techniques available for efficient fault detection in combinational circuits. 3. Understand the techniques to enhance testability of combinational circuits. 4. Understand various techniques that can be used to make sequential circuits easily testable. 5. Understand test generation and response evaluation techniques used in BIST schemes for VLSI Chips.			
Module-1	Introduction to Testing		9 hrs
Testing philosophy, Role of Testing, Digital and Analog VLSI testing, VLSI Trends affecting Testing. VLSI Testing Process and Test Equipment: How to test chips, Types of testing, Automatic Test Equipment. Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Fault models, Single stuck-at-fault. (Text 1: 1.1 to 1.4, 2.1 to 2.2, 4.1 to 4.5)			
Module-2	Test generation for Combinational Logic circuits:		9 hrs
Fault Diagnosis of digital circuits, Test generation techniques for combinational circuits, Detection of multiple faults in Combinational logic circuits. Testable Combinational logic circuit design: Read-Muller expansion technique, Three-Level OR-AND-OR design, Automatic synthesis of Testable Logic. (Text 2: 2.1 to 2.3, 3.1 to 3.3)			
Module-3	Test Generation for Sequential circuits		9 hrs
Testing of sequential circuits as iterative combinational circuits, state table verification, Test generation based on circuit structure, Functional fault models, Test generation based on functional fault models.			

Design of testable sequential circuits: Controllability and observability, Ad Hoc Design Rules for Improving Testability, Design of Diagnosable Sequential circuits, The scan path technique for testable sequential circuit design, Level- sensitive scan design (LSSD)

(Text 2: 4.1 to 4.5, 5.1 to 5.5)

Module-4	Test Techniques	9 hrs
Random access Scan Technique, Partial scan, Testable sequential circuit design using nanoscale testing. BIST: Test pattern generation for BIST		

Module-5	IDDQ testing	9 hrs
IDDQ testing: Faults detected by IDDQ tests, IDDQ testing Methods, limitation of IDDQ testing, Delta IDDQ testing, IDDQ built In Current testing, IDDQ design for testability (Text 1: 13.1 to 13.8)		

Testable memory design: RAM fault models, Test algorithms for RAMs, BIST techniques for RAM chips
(Text 2: 7.1 to 7.4)

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Explore testing fundamentals and fault modeling.
CO2	Develop algorithms and generate test vectors for combinational and sequential circuits to maximize fault coverage.
CO3	Generate test patterns for sequential circuits.
CO4	Implement DFT techniques, including scan-based testing, Boundary Scan, and Built-In Self-Test (BIST) to enhance controllability and observability.
CO5	Carry out Fault Analysis and Diagnosis using IDDQ testing.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE-IA Tests(A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Assessment and Quiz scaled to 20 marks.

Total CIE Theory (A+B)	50	20	Marks of Tests and Assignments awarded for a maximum of 30.
SEE(C)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE+SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B, and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Vishwani D Agarwal “Essential of Electronic Testing for Digital” , Memory and Mixed Signal Circuits” Springer, 2002. 4.
2.	Lala Parag K, “Digital Circuit Testing and Testability New York”, Academic Press 1997.

Reference Books:

1.	Abramovici M, Breuer M A and Friedman A “Digital Systems Testing and Testable Design” D Wiley 1994.
2.	Wang, Wu and Wen Morgan” VLSI Test Principles and Architectures” Kaufmann, 2006.

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Satellite Communication		
Course Code	BEC613B	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the basic principle of satellite orbits and trajectories. 2. Study of electronic systems associated with a satellite. 3. Understand the various technologies associated with the satellite communication. 4. Study of electronic systems associated with the earth station. Focus on a communication satellite and the national satellite system. 5. Study of satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation.			
Module-1	Satellite Orbits and Trajectories	9 hrs	
Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits, Orbital perturbations. Text 1			
Module-2	Satellite Launch, Operations and Subsystems	9 hrs	
Satellite launch and in-orbit operation: Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle. Satellite subsystem: Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. Text 1			
Module-3	Multiple Access Techniques and Satellite Link Design	9 hrs	
Multiple Access Techniques: Introduction, FDMA (No derivation), SCPC Systems, MCPC Systems, TDMA, CDMA, SDMA. Satellite Link Design Fundamentals: Transmission Equation, Satellite Link Parameters, Propagation considerations. Text 1			
Module-4	Earth Stations and Communication Satellites	9 hrs	
Earth Station: Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking. Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, regional satellite Systems, National Satellite Systems. Text 1			

Module-5	Remote Sensing, Weather and Navigation Satellites	9 hrs
Remote Sensing Satellites: Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications. Weather Forecasting Satellites: Fundamentals, Images, Orbits, Payloads, Applications. Navigation Satellites: Development of Satellite Navigation Systems, GPS system, Applications. Text 1		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Evaluate the satellite orbits and its trajectories with the definitions of parameters associated with it.
CO2	Analyse the electronic hardware systems associated with the satellite subsystem.
CO3	Describe the various technologies associated with satellite communication.
CO4	Explain the electronic system associated with Earth station. Explain the communication satellite and the national satellite system and other domain services.
CO5	Describe the role of earth station and ground system for satellite application.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests each of 50 marks, scaled down to 30 marks.
Alternate Assessment (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.

CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE are 20 out of allotted 50 marks to appear for SEE, with minimum 40 % scored in every component of CIE.			

Text Books:

1.	Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81- 265-2071-8.
----	---

Reference Books:

1.	Dennis Roddy, “Satellite Communications”, 4 th Edition, McGraw- Hill International edition, 2006.
2.	Timothy Pratt, Charles Bostian, Jeremy Allnutt, “Satellite Communications”, 2 nd Edition, Wiley India Pvt. Ltd, 2017, ISBN: 978-81-265-0833-4.

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Digital Image Processing		
Course Code	BEC613C	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours/Sem	SEE Marks	50
Credits:	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. To prepare students with fundamental knowledge/ overview in the field of Computer Vision with knowledge of mathematical concepts required for image processing. 2. To equip students with a basic foundation of computer vision and its applications. 3. Understand Segmentation and Object Recognition concepts through applications.			
Module-1	Digital Image Fundamentals	9 hrs	
What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels. Text 1: Chapter 1, Chapter 2: Sections 2.1 to 2.5.			
Module-2	Spatial Domain	9 hrs	
Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Noise models. Text 1: Chapter 3: Sections 3.2 to 3.6, Chap. 5.2			
Module-3	Frequency Domain	9 hrs	
Basics of Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters. Color Image Processing: Color Fundamentals, Color Models, Pseudo-color Image Processing. Text 1: Chapter 4: Sections 4.7 to 4.9 and Chapter 6: Sections 6.1 to 6.3.			
Module-4	Segmentation	9 hrs	
Thresholding, Thresholding detection methods, Threshold detection, Optimal thresholding, Multi-spectral thresholding, Optimal Thresholding, Edge based thresholding, Edge relaxation, Border tracing, Region based segmentation, Region merging, Region splitting, Splitting and merging, Watershed segmentation, Region growing post processing. Text 2: Chap 6, pp. 175-197, pg.223-235.			
Module-5	Object Recognition	9 hrs	

Knowledge representation, Statistical pattern recognition, Classification principle, Classifier setting, Classifier learning, Support Vector Machines, Cluster Analysis, Neural Nets, Feed-forward networks, Unsupervised learning, Hopfield neural nets. **Text 2: Chap 9, pp.380-409.**

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Assess image formation and the role of human visual system in terms of gray and color image data.
CO2	Apply image processing techniques in the Spatial and frequency domain.
CO3	Describe the color models and their role in various image processing applications
CO4	Apply the basic concepts of Segmentation for suitable applications.
CO5	Implement Object recognition techniques suitable for classification

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Text Books:

1.	Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 3 rd Edn, Pearson Education, 2009.
2.	Image Processing, Analysis and Machine Vision, Milan Sonka, Vaclav Hlavac, Roger Boyle, 4 th Edn, Cengage Learning, 2013.

Reference Books:

1.	Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2014.
2.	Fundamentals of Digital Image Processing- A K Jain, PHI Learning Private Limited 2014.

Weblinks and Video lectures (e-Resources):

1.	NPTEL Course on Computer Vision And Image Processing - Fundamentals And Applications - https://onlinecourses.nptel.ac.in/noc26_ee31/preview
2.	Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
3.	NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
4.	Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Cryptography		
Course Code	BEC613D	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. To understand fundamental concepts of computer security and classical encryption techniques. 2. To develop knowledge of number theory and finite fields for cryptographic applications. 3. To analyze symmetric key cryptographic algorithms such as DES and AES. 4. To understand principles of public-key cryptography including RSA and Diffie–Hellman key exchange. 5. To learn cryptographic hash functions and design pseudo-random sequence generators for stream cipher systems.			
Module-1	Introduction	9 hrs	
Computer Security Concepts, A Model for Network Security Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Steganography. (Text 1)			
Module-2	Basic Concepts of Number Theory and Finite Fields	9 hrs	
Divisibility and The Division Algorithm Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form GF(p), Polynomial Arithmetic, Finite Fields of the Form GF(2 ^m) (Text 1)			
Module-3	Block Ciphers	9 hrs	
Traditional Block Cipher structure, Data encryption standard (DES) The AES Cipher. More on Number Theory: Prime Numbers, Fermat’s and Euler’s theorem, discrete logarithm. (Text 1)			
Module-4	Asymmetric Ciphers	9 hrs	
Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1)			
Module-5	Cryptographic Hash functions	9 hrs	
Application of cryptographic Hash Functions, Secure Hash Algorithm (Text 1)			

Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, Rambutan, Additive generators. **(Text 2)**

Self-study component: Students shall independently explore emerging trends, tools, and applications in Network Security through literature surveys, online courses, technical articles, case studies, and hands-on activities.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply traditional cryptographic algorithms for encryption and decryption process
CO2	Apply symmetric and asymmetric cryptographic algorithms to encrypt and decrypt the data.
CO3	Implement concepts of modern algebra in cryptographic algorithms and hash function.
CO4	Design pseudo random sequence generation algorithms for stream cipher systems.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests each of 50 marks, scaled down to 30 marks.
Alternate Assessment (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.

- The minimum marks to be secured in CIE are 20 out of allotted 50 marks to appear for SEE, with minimum 40 % scored in every component of CIE.

Text Books:

1.	William Stallings, “Cryptography and Network Security Principles and Practice”, Pearson Education Inc., 6 th Edition, 2014, ISBN: 978-93-325-1877-3
2.	Bruce Schneier, “Applied Cryptography Protocols, Algorithms, and Source code in C”, Wiley Publications, 2 nd Edition, ISBN: 9971-51-348-X.

Reference Books:

1.	Behrouz A Forouzan, "Cryptography and Network Security", TMH, 2007.
2.	Atul Kahate, "Cryptography and Network Security", TMH, 2003.

