

www.sjcit.ac.in

||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

VII & VIII Semester
Scheme & Syllabus of B.E. Programme
Electronics & Communication Engineering
(2024 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



AICTE | NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300 | NBA | NAAC A