Web links and Video Lectures (e-Resources):

1.	https://nptel.ac.in/courses/106105031
----	---

Activity Based Learning (Suggested Activities in Class)/Practical Based learning:

1.	Programming Assignments / Mini Projects can be given to improve programming skills.
----	---

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Internet of Things		
Course Code	BEC654A	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the concepts of IoT and its applications in today’s scenario. 2. Study the IoT network architecture and design. 3. Understand IoT content generation and transport through networks use cases of IoT. 4. Understand the devices employed for IoT data acquisition			
Module-1	Introduction to IoT		9 hrs
Genesis of IoT, IoT and Digitization, IoT Impact – Connected Roadways, Connected Factory, Smart Connected Buildings, Smart Creatures, Convergence of IT and OT, Challenges. IoT Network Architecture and Design: Drivers behind new network Architectures, Simplified IoT Architecture. Text 1: Chapter 1 and 2			
Module-2	IoT Network Architecture and Design		9 hrs
Core IoT Functional Stack, Things Layer, Communication Network Layer – Access Network Sublayer, Gateways and Backhaul Sublayer, Network Transport Sublayer, IoT Network Text 1: Chapter 2			
Module-3	Engineering IoT Networks-1		9 hrs
Things in IoT – Sensors, Actuators, MEMS and Smart Objects. WSN, Communications Criteria - Range, Frequency Bands, Power Consumption, Topology, Constrained Devices. Standard Alliances (LTE Cat0, Cat-M) Text 1: Chapter 3			
Module-4	Engineering IoT Networks-2		9 hrs
IP as IoT Network Layer – Key advantages of IP. Application Protocols for IoT – Transport Layer, IoT Application Layer Protocols (CoAP, MQTT). Data and Analytics for IoT – structured and Unstructured data, Data in motion versus data at rest, IoT Data Analytics Overview and Challenge. Text 1: Chapter 5			
Module-5	IoT Use Cases		9 hrs
Home Automation: Smart lighting, home intrusion detection. Cities: Smart Parking. Environment: Weather Monitoring System, Air pollution monitoring. Agriculture: Smart irrigation. Text 2: Chapter 9			

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the fundamental concepts of IoT architecture to identify and utilize appropriate IoT devices.
CO2	Analyze the sensor data generated and map it to IoT protocol stack for transport.
CO3	Apply communications knowledge to facilitate transport of IoT data over various available communications media.
CO4	Implement a real-life IoT use case by applying sensing, data transmission, server-side analysis, and device-level actuation.
CO5	Apply knowledge of Information technology to design the IoT applications.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, “Cisco, IoT Fundamentals – Networking Technologies, Protocols, Use Cases for IOT”, Pearson Education; First edition 2017, ISBN: 978-9386873743.
2.	Arshdeep Bahga and Vijay Madisetti, “Internet of Things – A Hands-on Approach”, Orient Blackswan Private Limited - New Delhi; First edition

Reference Books:

1.	Internet of Things-From Research and innovation to Market deployment-Ovidiu Vermesan and Peter Friess.
2.	Catarina Reisand Marisada Silva Maximiano, “Internet of Things- Advanced application in healthcare”.

Weblinks and Video Lectures (e-Resources):

1.	https://nptel.ac.in/courses/108108123
----	---

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Introduction to Quantum Computing		
Course Code	BEC654B	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Introduce the fundamental concepts of classical information theory, Shannon entropy, and the four main verticals of modern quantum technologies. 2. Establish the Dirac bra-ket formalism, vector spaces, and foundational inner product properties that define quantum bits (qubits) and quantum states. 3. Master the algebraic operations, matrix representations, and spectral properties of crucial quantum operators, specifically focusing on the Pauli, Hermitian, and Unitary matrices. 4. Develop the mathematical mechanics of multi-qubit systems using tensor products and analyze the design and functionality of single-qubit and classical logic gates.			
Pre-requisites: <i>Quantum Physics (Available in BPHYE102/202-Engineering Physics)</i>			
Module-1	Introduction to Information Theory and Quantum Technologies		9 hrs
Classical Information, Information Content in a Signal, Probability Basics. Four verticals of quantum Technologies, Comparison of classical and Quantum computing. Text 1: Chapter 1			
Module-2	Qubits and Quantum States		9 hrs
Quantum bits, Vector spaces Linear combination of vectors, Basis and Dimension, Inner Products, Outer product, Orthonormality, Bra-Ket Formalism. Text 1: Chapter 2			
Module-3	Matrices		9 hrs
The Pauli Matrices, Representations of Operators Using Matrices and Matrix Representations, Matrix Representation of Operators in Two-Dimensional Spaces. Text 1: Chapter 3			
Module-4	Operators		9 hrs
The Pauli Operators, Hermitian, Unitary, and Normal Operators, Hermitian Operator, Unitary Operator, Normal Operator, Eigenvalues and Eigenvectors, The Characteristic Equation, Computing Inner Products. Text 1: Chapter 3			
Module-5	Quantum Gates and Algorithms		9 hrs

Tensor Products of Column Vectors Operators and Tensor Products, Tensor Products of Matrices, Classical Logic Gates, Single-Qubit Gates, Multi Qubit Gates. Quantum algorithms
Text 1: Chapter 4 and 8

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Demonstrate the quantum information concepts using Shannon entropy and identify the primary commercial verticals of quantum technologies.
CO2	Represent single-qubit states mathematically using vector spaces, bases, and Dirac bra-ket notation.
CO3	Compute eigenvalues, eigenvectors, and inner products for Pauli, Hermitian, and Unitary operators in multi-dimensional spaces.
CO4	Apply tensor products to multi-qubit states/matrices and analyze the operations of fundamental classical and single-qubit quantum gates.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Quantum Computing Explained- David McMohan, Wiley-interscience A John Wiley & Sons, Inc., Publication,2007.
----	---

Reference Books:

1.	Lecture notes on Quantum Computation, John Preskill, Caltech Physics 2019.
2.	An Introduction to Quantum Computing, Phillip Kaye, Raymond Loflamme and Michele Mosco, Oxford University Press- 2007.

Weblinks and Video Lectures (e-Resources):

1.	https://nptel.ac.in/courses/106106232
2.	https://www.ibm.com/think/topics/quantum-computing

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Verilog HDL		
Course Code	BEC654C	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Learn different Verilog HDL constructs. 2. Familiarize the different levels of abstraction in Verilog. 3. Understand Verilog Tasks and Functions. 4. Understand Timing and Delay Simulation.			
Module-1	Overview of Digital Design with Verilog HDL	9 hrs	
Evolution of Computer-Aided Digital Design (CAD), Emergence of HDLs, Typical Design flow, Importance of HDLs, Popularity of Verilog HDL, Trends in HDLs. (Text 1: 1.1 to 1.6) Gate-Level Modeling: Gate Types-Modeling using basic Verilog gate primitives, Description of AND/OR and BUF/NOT type gates. Gate Delays-Rise, Fall and Turn-Off Delays, Min, Max and Typical Delays. (Text1: 5.1, 5.2)			
Module-2	Hierarchical Modeling Concepts	9 hrs	
Design Methodologies, Top-down and Bottom-up design methodology, Modules, Instances, Components of a Simulation, Design Block, Stimulus Block (Test Bench) with example. (Text 1:2.1 to 2.6) Basic Concepts: Lexical Conventions, Data Types, System Tasks, Compiler Directives. (Text 1: 3.1 to 3.3). Modules and Ports: Modules, Ports, Connecting Ports, Hierarchical Names. (Text 1: 4.1 to 4.3)			
Module-3	Dataflow Modeling	9 hrs	
Continuous assignments, Delay Specification, Expressions, Operators, Operands, Operator Types, Examples (Text 1: 6.1 to 6.5)			
Module-4	Behavioral Description	9 hrs	
Structured Procedures, Initial and Always statements, Procedural Assignments Blocking and Non-Blocking statements, Conditional statements, Multiway Branching, Loops, Sequential and Parallel blocks, Examples-4-to-1 Multiplexer, 4-bit Counter. (Text 1: 7.1, 7.2, 7.4, 7.5, 7.6, 7.7, 7.9.1, 7.9.2)			
Module-5	Structural Description	9 hrs	

Tasks and Functions: Differences between Tasks and Functions, Declaration and Invocation, Examples (**Text 1: 8.1, 8.2, 8.2.1, 8.2.2, 8.3, 8.3.1, 8.3.2**)
Stimulus and Response: Reference signals, Simple stimulus, Simple output (**Text 2: 5.1, 5.2, 5.3**)

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Demonstrate the Verilog HDL Design Flow.
CO2	Describe the Basic Concepts of Verilog HDL Programming.
CO3	Develop Verilog programs in Gate, Dataflow, Behavioural, and structural modeling levels of Abstraction.
CO4	Develop efficient Verilog programs using Verilog Tasks and Functions and verify using test bench.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE-IA Tests(A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Assessment and Quiz scaled to 20 marks.
Total CIE Theory (A+B)	50	20	Marks of Tests and Assignments awarded for a maximum of 30.
SEE(C)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE+SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B, and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Verilog HDL: A Guide to Digital Design and Synthesis”, Samir Palnitkar, Pearson education, Second edition.
2.	“Writing Testbenches: Functional Verification of HDL Models” 2 nd Edition”, Janinick Bergeron, Kulwer Academic Publishers, 2003

Reference Books:

1.	Donald E. Thomas, Philip R. Moorby, “The Verilog Hardware Description Language”, Springer Science+Business Media, LLC, Fifth edition.
2.	Michael D. Ciletti, “Advanced Digital Design with the Verilog HDL” Pearson (Prentice Hall), Second edition.
3.	Padmanabhan, Tripura Sundari, “Design through Verilog HDL”, Wiley, 2016 or earlier

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Basic VLSI Design		
Course Code	BEC654D	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. This course deals with analysis and design of digital CMOS integrated circuits. 2. The course emphasizes on basic theory of digital circuits, design principles and techniques for digital design blocks implemented in CMOS technology. 3. This course will also cover switching characteristics of digital circuits along with delay and power estimation. 4. Understanding the CMOS sequential circuits and memory design concepts.			
Module-1	Introduction to CMOS Circuits	9 hrs	
Introduction, A brief History, MOS Transistors, MOS Transistor switches, CMOS Logic, Circuit and System Representation. Text 1: Chapter 1			
Module-2	MOS Transistor Theory	9 hrs	
n-MOS enhancement transistor, p-MOS transistor, Threshold Voltage, Threshold voltage adjustment, Body effect, MOS device design equations, Second Order Effects, V-I characteristics, CMOS inverter DC characteristics, Noise margin, Alternate CMOS inverters. Transmission gate Tristate Inverter. Text 1: Chapter 2			
Module-3	CMOS Process Technology	9 hrs	
Silicon Semiconductor Technology: An overview, Basic CMOS Technology, Layout Design Rules. Scaling of MOS transistor Dimensions. Text 1: Chapter 3			
Module-4	CMOS Circuit and Logic Design	9 hrs	
Introduction, CMOS Logic Gate design, Basic Physical Design of simple Logic Gates-Inverter, NAND and NOR gates. CMOS Logic structures, CMOS Complementary logic, Dynamic CMOS logic, Clocked CMOS Logic, Pass transistor Logic, CMOS Domino Logic. Text 1: Chapter 5			
Module-5	Sequential MOS Logic Circuits	9 hrs	
Introduction, Behaviour of Bistable Elements (Excluding Mathematical analysis) SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, Clocked SR Latch, Clocked JK Latch. Text 2: Chapter 8			

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the fundamental knowledge of MOS transistors to the design of digital CMOS integrated circuits
CO2	Apply the basic theory of MOS transistors to analyze the DC characteristics of CMOS logic circuits
CO3	Evaluate CMOS process technology, layout design rules, and scaling concepts to determine their impact on circuit performance.
CO4	Analyze and design other CMOS logic circuits
CO5	Apply sequential CMOS logic concepts to design and evaluate basic memory elements.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE-IA Tests(A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Assessment and Quiz scaled to 20 marks.
Total CIE Theory (A+B)	50	20	Marks of Tests and Assignments awarded for a maximum of 30.
SEE(C)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be before 3 hours.
CIE+SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B, and C.
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Neil H. E. Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design" A Systems Perspective, 2 nd Edition, Pearson Education
----	--

2.	“CMOS Digital Integrated Circuits: Analysis and Design”, Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill.
----	---

Reference Books:

1.	“CMOS VLSI Design- A Circuits and Systems Perspective”, Neil H E Weste, and David Money Harris 4th Edition, Pearson Education.
2.	“Basic VLSI Design”, Douglas A Pucknell, Kamran Eshraghian, 3rd Edition, Prentice Hall of India publication, 2005.

Web links and Video Lectures (e-Resources):

1	https://www.youtube.com/watch?v=oL8SKNxEaHs&list=PLLy_2iUCG87Bdulp9brz9AcvW_TnFCUmM
2	https://www.youtube.com/watch?v=lRptlfCHd8Y&list=PLCmoXVuSEVHIEJi3SwdyJ4EICffuyqpk
3	https://www.youtube.com/watch?v=yLqLD8Y4-Qc

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	ADVANCED COMMUNICATION LAB		
Course Code	BECL606	CIE Marks	50
L: T: P	0: 0: 2	SEE Marks	50
Credits	1	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> - Design of basic digital modulation techniques using electronic hardware. - Simulate vector computations and derive the orthonormal basis set using Gram Schmidt procedure. - Simulate the digital transmission and reception in AWGN channel - Simulate the digital modulations using software and display the signals and its vector representations. - Implement the source coding algorithms using a suitable software platform.			
Sl. No	Experiments		
	Part 1: Hardware Experiments		
1	Generation and demodulation of the Amplitude Shift Keying signal.		
2	Generation and demodulation of the Phase Shift Keying signal.		
3	Generation and demodulation of the Frequency Shift Keying signal.		
4	Generation of DPSK signal and detection of data using DPSK transmitter and receiver		
5	Generation of QPSK signal and detection of data using QPSK transmitter and receiver		
6	Generation of PN sequence.		
	Part 2: Simulation Experiments (Use MOKU-GO / MATLAB / Scilab / LabVIEW or any other suitable software)		
7	Encoding and Decoding of binary data using Huffman code.		
8	Encoding and Decoding of binary data using a Hamming code.		
9	For a given data, use the CRC-CCITT polynomial to obtain the CRC code. Verify for the cases, a) Without error b) With error.		
10	Encoding and Decoding of binary data using Convolution code.		
11	Generate 16-QAM Modulation and obtain the QAM constellation.		

12	Simulation of binary baseband signals using a rectangular pulse and estimate the BER for AWGN channel using matched filter receiver.
----	--

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Design the basic digital modulation and demodulation circuits for different engineering applications
CO2	Design of optimum communication receivers for AWGN channels.
CO3	Illustration of different digital modulations using the signals and its equivalent vector representations
CO4	Implement the source coding and channel coding procedures using suitable software.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

1	Herbert Taub, Donald L Schilling, Goutam Saha, “Principles of Communication Systems”, Mc Graw Hill Education, 2013, ISBN: 978-1-25-
2	B. P Lathi, Zhi Ding, “Modern Digital and Analog Communication Systems” 4th Edition, Oxford University



ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Tools For Technical Writing and Patenting		
Course Code:	BECT657A	CIE Marks	50
(L: T: P) + SL	(1: 0: 0) + 15 Hours / Sem	SEE Marks	50
Credits:	1	Exam Hours	2
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> <i>Course Learning objectives:</i> 1. Understand the fundamentals of technical and scientific writing used in research and professional contexts. 2. Develop skills to structure, write, and revise scientific manuscripts using standard conventions. To learn the techniques to enhance testability of combinational circuits. 3. Apply ethical research practices including proper citation, plagiarism avoidance, and responsible use of sources. 4. Gain knowledge of research dissemination, journal selection, and grant proposal preparation. 5. Enhance oral, visual, and digital communication skills for effective science communication.			
Module-1	Technical writing and its importance	3 hrs	
What is technical writing, and why it is important? Nature and importance of technical writing, differences between technical writing and technical communication, Clarity, conciseness, tone in engineering documents. Learning Activity: Discussion on real-world examples of scientific communication success and failures.			
Module-2	Writing Scientific Papers	3 hrs	
Writing Scientific Papers: Structure of a scientific manuscript using the IMRaD structure (Introduction, Methods, Results, Discussion), Developing clear, concise, and informative titles and abstracts, Designing and presenting effective tables and figures for data clarity, Writing an impactful discussion and conclusion, Standard tools for plagiarism. Learning Activity: Peer review of a short research article draft			
Module-3	Research Dissemination and Grant Proposal Writing	3 hrs	
Research Dissemination and Grant Proposal Writing: Choosing the right journal for publication, Understanding impact factors and journal metrics, Types of grants and funding agencies (Government, Industry, Private Foundations), Key components of a grant proposal (Title, Summary, Objectives, Methodology, Budget)			

Learning Activity: Writing and reviewing a mini-grant proposal		
Module-4	Presenting Science	3 hrs
Talks, Posters, and Digital Platforms: Designing and delivering a compelling scientific talk, creating engaging and visually appealing slides, Poster design and presentation tips, Science communication through social media (Twitter, LinkedIn, YouTube). Learning Activity: Students present a short research talk and receive feedback		
Module-5	Digital tools	3 hrs
Creating effective infographics and scientific illustrations, Using AI tools for scientific communication, Video abstracts and science podcasts. Indian Patent advanced search system: Patent search, patent e-register, application status. Learning Activity: Designing an infographic or short video on a scientific topic		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Explain the principles of technical and scientific writing, including clarity, conciseness, tone, and audience awareness.
CO2	Prepare well-structured scientific documents such as research papers, abstracts, figures, and tables following standard formats.
CO3	Apply ethical writing practices by managing citations correctly and avoiding plagiarism in academic and professional writing.
CO4	Analyse publication venues, journal metrics, and funding opportunities, and develop basic grant proposals.
CO5	Design and deliver effective scientific presentations using oral, visual, poster, and digital communication platforms.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks

SEE (C)	50	18	Question Paper having 50 MCQs with each question carrying 01 mark, and exam duration shall be for 2 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Folk, Matthew. "Introduction to Technical Writing A Rhetorical Approach".
2.	Will Fleming TPW: Technical & Professional Writing

Reference Books:

1.	Alley, M. (2018). The Craft of Scientific Writing. Springer.
2.	Day, R. A., & Gastel, B. (2011). How to Write and Publish a Scientific Paper. Cambridge University Press.
3.	Montgomery, S. (2003). The Chicago Guide to Communicating Science. University of Chicago Press.
4.	Gastel, B., & Day, R. A. (2016). How to Write and Publish a Scientific Paper. Greenwood.

Weblinks and Video Lectures:

1.	https://youtube.com/@introductiontoprofessional1456?si=dLnKQCxrt0eEFvPt
----	---

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Introduction to Photonics		
Course Code	BECT657B	CIE Marks	50
(L: T: P) + SL	(1: 0: 0) + 15 Hours / Sem	SEE Marks	50
Credits	1	Exam Hours	2
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the fundamental principles of optoelectronics, electromagnetic wave propagation, and optical wave behaviour in dielectric media. 2. Analyze planar slab waveguides and explain optical mode confinement, guided modes, and numerical aperture in optical waveguides. 3. Examine different types of dispersion in optical waveguides and evaluate their influence on signal propagation and transmission performance. 4. Interpret optical losses and nonlinear effects in dielectric waveguides, including absorption, scattering, and effective index concepts. 5. Design and analyze different optical waveguide structures such as rib, ridge, and slot waveguides for photonic integrated circuit applications.			
Module-1	Fundamental of Optoelectronic	3 hrs	
The Wave Equation, Phase Velocity, Group Velocity, Boundary Conditions, Total Internal Reflection. (No quantitative analysis). Text 1			
Module-2	Planar Slab Waveguide	3 hrs	
Analysis of the Planar waveguide, Optical Mode Confinement, Symmetric Waveguide, Properties of Mode, Guided Modes in Waveguide, Numerical Aperture. Text 1			
Module-3	Dispersion in Waveguides	3 hrs	
Types of Dispersion, Material dispersion, Group index & Group delay, Group Velocity dispersion, Modal dispersion, Waveguide dispersion. Text 1			
Module-4	Step-Index Circular Waveguides	3 hrs	
Field Distribution in the step index fiber, Spatial Modes, Normalized Frequency (V number), Cutoff, Total number of modes in a step-index waveguide. Text 1			
Module-5	Waveguide Modulators	3 hrs	
Electrooptic Modulators and Electrooptic effect, Electrooptic Intensity modulators, Interferometric Modulators, Fabry-Perrot Modulator, Mach Zender Modulator. Text 1			

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the fundamental principles of optoelectronics including Maxwell's equations, wave propagation, phase velocity, group velocity, and total internal reflection relevant to photonic integrated circuits
CO2	Analyze planar slab waveguides and interpret optical mode confinement, guided modes, numerical aperture, and propagation characteristics in symmetric waveguides.
CO3	Evaluate different dispersion mechanisms in optical waveguides including material, modal, and waveguide dispersion for single mode propagation.
CO4	Analyze propagation losses and evaluate nonlinear effects in dielectric waveguides using effective index concepts for photonic device applications
CO5	Design and compare different slab waveguide structures such as rib, ridge, and slot waveguides for photonic integrated circuit applications

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	Question Paper having 50 MCQs with each question carrying 01 mark, and exam duration shall be for 2 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Clifford R. Pollock, “Fundamentals of Optoelectronics,” School of Electrical Engineering, Cornell University.
----	---

Reference Books:

1.	B. E. A. Saleh, M. C. Teich, “Fundamentals of Photonics,” 3 rd Edition, Wiley
----	--

Weblinks and Video Lectures:

1.	https://nptel.ac.in/courses/108108174
2.	https://www.youtube.com/watch?v=ThTV95wZmlY&list=PLgMDNELGJ1CaJDi4aONDYB2afOB6YRIm7

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Advanced IoT		
Course Code	BECL657C	CIE Marks	50
(L: T: P)	(0: 0: 2)	SEE Marks	50
Credits	1	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the fundamentals of IoT systems, sensors, actuators, and ESP32-based embedded platforms. 2. Develop programs to interface sensors, displays, and actuators using wired communication protocols such as UART, I2C, and SPI. 3. Implement cloud-based IoT applications using ThingSpeak, MQTT, TCP, and UDP protocols. 4. Design IoT solutions for data acquisition, monitoring, and remote-control applications. 5. Analyze the performance of communication protocols used in IoT systems.			
Sl. No	List of Experiments		
1	To study and implement UART communication between ESP32 and a PC for transmitting and receiving sensor data.		
2	To interface an OLED display with ESP32 using the I2C protocol and display temperature and humidity readings from a DHT11 sensor.		
3	To interface the motor using a relay with Arduino /Raspberry Pi and write a program to 'turn ON' the motor when a push button is pressed.		
4	To interface an SPI-based OLED/TFT display with ESP32 and display sensor readings.		
5	To develop a multi-sensor monitoring system using ESP32 and an I2C OLED display to acquire and display data from LDR, soil moisture, and DHT11 sensors.		
6	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.		
7	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.		
8	Write a program to interface LED using Telegram App..		
9	Write a program on Arduino/Raspberry Pi to publish temperature data to the MQTT broker.		

10	Write a program to create a UDP server on Arduino/Raspberry Pi and respond with humidity data to the UDP client when requested.
11	Write a program to create a TCP server on Arduino /Raspberry Pi and respond with humidity data to the TCP client when requested.
12	Write a program on Arduino / Raspberry Pi to subscribe to the MQTT broker for temperature data and print it.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Implement sensor and actuator interfacing applications using ESP32 and embedded programming techniques.
CO2	Develop IoT applications using wired communication protocols such as UART, I2C, and SPI for data acquisition and display.
CO3	Construct cloud-connected IoT systems using ThingSpeak and MQTT protocols for data publishing and monitoring.
CO4	Analyze the operation of TCP, UDP, MQTT, and cloud communication protocols in IoT applications.
CO5	Design and integrate complete IoT-based monitoring and control systems using ESP32, sensors, actuators, and communication networks.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam conducted for 100 marks and scaled down to

			50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			



ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Data Analytics Lab using Python		
Course Code	BECL657D	CIE Marks	50
(L: T: P)	(0: 0: 2)	SEE Marks	50
Credits	1	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand core concepts of data analytics and recognize the role of Python in data-driven decision making. 2. Perform data pre-processing and data visualization. 3. Implement statistical and analytical techniques. 4. Develop real-world problem-solving skills.			
Sl. No	Problems		
	Note: Python programming to be carried out to obtain solutions		
1	Fetch the data elements (specific row/s, column/s, from a location, specific group of elements, elements of specific type/s) from a dataset provided in a table.		
2	Perform data visualization through bar chart, pie chart, histogram, scatter plot, etc. from a dataset provided in a table.		
3	Solve the problems related to Discrete (Binomial and Poisson) and Continuous (Uniform and Normal) probability distributions. Example problems are given below: A survey found that 60 percent of all consumers were very satisfied with the quality of the electronic toy manufactured by a PQR company. Suppose that 25 consumers are sampled and if survey result still holds true today, what is the probability that exactly 18 are satisfied with the quality? Suppose customers arrive randomly on weekday afternoons at a restaurant with an average of 5 customers every 8 minutes. What is the probability of having more than 7 customers in a 8-minute interval on a weekday afternoon? Suppose the amount of time it takes to assemble a plastic module range from 28 to 40 seconds and that assembly times are uniformly distributed. Describe the distribution. What is the probability that a given assembly will take 33 to 36 seconds? What is the probability of obtaining a score greater than 675 in a competitive examination which has mean score of 375 and a standard deviation of 90? Assume the scores are normally distributed.		

4	Assume that a sample of 40 edible oil packets provides a sample mean of 504 ml. The population standard deviation is believed to be 8 ml. Perform a hypothesis test, at the 0.03 level of significance, population mean of 500 ml and to help determine whether the filling process should continue operating or to be stopped and corrected. What if the sample mean is 506 ml? In a city, the traffic police reported that 50% of the accidents were caused due to drunk and driving. A sample of 150 accidents showed that 80 were caused due to drunk and driving. Use these data to test the police's claim with $\alpha = 0.05$.																											
5	A product developer is interested in reducing the drying time of a primer paint. Two formulations of the paint are tested. Formulation 1 is the standard chemistry and formulation 2 has a new drying ingredient that should reduce the drying time. From experience, it is known that the standard deviation of drying time is 8 minutes and inherent variability should be unaffected by the addition of the new ingredient. Ten specimens are painted with formulation 1 and another 10 specimens are painted with formulation 2, the 20 specimens are painted in random order. The two-sample average drying times are $\bar{x}_1=121$ minutes and $\bar{x}_2=112$ minutes, respectively. What conclusions can the product developer draw about the effectiveness of the new ingredient, using $\alpha=0.5$? <i>[Source: Applied Probability and Statistics for Engineers by Douglas C Montgomery and George C. Runger, John Wiley, 3rd Ed, 2003]</i>																											
6	Two catalysts are being analysed to determine how they affect the mean yield of a chemical process. Specifically, catalyst 1 is currently in use, but catalyst 2 is acceptable. Since catalyst 2 is cheaper, it should be adopted, provided it does not change the process yield. A test is run in the pilot plant and results are shown in Table Q6. Is there any difference between mean yields? Use $\alpha = 0.05$ and assume equal variances. <i>[Source: NPTEL Course titled, "Data Analytics with Python" by Dr. A. Ramesh, Department of Management Studies, IIT Roorkee]</i> <table><caption>Table Q6</caption><tr><th>Observation number</th><th>Catalyst 1</th><th>Catalyst 2</th></tr><tr><td>1</td><td>91.5</td><td>89.19</td></tr><tr><td>2</td><td>94.18</td><td>90.95</td></tr><tr><td>3</td><td>92.18</td><td>90.46</td></tr><tr><td>4</td><td>95.39</td><td>93.21</td></tr><tr><td>5</td><td>91.79</td><td>97.19</td></tr><tr><td>6</td><td>89.07</td><td>97.04</td></tr><tr><td>7</td><td>94.72</td><td>91.07</td></tr><tr><td>8</td><td>89.21</td><td>92.75</td></tr></table>	Observation number	Catalyst 1	Catalyst 2	1	91.5	89.19	2	94.18	90.95	3	92.18	90.46	4	95.39	93.21	5	91.79	97.19	6	89.07	97.04	7	94.72	91.07	8	89.21	92.75
Observation number	Catalyst 1	Catalyst 2																										
1	91.5	89.19																										
2	94.18	90.95																										
3	92.18	90.46																										
4	95.39	93.21																										
5	91.79	97.19																										
6	89.07	97.04																										
7	94.72	91.07																										
8	89.21	92.75																										
7	A team of engineers decides to investigate four levels of hardwood concentration: 5%, 10%, 15% and 20%. They decide to make up six test specimens at each																											

	concentration level, using a pilot plant. All 24 specimens are tested on a laboratory tensile tester in random order. The data from this experiment are shown in Table Q7. <i>[Source: NPTEL Course titled, “Data Analytics with Python” by Dr. A. Ramesh, Department of Management Studies, IIT Roorkee]</i> Table Q7 <table><tr><th>Hardwood concentration 5%</th><th>Hardwood concentration 10%</th><th>Hardwood concentration 15%</th><th>Hardwood concentration 20%</th></tr><tr><td>7</td><td>12</td><td>14</td><td>19</td></tr><tr><td>8</td><td>17</td><td>18</td><td>25</td></tr><tr><td>15</td><td>13</td><td>19</td><td>22</td></tr><tr><td>11</td><td>18</td><td>17</td><td>23</td></tr><tr><td>9</td><td>19</td><td>16</td><td>18</td></tr><tr><td>10</td><td>15</td><td>18</td><td>20</td></tr></table> Analysis of variance (ANOVA) to test the hypothesis that hardwood concentrations do not affect the mean tensile strength of the paper.	Hardwood concentration 5%	Hardwood concentration 10%	Hardwood concentration 15%	Hardwood concentration 20%	7	12	14	19	8	17	18	25	15	13	19	22	11	18	17	23	9	19	16	18	10	15	18	20
Hardwood concentration 5%	Hardwood concentration 10%	Hardwood concentration 15%	Hardwood concentration 20%																										
7	12	14	19																										
8	17	18	25																										
15	13	19	22																										
11	18	17	23																										
9	19	16	18																										
10	15	18	20																										
8	Table Q8 shows data from 20 cases, wherein the auto-rickshaw fare is listed against the number of kilometres travelled in a city. The auto-rickshaw fare is based on base charge, approximate expense plus profit as calculated by rickshaw owner. However, the city administration wants to standardize the fare calculation by using linear regression. Using the data, obtain a scatter plot and come up with a linear equation as a result of regression. Table Q8 <table><tr><th>Case number</th><th>Kilometre travelled</th><th>Fare</th></tr><tr><td>1</td><td>0.5</td><td>30</td></tr><tr><td>2</td><td>1</td><td>32</td></tr><tr><td>3</td><td>1.5</td><td>33</td></tr><tr><td>4</td><td>2</td><td>35</td></tr></table>	Case number	Kilometre travelled	Fare	1	0.5	30	2	1	32	3	1.5	33	4	2	35													
Case number	Kilometre travelled	Fare																											
1	0.5	30																											
2	1	32																											
3	1.5	33																											
4	2	35																											

		5	3	58																					
		6	3.5	66																					
		7	4	85																					
		8	5	103																					
		9	5.2	105																					
		10	5.6	110																					
		11	6	120																					
		12	6.5	132																					
		13	7	143																					
		14	7.3	148																					
		15	8	155																					
		16	8.5	165																					
		17	9	175																					
		18	9.5	183																					
		19	9.7	187																					
		20	10	190																					
9	Table Q9 shows data from 20 cases, wherein the decision to go to movie has been taken based on the three input variables (Free-time, Rain and Homework done status). Come up with scatter plot and an output equation resulting from logistic regression considered for the data given in the table. If a new set of input is given, the decision shall be yes or 1, if the output is greater than 0.65. Table Q9 <table><tr><th>Case number</th><th>Free-time available in hours</th><th>Rain in mm</th><th>Homework Done=1 and Not Done = 0</th><th>Go to Movie Yes =1, No = 0</th></tr><tr><td>1</td><td>5</td><td>2</td><td>0</td><td>1</td></tr><tr><td>2</td><td>6</td><td>0</td><td>0</td><td>1</td></tr><tr><td>3</td><td>8</td><td>10</td><td>1</td><td>0</td></tr></table>					Case number	Free-time available in hours	Rain in mm	Homework Done=1 and Not Done = 0	Go to Movie Yes =1, No = 0	1	5	2	0	1	2	6	0	0	1	3	8	10	1	0
Case number	Free-time available in hours	Rain in mm	Homework Done=1 and Not Done = 0	Go to Movie Yes =1, No = 0																					
1	5	2	0	1																					
2	6	0	0	1																					
3	8	10	1	0																					

	4	6	5	1	1																
	5	10	10	0	1																
	6	12	3	1	1																
	7	4	4	1	1																
	8	5	4	0	0																
	9	8	0	1	1																
	10	7	2	1	1																
	11	6	10	1	0																
	12	4	0	1	1																
	13	4	1	1	1																
	14	12	20	1	0																
	15	12	0	1	1																
	16	9	5	0	0																
	17	9	4	1	1																
	18	2	0	1	0																
	19	3	0	1	0																
	20	8	18	1	0																
	10	Table Q10 shows data from 20 samples, wherein the feature values of each sample have been listed. Obtain the scatter plot and perform the k-means clustering analysis (k=2) to determine the cluster of each sample. Table Q10 <table><tr><th>Sample number</th><th>Feature 1</th><th>Feature 2</th></tr><tr><td>1</td><td>1</td><td>9.5</td></tr><tr><td>2</td><td>1.25</td><td>8.5</td></tr><tr><td>3</td><td>2</td><td>8</td></tr><tr><td>4</td><td>6</td><td>3</td></tr></table>					Sample number	Feature 1	Feature 2	1	1	9.5	2	1.25	8.5	3	2	8	4	6	3
	Sample number	Feature 1	Feature 2																		
	1	1	9.5																		
2	1.25	8.5																			
3	2	8																			
4	6	3																			

	5	7	3
	6	9	1.5
	7	11	0.75
	8	2.5	9.5
	9	3.5	11.5
	10	4	1
	11	5	1
	12	1	6
	13	0.75	11
	14	12	0.25
	15	11	3
	16	9	2
	17	5	9
	18	2	11
	19	9	0.75
	20	7	1.5

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the operations and functions related to data handling in Python thus enabling data pre-processing.
CO2	Realize data visualization by invoking functions available in packages and libraries.
CO3	Implement statistical and analytical techniques through effective utilization of the data.
CO4	Solve the problems related to prediction and classification.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Indian Knowledge System		
Course Code:	BIKS608	CIE Marks	100
(L: T: P) + SL	(1: 0: 0) + 15 Hours / Sem	SEE Marks	--
Credits:	--	Exam Hours	--
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system. 2. To make the students understand the traditional knowledge and analyze it and apply it to their day-to-day life.			
Module-1	Introduction to Indian Knowledge Systems (IKS)	5 hrs	
Overview, Importance of ancient knowledge, The IKS corpus, Vedic Corpus, Philosophical systems, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.			
Module-2	Fundamental concepts for science and technology	5 hrs	
Linguistics, Numbers and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.			
Module-3	Traditional Knowledge in Professional Domain	5 hrs	
Town planning and architecture, Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and Public administration.			

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Provide an overview of the concept of the Indian Knowledge System and its importance.
CO2	Appreciate the need for 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.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two assessment methods as per 24RNBE4.2, scaled to 40 marks.
CIE + SEE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Text Books:

1.	Introduction to Indian Knowledge System- concepts and applications, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0M.
----	---

Reference Books:

1.	Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230
2.	Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334

Weblinks and Video Lectures:

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
6	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf

7

https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAIaIQobChMImp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE



ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	NSS-National Service Scheme		
Course Code	BNSK659	CIE Marks	100
(L: T: P)	(0: 0: 2)	SEE Marks	--
Credits	--	Exam Hours	--
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Identify the needs and problems of the community and involve in problem solving. 2. Develop a sense of social and civic responsibility and utilize knowledge in finding practical solutions to individual and community problems. 3. Develop competence required for group living and sharing of responsibilities, and gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.			
Module-1			3 hrs
Contribution to national-level initiatives of the Government of India, such as Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharat, Make in India, the Mudra Scheme, and other skill development programs.			
Module-2			3 hrs
Spreading public awareness through rural outreach programs. (minimum 5 programs)			
Module-3			3 hrs
Innovative approaches to assist in the marketing of rural produce.			
Module-4			3 hrs
Creating awareness on rainwater harvesting in Urban areas.			
Module-5			3 hrs
Creating awareness on digital payment frauds to locals			

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Identify and analyze community needs and actively participate in solving social issues through NSS activities.
-----	--

CO2	Demonstrate social and civic responsibility by engaging in national initiatives and rural outreach programs.
CO3	Develop leadership qualities, teamwork skills, and the ability to mobilize community participation effectively.
CO4	Apply innovative approaches to address real-world problems such as rural development, environmental sustainability, and digital awareness.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two assessment methods as per 24RNBE4.2, scaled to 40 marks.
CIE + SEE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Text Books:

1.	NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2.	Government of Karnataka, NSS Cell, Activities Reports and its Manual.
3.	Government of India, NSS Cell, Activities Reports and its Manual.

Web links:

1.	https://nss.gov.in/
2.	https://pledge.mygov.in/

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Physical Education		
Course Code	BPEK659	CIE Marks	100
(L: T: P)	(0: 0: 2)	SEE Marks	--
Credits	--	Exam Hours	--
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness 2. Familiarization of health-related Exercises, Sports for overall growth and development 3. Participate in the competition at regional/state / national / international levels. 4. Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.			
Module-1	Athletics – Track Events	3 hrs	
Relay Race: Starting, Baton Holding/Carrying, Baton Exchange in between zone, and Finishing			
Module-2	Athletics - Jumps	3 hrs	
Triple Jump • Approach Run • Take-off • Step, • Flight in the Hop • Jump and Landing			
Module-3	Athletics - Throws	3 hrs	
Javelin Throw • Grip • Carry and Recovery (3/5 Impulse stride). • Release			
Module-4	Cricket	3 hrs	
A. Fundamental skills • Batting - Forward Defense Stroke, Backward Defense Stroke, Off Drive, On Drive, Straight Drive, Cover Drive, Square Cut. • Bowling -Out-swing, In-swing, Off Break, Leg Break and Googly. • Fielding: Catching - The High Catch, The Skim Catch, The Close Catch and throwing at the stumps from different angles. Long Barrier and Throw, Short			

Throw, Long Throw, Throwing on the Turn. • Wicket Keeping B. Rules and their interpretation and duties of the officials		
Module-5	Basketball	3 hrs
A. Fundamental skills • Player Stances – walking, extending walking, L stance, cat stance • Grip – standard grip, choke grip • Batting – swing and bunt. Pitching • Baseball: slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball, B. Rules and their interpretation and duties of the officials		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Demonstrate the techniques of relay races, including starting, baton holding, exchange within the zone, and finishing, along with basic skills of javelin throw.
CO2	Apply the fundamental techniques of triple jump, including approach run, take-off, hop, step, jump, flight, and landing.
CO3	Develop and perform javelin throw techniques, including grip, carry, impulse stride, release, and recovery with proper coordination.
CO4	Exhibit fundamental skills of cricket, including batting, bowling, fielding, wicket keeping, and understand rules and duties of officials.
CO5	Demonstrate basic skills and techniques in baseball, including player stances, grip, batting, pitching, and understand rules and officiating.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two assessment methods as per 24RNBE4.2, scaled to 40 marks.
CIE + SEE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks

- The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.

Text Books:

1.	Health and Physical Education by V.K. Sharma
2.	Introduction to Physical Education, Fitness, and Sport by Daryl Siedentop
3.	Physical Education Activities, Sports and Games: The Origin and Background, Rules of Play, Teaching Hints and Fundamentals by Louis E. Means

Reference Books:

1.	Saraswati Health and Physical Education Textbook
2.	Foundations of Physical Education, Exercise Science and Sport by Deborah A. Wuest

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VI			
Course Title	Yoga		
Course Code	BYOK659	CIE Marks	100
(L: T: P)	(0: 0: 2)	SEE Marks	--
Credits	--	Exam Hours	--
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> 1. Physical, Mental and spiritual Objectives of Yoga 2. Explain the meaning of Yoga. 3. Discuss the importance of the Yoga and its scope. 4. Describe the aims and objectives of Yoga. 5. Clarify the misconceptions on Yoga.			
Module-1	Suryanamaskara	3 hrs	
Suryanamaskar 12 count 6 rounds • Suryanamaskar prayer. • Meaning, need & Importance • Benefits of Suryanamaskara			
Module-2	Asanas	3 hrs	
Need & importance of different Asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana. Sitting: 1. Bakasana 2. Hanumanasana 3. Yogamudra in Vajrasana Standing: 1. Vatasana 2. Garudasana			
Module-3	Asanas - Sitting and Standing	3 hrs	
Need, importance of Asana. Different types, Asana by name, technique, precautionary measures and benefits of each asana Prone line 1. Bhujangasana 2. Shalabh asana Supine line 1. Utthita dvipadasana, 2. Ardha halasana Balancing 1. Sheershasana			

Module-4	Pranayama	3 hrs
Kapalabhati - Revision of Kapalabhati practice 80 strokes/min 3 round		
Module-5	Pranayama	3 hrs
Pranayama 1. Bhastrika 2. Bhramari Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Explain the meaning, definition, scope, and objectives of Yoga and its role in physical, mental, and spiritual well-being.
CO2	Demonstrate Suryanamaskara (12 counts, 6 rounds) with correct technique and understand its importance and benefits.
CO3	Apply knowledge of yogic practices, rules, and regulations while identifying and correcting common misconceptions of Yoga.
CO4	Perform sitting, standing, and supine Asanas with proper technique, precautions, and awareness of their benefits.
CO5	Practice Pranayama techniques (Kapalabhati, Ujjayi, Sheetali) to improve breathing control, concentration, and overall health.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two assessment methods as per 24RNBE4.2, scaled to 40 marks.
CIE + SEE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Text Books:

1.	The Yoga Sutras of Patanjali – Sri Swami Satchidananda.
2.	Light on Yoga — B.K.S Iyengar.

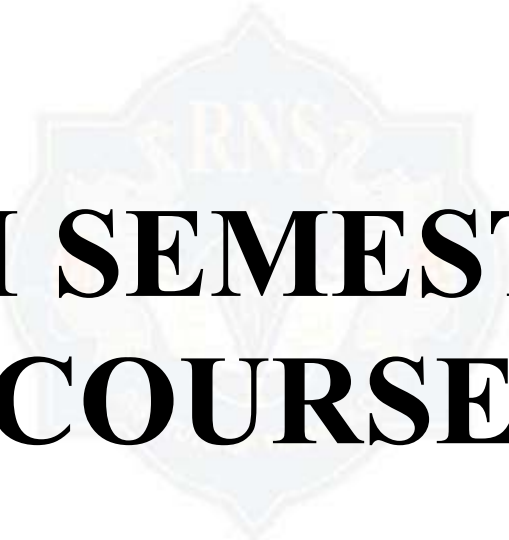
Reference Books:

1.	The Heart of Yoga — T.K.V Desikachar.
2.	Asana Pranayama Mudra Bandha by Swami Satyananda Saraswati.



ESTD : 2001

An Institute with a Difference



VII SEMESTER COURSES

ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Computer Networks		
Course Code	BEC701	CIE Marks	50
(L: T: P) + SL	(3: 0: 2) + 45 Hours / Sem	SEE Marks	50
Credits	4	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> - Understand the layering architecture of OSI reference model and TCP/IP protocol suite. - Understand the protocols associated with each layer. - Learn the different networking architectures and their representations. - Learn the various routing techniques and the transport layer services.			
Module-1	Introduction	9 hrs	
Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet. Text 1: Chapter-1(1.1, 1.2, 1.3(1.3.1- 1.3.4)). Network Models: TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP. Chapter-2 (2.2,2.3) Wired and Wireless LANs: Ethernet Protocol, Standard Ethernet. (15.1,17.2)			
Module-2	Application Layer	9 hrs	
Introduction: providing services, Application- layer paradigms, Standard Client Server Protocols: Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. Quality of Service (25.1, 26.1.2, 26.2, 26.3, 26.6, 30.1, 30.2.)			
Module-3	Transport Layer	9 hrs	
Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go- BackN Protocol, Selective repeat protocol, Piggybacking Transport-Layer Protocols in the Internet: User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Error control, TCP congestion control. (23.1, 23.2.1, 23.2.2, 23.2.3, 23.2.4, 23.2.5,24.2, 24.3.1, 24.3.2, 24.3.3, 24.3.4, 24.3.6, 24.3.8, 24.3.9)			

Module-4	Network Layer	9 hrs
Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams. IPv6 addressing and Protocol. Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing. (18.1(excluding 18.1.3), 18.2, 18.4,19.1,20.1, 20.2,22.1 and 22.2)		
Module-5	Data-Link Layer	9 hrs
Introduction: Nodes and Links, Services, Two Categories' of link, Sublayers, Link Layer addressing: Types of addresses, ARP (1.1,1.2, 1.3.1 to 1.3.4,2.2, 2.3 ,9.1, 9.2.1, 9.2.2) Data Link Control (DLC) services: Framing, Flow and Error Control. Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Virtual LANs: Membership, Configuration, Communication between Switches, Advantages. (11.1,12.1,13.1, 13.2.1 to 13.2.5)		

Practical component of IPCC:

Exp. No.	Simulation experiments using NS2/ NS3/ OPNET/ NCTUNS/ NetSim/QualNet or any other equivalent tool
Part A	
1	Implement a point to point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth.
2	Implement a four node point to point network with links n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP.
3	Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.
4	Implement Ethernet LAN using n nodes and assign multiple traffic to the nodes and obtain congestion window for different sources/ destinations.
5	Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.
6	Implementation of Link state routing algorithm
Part B	

Implement the following using programming languages C/C++ etc.	
7	Write a program for a HLDC frame to perform the following. i) Bit stuffing ii) Character stuffing.
8	Write a program for distance vector algorithm to find suitable path for transmission
9	Implement Dijkstra's algorithm to compute the shortest routing path.
10	For the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for the cases: i) without error ii) with error
11	Implementation of Stop and Wait Protocol and Sliding Window Protocol
12	Write a program for congestion control using leaky bucket algorithm.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Understand the concepts of networking thoroughly
CO2	Identify the protocols and services of different layers.
CO3	Analyze the basic network configurations and standards associated with each network.
CO4	Discuss and analyze the various applications that can be implemented on networks.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CIE Theory (A+B)	30	12	Marks of Tests and Assignments awarded for a maximum of 30.
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and

			Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	20	8	Marks of Experiments, Record and Test awarded for a maximum of 20 marks.
CIE: Theory + Practical (A+B+C)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (D)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be before 3 hours.
CIE+SEE (A+B+C+D)	100	40	Final marks shall be the sum of marks scored in Components A, B, C and D
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.			

Text Books:

1.	Forouzan, “Data Communications and Networking”, 5th Edition, McGraw Hill, 2016 ISBN: 1-25-906475-3
----	--

Reference Books:

1.	A.S Tanenbaum – “Computer Networks”, 4th Edition, PHI, 2003
2.	James J Kurose, Keith W Ross, “Computer Networks”, Pearson Education, 2013, ISBN: 0-273-76896-4
3.	Wayarles Tomasi, “Introduction to Data Communication and Networking”, Pearson Education, 2007, ISBN:0130138282

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Microwave and Antennas		
Course Code	BEC702	CIE Marks	50
(L: T: P) + SL	(3: 0: 2) + 45 Hours / Sem	SEE Marks	50
Credits	4	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> - Describe the microwave properties and its transmission media. - Describe the microwave device for several applications. - Understand the basic concepts of antenna theory. - Identify antenna type for specific applications.			
Module-1	Microwave transmission lines	9 hrs	
Microwave frequencies, Microwave devices, Microwave systems. Transmission line equations and solutions, Reflection Coefficient and Transmission Coefficient. Standing wave and standing wave ratio. Text 1: 0.1, 0.2, 0.3, 3.1, 3.2, 3.3			
Module-2	Microwave Waveguides and Components	9 hrs	
Introduction, Rectangular Waveguides: Solutions of Wave Equations in Rectangular Coordinates. Microwave Hybrid Circuits: Waveguide Tee, Magic Tees (Hybrid Trees). Directional Couplers: Two-Hole Directional Couplers, S Matrix of a Directional Coupler. Circulators and Isolators: Microwave Circulators, Microwave Isolators. Text 1: 4.1, 4.1.1, 4.4.1, 4.4.2, 4.4.3, 4.5, 4.5.1, 4.5.2, 4.6, 4.6.1, 4.6.2			
Module-3	Antenna Basics	9 hrs	
Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam efficiency, Directivity and Gain, Antenna Aperture, Effective height, Radio communication Link, Antenna Field Zones. Point Sources: Introduction, Point Source Defined, Power Patterns, A Power Theorem, Radiation Intensity Text 2: 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.9,2.10,2.11,2.13,4.1,4.2,4.3,4.4,4.5			
Module-4	Antenna arrays	9 hrs	
Arrays of Two isotropic point sources, Pattern multiplication, Linear arrays of n Isotropic sources of equal amplitude and spacing. Electric dipole: Introduction, short Electric dipole, Fields of a short dipole. Radiation resistance of a short dipole. Thin linear antenna (field analysis), small Loop, Loop Antenna-			

General case. Text 2: 4.9,4.11,4.13,5.1,5.2,5.3,5.4,6.2,6.4

Module-5	Antenna Types	9 hrs
-----------------	----------------------	--------------

Strip Lines: Introduction: Microstrip lines. Parallel Strip lines.
Patch Microstrip Antennas, Horn Antennas, Rectangular Antennas, Yagi Uda array, Paraboloidal Reflector.

Special Antennas: Antennas for mobile communication, Antenna for GPR, Embedded Antennas (qualitative Analysis)

Text 1: 11.0,11.1,11.2

Text 2: 6.18,6.19,6.20,7.7,8.7,17.25,17.26,17.27

Practical component of IPCC:

Exp. No.	Programs
1	Measurement of frequency, guide wavelength, power and attenuation in a microwave Test bench.
2	Measurement of VSWR and reflection coefficient and attenuation in a microwave test bench setup.
3	Study of characteristics of H plane Tee.
4	Study of characteristics of E plane Tee.
5	Study of characteristics of Magic Tee.
6	Determination of resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate.
7	Coupling and Isolation characteristics of microstrip directional coupler.
8	Determination of power division of microstrip power divider.
9	To plot a 2D and 3D radiation pattern of dipole Antenna (Use any simulation software).
10	Obtain the radiation pattern of a Yagi-Uda Antenna array and calculate its directivity.

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Analyze and interpret the use and advantages of microwave transmission.
CO2	Analyze various parameters related to transmission lines.

CO3	Apply microwave devices for several applications.
CO4	Analyze various antenna parameters and their significance in building the RF system.
CO5	Apply various antenna configuration for suitable applications.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CIE Theory (A+B)	30	12	Marks of Tests and Assignments awarded for a maximum of 30.
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	20	8	Marks of Experiments, Record and Test awarded for a maximum of 20 marks.
CIE: Theory + Practical (A+B+C)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (D)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall before 3 hours.
CIE+SEE (A+B+C+D)	100	40	Final marks shall be the sum of marks scored in Components A, B, C and D

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.

Text Books:

1.	Microwave Devices and Circuits- Samuel Y Liao, Pearson Education.
2.	Antennas and wave Propagation – John D Krauss, Ronald J Marhefka, Ahmad S Khan 4 th Edition, McGraw Hill Education, 2013.

Reference Books:

1.	Microwave Engineering – David M Pozar John Wiley India Pvt Ltd., 3rd edition, 2008.
2.	Microwave Engineering – Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.
3.	Microwave Engineering – Annapurna Das, Sisir K Das, TMH Publication, 2nd Edition, 2010.
4.	Antenna Theory Analysis and Design - Constantine A. Balanis Wiley India Pvt Ltd., 3rd edition, 2013

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	5G Wireless Communication		
Course Code	BEC703	CIE Marks	50
(L: T: P) + SL	(3: 2: 0) + 45 Hours / Sem	SEE Marks	50
Credits	4	Exam Hours	3
Course Learning Objectives: The objectives of the course are to facilitate the learners to: 1. Understand the essential principles of 5G communications. 2. Familiarize the 5G Network architecture and technologies 3. Analyze advanced 5G radio-access technologies, multi-user access schemes, and dense deployment scenarios. 4. Analyze 5G spectrum landscape, spectrum sharing techniques, and network slicing concepts.			
Module-1	History of 5G	9 hrs	
Historical background, 5G use cases and system concept: Use cases, requirements and key performance indicators, 5G system concept: Concept overview, extreme mobile broad band, massive machine-type communication, ultra-reliable machine-type communication, dynamic radio access network, lean system control plane, localised contents and traffic flows, spectrum tool box. Text 1			
Module-2	5G Overview	9 hrs	
The 5G Architecture: Introduction, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployment. Text 1			
Module-3	5G Architecture	9 hrs	
Characteristics of 5G, 4G Vs 5G, 5G System Architecture, 5G Deployment architecture, NG core, Network functions in NG core, Communication approach for Core Network Functions, Next Gen Radio Access Networks (NG-RAN), 5G New Radio (5G NR), Technologies accelerating 5G Radio, Small Cells. Text 2			
Module-4	The 5G radio-access technologies-1	9 hrs	
The 5G radio-access technologies: Access design principles for multi-user communications, Multi carrier with filtering: a new waveform, Non-orthogonal schemes for efficient multiple access Text 1			
Module-5	The 5G radio-access technologies-2	9 hrs	
Radio access for dense deployments, Radio access for V2X communication, Radio access for massive machine-type communication. Text 1			

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Analyze the fundamental concepts of 5G wireless communication systems to interpret its evolution.
CO2	Analyze the high-level requirements for the 5G architecture, and technological advancements.
CO3	Analyze the components of the 5G system including NG-Core, NG-RAN, 5G NR, and different deployment architectures to understand their functional roles.
CO4	Apply 5G radio-access technologies and advanced communication techniques to support high-data-rate, ultra-low-latency, and massive connectivity applications.

Assessment Details (Both CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	“5G Mobile and Wireless Communication Technology”, Afif Osseiran, Jose F Monserrat, Patrick. 2019
----	---

2.	“Introduction to 5G Wireless Networks”, Saro Velrajan, First edition, 2020, KDP ISBN: 9798643303107
----	--

Reference Books:

1.	5G Core Networks Powering Digitization, Stephen Rommer, Academic Press, 2019 ISBN: 978
2.	Wireless Communications Wireless Communications: Principles and Practice" Theodore Rappaport, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
3.	Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, Wiley, 2015, ISBN: 9781118867525.

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Wireless Sensor Networks		
Course Code	BEC714A	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: The objectives of the course are to facilitate the learners to: - To introduce the fundamentals, architecture, applications, and challenges of cellular and ad hoc wireless networks. - To provide an understanding of MAC protocol design issues and to analyze contention-based, reservation-based, and scheduling-based MAC protocols for ad hoc networks. - To study routing protocol designs challenges and classify proactive, reactive, hybrid, and hierarchical routing protocols for ad hoc wireless networks. - To explain sensor nodes, transmission technologies, and system architectures used in wireless sensor networks. - To develop the ability to simulate and evaluate wireless sensor network platforms using modern simulation tools.			
Module-1	AD HOC Wireless Networks		9 hrs
Introduction: Cellular and AD HOC wireless networks, Application of Ad Hoc wireless networks, issues in AD HOC wireless networks, Ad-hoc wireless internet. Examples of category 2 WSN applications, examples of category 1 WSN application. Text 1, Text 2			
Module-2	MAC Protocols for AD HOC Wireless Networks		9 hrs
Introduction, Issues in designing a mac protocol for AD HOC wireless networks, design goals of MAC protocols, Classification of MAC protocols, contention-based protocols (MACAW, FAMA, BTMAMARCH), contention-based protocols with reservation mechanisms (D-PRMA, CATA, HMA), contention-based protocols with scheduling mechanism (DPS, DWOP), MAC protocols using directional antennas. Text 1			
Module-3	Routing Protocols for AD HOC Wireless Networks		9 hrs
Introduction, Issues in designing a routing protocol for Ad-hoc wireless networks, classification of routing protocols, Table driven routing protocols (DSDV, WRP, CGSR), on-demand routing protocols (DSR, AOVD, LAR, ABR), hybrid routing protocols (CEDAR, ZRP, ZHLS), Hierarchical routing protocols. Text 1			

Module-4	Wireless Sensor Technology, Wireless Transmission Technology and Systems	9 hrs
Wireless Sensor Technology: Introduction, sensor node technology-overview, hardware and software, sensor taxonomy, WN operating environment, WN trends Wireless Transmission Technology and Systems: introduction, campus application, MAN/WAN applications Text 2		
Module-5	Sensor Network Platforms and Tools, Advanced Applications	9 hrs
Sensor Network Platforms and Tools: Sensor node hardware, sensor network programming challenges, node-level software platforms - tinyOS, nesC component implementation, nesC-concurrency and atomicity. Advanced Applications: Emerging applications-asset and warehouse management, automative, building monitoring, environmental monitoring, industrial process control. military battlefield awareness, security and surveillance, future research directions: secure embedded systems, light weight signal processing, networks of high data rate sensors. QOS and Energy Management: Issues and challenges in providing QOS, classifications, MAC, network layer solutions, QOS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes. Text 3		

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Acquire knowledge of the fundamentals, applications, and challenges of cellular and ad hoc wireless networks.
CO2	Analyze, classify, and evaluate MAC protocol design challenges and solutions for ad hoc wireless networks, including contention-based, reservation-based, scheduling-based, and directional-antenna MAC protocols.
CO3	Analyze routing protocol design issues and strategies for ad hoc wireless networks, including proactive, reactive, hybrid, and hierarchical routing approaches.
CO4	Analyze the sensor, transmission technology and systems associated with WSN.
CO5	Explore wireless sensor network platforms using modern tools.

Assessment Details (Both CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
-----------------	---------------	-----------------------	--------------------

CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	C.Siva Ram Murthy and B.S.Manoj, “AD HOC wireless networks”, Pearson Education-2008
2.	Kazem Sohraby, Daniel Minoli and Taieb Znati, “wireless sensor Network”, Wiley,2015
3.	Feng Zhao & Leonidas J. Guibas, “wireless sensor networks-An information processing approach”, Elsevier,2007

Reference Books:

1.	Jochen Schiller, “Mobile Communications”, Pearson Education, 2 nd Edition, 2003.
2.	William Stallings, “Wireless Communications and networks”, Pearson Education-2004.
3.	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Analog and Mixed Signal Circuit Design		
Course Code	BEC714B	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The objectives of the course are to facilitate the learners to:</i> - Understand and analyze noise sources, characteristics, and their effects in analog electronic circuits and amplifiers. - Understand stability concepts and frequency compensation techniques in operational amplifiers. - Understand DAC specifications and analyze different digital-to-analog converter architectures. - Understand ADC specifications and analyze different analog-to-digital converter architectures and their accuracy issues. - Understand the operation and applications of Phase-Locked Loops (PLLs) and Delay-Locked Loops (DLLs).			
Module-1	Noise	9 hrs	
Statistical Characteristics of Noise - Noise Spectrum, Amplitude Distribution, Correlated and Uncorrelated Sources, Types of Noise - Thermal Noise, Flicker Noise, Representation of Noise in Circuits, Noise in Single-Stage Amplifiers - Common-Source Stage, Common-Gate Stage, Source Followers, Cascode Stage, Noise in Differential Pairs, Noise Bandwidth Text 1: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6			
Module-2	Stability and Compensation Techniques	9 hrs	
General Considerations, Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two-Stage Op Amps - Slewing in Two-Stage Op Amps, Other Compensation Techniques Text 1: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6			
Module-3	Digital to Analog Converters (DACs): Fundamentals and Architectures	9 hrs	
DAC Fundamentals: Introduction, Differential Nonlinearity, Integral Nonlinearity, Offset, Gain Error, Latency, Signal-to-Noise Ratio (SNR), Dynamic Range. DAC Architectures: R-2R Ladder Networks, Current Steering - Mismatch Errors Related to Current-Steering DACs, Charge-Scaling DACs - Layout Considerations for a Binary-Weighted Capacitor Array, The Split Array Cyclic DAC, Pipeline DAC			

Text 2: 28.4, 29.1.3, 29.1.4, 29.1.5, 29.1.6, 29.1.7		
Module-4	Analog to Digital Converters (ADCs): Fundamentals and Architectures	9 hrs
ADC Fundamentals: Introduction, Quantization Error, Differential Nonlinearity, Missing Code, Integral Nonlinearity, Offset and Gain Error, Aliasing ADC Architectures: Flash, The Two-Step Flash ADC, The Pipeline ADC, Integrating ADCs, The Successive Approximation ADC, The Oversampling ADC Text 2: 28.5, 29.2.1, 29.2.2, 29.2.3, 29.2.4, 29.2.5, 29.2.6		
Module-5	Phase Locked Loops (PLLs)	9 hrs
Simple PLL - Phase Detector, Basic PLL Topology, Dynamics of Simple PLL, Charge-Pump PLLs - Problem of Lock Acquisition, Phase/Frequency Detector and Charge Pump, Basic Charge-Pump PLL, Applications - Frequency Multiplication and Synthesis, Skew Reduction, Jitter Reduction Text 1: 15.1, 15.2, 15.5		

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Analyse noise sources and evaluate their impact on analog electronic circuits and amplifiers.
CO2	Analyse the stability and frequency compensation techniques used in operational amplifiers.
CO3	Analyse the various DAC and ADC architectures based on specifications
CO4	Analyse the operation of PLLs in elect and electronic systems.

Assessment Details (Both CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks

SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	B Razavi, “Fundamentals of Microelectronics”, 3rd edition, John Wiley and Sons.
2.	R Jacob Baker, “CMOS Circuit Design, Layout and Simulation”, 2 nd edition, Wiley-IEEE Press.

Reference Books:

1.	Adel S Sedra, and Kenneth C Smith, “Microelectronic Circuits-Theory and Applications”, 7th edition, Oxford University Press.
----	--

Weblinks and Video Lectures (e-Resources):

1.	https://www.youtube.com/playlist?list=PLxEISdW0D0EP57iMeenzgs2eD7f4ty6qc
2.	https://nptel.ac.in/courses/108106184

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Machine Learning with Python		
Course Code	BEC714C	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: The objectives of the course are to facilitate the learners to: - Understand the fundamentals of Machine Learning, Python ML libraries such as NumPy, Pandas, Matplotlib and real-world applications. - Gain knowledge of supervised and unsupervised learning techniques and their theoretical foundations. - Understand Bayesian decision theory and probabilistic approaches for classification and decision-making. - Learn clustering techniques and evaluate clustering performance. - Understand and implement decision tree algorithms for classification and regression problems.			
Module-1	Introduction	9 hrs	
Why machine Learning, Problems machine Learning can solve, knowing your task and knowing your data, why Python, Scikit-Learn, Installing Scikit-learn, Essential Libraries and Tools: Jupyter Notebook, Numpy, SciPy, matplotlib, pandas. Text 1 What is Machine Learning, Examples of Machine Learning Applications: Learning Associations, classification, Regression, Unsupervised Learning, Reinforcement Learning. Text 2			
Module-2	Supervised Learning	9 hrs	
Learning a Class from Examples, Vapnik-Chervonenkis Dimension, Probably Approximately Correct Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm. Text 2			
Module-3	Bayesian Decision Theory and Clustering	9 hrs	
Introduction, Classification, Losses and Risks, Discriminant Functions, Association Rules. Clustering Introduction, Mixed Densities, K-Means Clustering, Supervised Learning after Clustering, Spectral Clustering, Hierarchical Clustering, Choosing the Number of Clusters. Text 2			

Module-4	Decision Trees	9 hrs
Introduction, Univariate Trees, Classification Trees, Regression Trees, Pruning, Rule Extraction from Trees, Learning Rules from Data, Multivariate Trees. Text 2		
Module-5	Design and Analysis of Machine Learning Experiments	9 hrs
Introduction, Factors, Response, and Strategy of Experimentation, Response Surface Design Randomization, Replication, and Blocking, Guidelines for Machine Learning Experiments, Cross-Validation and Resampling Methods, K-Fold Cross-Validation, 5×2 Cross-Validation, Bootstrapping, Measuring Classifier Performance. Text 2		

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Examine fundamental concepts of machine learning, types of learning, and real-world applications.
CO2	Apply supervised learning techniques including classification and regression models to solve practical problems.
CO3	Analyse model performance using concepts such as VC dimension, PAC learning, generalization, and model selection.
CO4	Apply Bayesian decision theory concepts including loss functions, risk minimization, and discriminant functions.
CO5	Analyze clustering algorithms such as K-Means, Hierarchical Clustering, and Spectral Clustering and determine optimal clusters.

Assessment Details (Both CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down

			to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Andreasc Muller & Sarah Guido, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O’Reilly Publication, 2019.
2.	Ethem Alpaydin, “Introduction to Machine Learning”, PHI learning, 3 rd edition 2015

Reference Books:

1.	Tom Mitchell, “Machine Learning”, McGraw-Hill Edition 1, 2013.
2.	Peter Harrington, “Machine Learning in Action”, Dreamtech press Indian Edition, 2017.
3.	Aurelien Geron, “Hands-on Machine Learning with ScikitLearn & Tensorflow”, O’reilly Publication, 2017

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

1.	Introduction to Machine Learning - https://nptel.ac.in/courses/106106139
2.	Machine Learning - https://nptel.ac.in/courses/106106202

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Optical Fiber Communication		
Course Code	BEC714D	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: The objectives of the course are to facilitate the learners to: 1. Learn the basic principle of optical fiber communication with different modes of light propagation. 2. Understand the transmission characteristics and losses in optical fiber. 3. Study of optical components and its applications in optical communication networks. 4. Learn the network standards in optical fiber and understand the network architectures along with its functionalities.			
Module-1	Optical Fiber Communication Fundamentals	9 hrs	
Optical fiber Communications: Optical Communication System, The general system, Advantages of optical fiber communication. Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity, Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers.			
Module-2	Fiber Transmission Characteristics and Passive Components	9 hrs	
Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber. Optical fiber connectors: Fiber alignment and joint loss, Fiber splices: Fusion Splices, Mechanical splices, Fiber connectors: Cylindrical ferrule connectors, Duplex and Multiple fiber connectors, Fiber couplers: three and four port couplers, star couplers, Optical Isolators and Circulators.			
Module-3	Optical Sources	9 hrs	
Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation of an LED. Laser Diodes: Modes and Threshold conditions, Laser diode rate equations, External Quantum Efficiency, Resonant Frequencies, Single-Mode Lasers, Modulation of Laser Diodes.			

Module-4	Photodetectors and Optical Receivers	9 hrs
Photodetectors: Physical principles of Photodiodes, Photo detector noise, Detector response time. Optical receiver: Fundamental Receiver Operation, Digital Signal Transmission, Error sources, Front-End Amplifiers, Receiver sensitivity, The Quantum Limit.		
Module-5	WDM, Optical Amplifiers and Optical Networks	9 hrs
WDM concepts and components: Overview of WDM: Operational Principles of WDM, WDM standards, Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters. Optical amplifiers: Basic application and Types, Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers. Optical networks: Network concepts, network topologies, SONET/SDH.		

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Apply the principles of optical fiber to demonstrate its working for different modes of signal propagation.
CO2	Analyze the transmission characteristics and various losses in optical fiber communication.
CO3	Analyze the characteristics and operation of LEDs and laser diodes used as optical sources in optical communication systems.
CO4	Analyze the characteristics and operation of photodetectors and optical receivers in optical communication systems.
CO5	Evaluate the principles of WDM, optical amplifiers, and SONET/SDH standards in optical networks

Assessment Details (Both CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30		Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20		Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.

Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C .
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Gerd Keiser , “Optical Fiber Communication”, 5 th Edition, Mc Graw Hill Education (India) Private Limited, 2013
2.	John M Senior , “Optical Fiber Communications”, Principles and Practice, 3 rd Edition, Pearson Education, 2010.

Reference Books:

1.	Joseph C Palais , Fiber Optic Communication, Pearson Education, 2005.
2.	G. Agarwal , Fiber Optic Communication System, 3rd Edition, John Wiley and Sons, 2014.

Weblinks and Video Lectures (e-Resources):

1.	https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ee61
2.	https://nptel.ac.in/courses/115107095

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

1.	Quizzes
2.	Assignments and Seminars

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Electromagnetic Compatibility		
Course Code	BEC755A	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours/Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: The objectives of the course are to facilitate the learners to: 1. Understand concepts and overview of electromagnetic compatibility (EMC) and EMI that covers the history of EMI occurrence. 2. Compare and discuss the worldwide EMC regulatory requirements. 3. Discussion of behaviours of passive components at high frequencies and their impacts on EMC 4. To understand, discuss and illustrate Cabling, Grounding and Shielding Techniques 5. To understand, discuss and analyze Electrostatic discharge (ESD) and its effects			
Module-1	Introduction		9 hrs
Designing for Electromagnetic compatibility, EMC regulations, Typical Noise path, Use of network theory. Methods of noise coupling miscellaneous noise sources, Methods of eliminating interference. Text1			
Module-2	Cabling		9 hrs
Capacitive coupling. Effect of shield on capacitive coupling. Inductive coupling, mutual inductance calculations. Effect of shield on magnetic coupling. Magnetic coupling between shield and inner conductor. Shielding to prevent magnetic radiation, Shielding a receptor against magnetic fields. Text1			
Module-3	Grounding		9 hrs
Safety grounds, signal grounds single point ground systems hybrid grounds, multipoint ground systems, functional ground layout, practical low frequency grounding, hardware grounds, single ground reference for a circuit, amplifier shield, grounding of cable shields, ground loops, and methods for breaking ground loops. Text1			
Module-4	Highway Materials and Pavements		9 hrs
Desirable properties of aggregates, soil subgrade & Shielding: Near fields and far fields. Characteristic and wave impedance, shielding effectiveness, absorption loss, reflection loss, composite absorption and reflection loss. Apertures, conductive gaskets, conductive windows, conductive coating, cavity resonance. Text 1			
Module-5	Electrostatic Discharges		9 hrs

Static Generation, human body model, static discharge, ESD Protection in equipment design, software and ESD protection, ESD protection, ESD versus EMC. **Text 1**

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Apply EMC regulatory standards from North America, European Community, and Asia-Pacific regions to evaluate and ensure compliance of electronic systems in real-world scenarios.
CO2	Apply and compare various methods of eliminating interferences.
CO3	Apply and implement methods of cabling and grounding of cables and cable shields.
CO4	Analyze grounding and shielding methodologies for different product groups and operating frequencies, and apply the most suitable technique.
CO5	Apply the concepts of non-linear phenomena and Electrostatic Discharge (ESD) along with good design practices to design and implement effective ESD protection schemes.

Assessment Details (Both CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to			

appear for SEE.

Text Books:

1.	H W Ott, “Noise Reduction Techniques in Electronic systems”, Second Edition, John Wiley Publisher, 1989
----	---

Reference Books:

1.	Clayton R Paul, “Introduction to Electromagnetic Compatibility”, Second edition, Wiley Interscience publisher, 2006
2.	Prasad V Kodaly, “Engineering Electromagnetic Compatibility”, Second edition, Wiley-Blackwell and S Chand publisher, year



ESTD : 2001

An Institute with a Difference

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Micro Electro Mechanical Systems		
Course Code	BEC755B	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> - With fundamental knowledge / overview in the field of Micro Electro Mechanical Systems - To equip with a basic foundation in electronics engineering, mechanical engineering and chemical process involved in manufacturing the Devices of MEMS. - To inculcate ethical and professional attitude to relate engineering problems to broader social context and life-long learning.			
Module-1	Overview of MEMS and Microsystems	9 hrs	
MEMS and Microsystems, Typical MEMS and Microsystems Products, Evolution of microfabrication, Microsystems and Microelectronics, Multidisciplinary nature of microsystems, Miniaturization, Applications and markets. Text 1: 1.1 to 1.9			
Module-2	MEMS Devices and Materials	9 hrs	
Introduction, Micro sensors (Pressure sensor, Vibration Sensor, Accelerometer), Micro actuators, MEMS with micro actuators, Micro accelerometers and Microfluidics. Text1: 2.1 to 2.6 Introduction, Substrates and wafers, Active substrates, Silicon as a substrate material, Silicon compounds, Silicon piezo resistors, Gallium arsenide, Quartz, Polymers for MEMS, Packaging materials. Text 1.			
Module-3	Engineering Mechanics for Microsystem design	9 hrs	
Introduction, Static bending of thin plates, Mechanical vibrations, Thermo-mechanics, Fracture mechanics, thin film mechanics, Overview on finite element stress analysis. Text 1: 4.1 to 4.7.			
Module-4	Micromachining Technologies & Etching	9 hrs	
Evaporation, sputtering, Chemical vapour deposition, Epitaxial growth of silicon, thermal oxidation. Lithography. Isotropic etching, Anisotropic etching, etch stops, dry etching, silicon micromachining, advanced process of microfabrication. Text 1			

Module-5	Overview of Micro Manufacturing & Packaging	9 hrs
Introduction, Bulk manufacturing, The LIGA Process. Summary of micro manufacturing. Introduction, Overview of Mechanical packaging of microelectronics, Microsystem packaging. Text 1: 9.1 to 9.5 7 & 11.1 to 11.3.		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Apply the sensing principles of microsystems for real time applications.
CO2	Design the microstructures of various micro sensors and tailor the device structures.
CO3	Analyse the manufacturing methods and Selection of the right Materials for MEMS.
CO4	Analyse various MEMS Devices using simulation tools.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 25 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any one Assessment methods as per 24RNBE4.2 scaled to 25 marks.
Total CIE Theory (A+B)	50	20	Marks of Tests and Assignments awarded for a maximum of 50.
SEE (C)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall before 3 hours.
CIE+SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	“MEMS and Micro Systems: Design, manufacturing and Nano scale Engineering” Tai-Ran Hsu, 2 nd edition, John Wiley & Sons
----	--

Reference Books:

1.	“Micro and smart systems”, G. K. Anantha suresh, K. J. Vinoy S. Gopalakrishnan, K. N. Aatre, 1 st edition, Wiley India.
2.	“Mems by Dileep Kumar Bhattacharya, Cengage Learning.
3.	“Foundation of MEMS”, Chang liu, 2012, pearson education Inc, ISBN-13:978-0-13-24976-7.

Weblinks and Video Lectures (e-Resources):

1.	https://nptel.ac.in/courses/117/105/117105082/
2.	https://nptel.ac.in/courses/108/108/108108113/

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Smart and Wearable Sensors		
Course Code	BEC755C	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The purpose of the course is to facilitate the learner to:</i> - Understand the fundamentals, taxonomy, and design attributes of smart and wearable sensors, along with their societal and technological implications. - Examine inertial, physiological, and medical IoT sensors, including system architectures, secure communication protocols, and identity management frameworks. - Assess wearable body sensor networks (WBSN) with respect to architecture, threats, privacy, and security solutions. - Apply wearable sensor technologies in healthcare contexts such as temperature monitoring, HRV-based biometry, and optical heart rate measurement, while considering clinical and practical constraints. - Develop integrated wearable sensor-based systems by combining hardware, firmware, and Python-based data analytics to address real-world healthcare and IoT challenges.			
Module-1	Fundamentals, Advancements, and a Roadmap for the Future	9 hrs	
Word of wearables, Attributes of wearables, Textile and Clothing – the meta wearable., Challenges and Opportunities. The Future of Wearables: Defining the Research Roadmap. Text 1: Chapter – 1.1- 1, 2, 3, 4, 5.			
Module-2	Social aspects of wearables	9 hrs	
Social interpretation of aesthetics, Adoption of innovation aesthetics change, on-body interaction, case study: Google glass, Wearable Haptics. Text 1: 1.2 2- 1, 2, 3, 4, 5, 1.3			
Module-3	Medical IoT systems	9 hrs	
Introduction, System processes, Secure routing, the cloud-side, System implementation. Access control and identity management: Security for IoT, intelligence, Transiency. Text 2: Chapter – 5.1, 5.2, 5.3, 5.4, 6.2-6.3			
Module-4	Wearable body sensor networks (WBSN)	9 hrs	

Generalized system architecture, Security requirements in a WBSN, Threats and attacks, Possible solutions for security and privacy in WBSN. GUI-based software development for sensor data collection, data extraction and data analysis using Python frameworks.

Text 2: Chapter – 7.1, 7.2, 7.3, 7.4, 7.5, 4.1-4.3

Module-5	Wearable inertial sensor and its applications	9 hrs
Introduction, wireless sensors, obtained parameters from inertial sensors, applications of wearable motion sensors, Practical Considerations for Wearable Inertial Sensor Applications in Clinical Practice and Future Research Directions, Application of Optical Heart Rate Monitoring		
Text 1: 2.2- 1, 2, 3, 4, 5		

Course Outcomes:

After successfully completing the course, the student will be able to:

CO1	Understand fundamentals, taxonomy, and design of smart/wearable sensors, including societal and technological impacts.
CO2	Examine inertial, physiological, and medical IoT sensors to identify system architectures, secure communication protocols, and identity management frameworks.
CO3	Evaluate wearable body sensor networks (WBSN) for architecture, threats, privacy, and security using case studies.
CO4	Apply wearable sensor technologies in healthcare (temperature, HRV biometry, optical heart rate) under clinical and practical constraints.
CO5	Develop wearable sensor systems by integrating hardware, firmware, and Python-based analytics to solve healthcare and IoT challenges.

Assessment Details (CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 25 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any one Assessment methods as per 24RNBE4.2 scaled to 25 marks.
Total CIE Theory (A+B)	50	20	Marks of Tests and Assignments awarded for a maximum of 50.

SEE (C)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be before 3 hours.
CIE+SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Text Books:

1.	Edward Sazonov Wearable Sensors: Fundamentals, Implementation and Applications, 2 nd edition, Academic Press, 2020
2.	Subhas Chandra Mukhopadhyay and Tarikul Islam, Wearable Sensors, IOP publishing, 2017

Reference Books:

1.	"Flexible and Wearable Sensors: Materials, Technologies, and Challenges" by Gupta et al. – Focuses on nanomaterials, stretchable electronics, and self-healing sensors.
2.	Gastaldi, L.; Digo, E. Recent Advance and Application of Wearable Inertial Sensors in Motion Analysis. <i>Sensors</i> 2025, 25, 818. https://doi.org/10.3390/s25030818

Weblinks and Video Lectures (e-Resources):

1.	https://nptel.ac.in/courses/108106193
2.	https://onlinecourses.nptel.ac.in/noc26_ee41/preview
3.	https://www.coursera.org/specializations/sensor-technologies-for-biomedical-applications

B.E. (Electronics and Communication Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – VII			
Course Title	Robotics and Applications		
Course Code	BEC755D	CIE Marks	50
(L: T: P) + SL	(3: 0: 0) + 45 Hours / Sem	SEE Marks	50
Credits	3	Exam Hours	3
Course Learning Objectives: <i>The objectives of the course are to facilitate the learners to:</i> - Understand and discuss the fundamental elementary concepts of Robotics. - Provide insight into different types of robots. - Explain intelligent module for robotic motion control. - Educate on various path planning techniques. - Illustrate the working of innovative robotic devices.			
Module-1	Introduction to Robotics	9 hrs	
Introduction to Robotics and Automation, laws of robot, brief history of robotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics market and the future prospects, advantages and disadvantages of robots. Text 1			
Module-2	Anatomy of a Robot	9 hrs	
Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix. Text 1			
Module-3	Robot Anatomy and Motion Analysis	9 hrs	
Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control. Text 1/3			
Module-4	Path Planning	9 hrs	
Definition-Joint space technique, Use of P-degree polynomial-Cubic, polynomial- Cartesian space technique, parametric descriptions, straight line and circular paths, position and orientation planning. Text 1/3			
Module-5	Robotics Applications: Material Handling	9 hrs	
Pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel			

and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Robots, Autonomous robots, and Swarm robots. **Text 2**

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Apply the concepts of robotics and automation to analyze their significance, social impact, and future prospects in various engineering applications.
CO2	Apply the knowledge of robotic systems to identify and describe the components and anatomy of robots.
CO3	Apply various path planning techniques to analyse different motions of robotic systems.
CO4	Apply suitable drives and end-effectors for given robotic applications.
CO5	Apply robotics concept to automate the monotonous and hazardous tasks and categorize various types of robots based on the design and applications in real world scenarios.

Assessment Details (Both CIE and SEE):

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNB4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to			

appear for SEE.

Text Books:

1.	S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education, 2009.
2.	Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).
3.	Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rd edition, 2017.

Reference Books:

1.	Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
2.	Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987. https://www.robots.com/applications .

Weblinks and Video Lectures (e-Resources):

1.	https://roboticscasual.com/ros-tutorial-pick-and-place-task-with-the-moveit-c-interface/
2.	https://roboticscasual.com/ros-tutorial-simulate-ur5-robot-in-gazebo-urdf-explained/
3.	https://roboticscasual.com/the-best-degrees-to-work-in-robotics/
4.	https://roboticscasual.com/robotics-tutorials/
5.	https://www.ieee-ras.org/educational-resources-outreach/educational-material-in-robotics-andautomation
6.	https://www.academia.edu/20361073/Web_Based_Control_and_Robotics_Education_pdf
7.	https://github.com/Developer-Y/cs-video-courses
8.	https://www.isa.org/
9.	https://www.asme.org/engineering-topics/articles/bioengineering/top-6robotic-applications-in-medicine



VISION

Building RNSIT into a World Class Institution.



MISSION

To impart high quality education in Engineering, Technology and Management with a difference, enabling students to excel in their career by

- Attracting quality students and preparing them with a strong foundation in fundamentals so as to achieve distinctions in various walks of life leading to outstanding contributions.
- Imparting value based, need based, choice based and skill based professional education to the aspiring youth and carving them into disciplined, World class professionals with social responsibility.

- Promoting excellence in Teaching, Research and Consultancy that galvanizes academic consciousness among Faculty and Students.
- Exposing Students to emerging frontiers of knowledge in various domains and make them suitable for Industry, Entrepreneurship, Higher studies, and Research & Development.
- Providing freedom of action and choice for all the Stakeholders with better visibility.

 www.rnsit.ac.in

follow us on:    

RR Nagar, Dr. Vishnuvardhan Road, Bengaluru - 560 098
Ph: (080) 28611880, 28611881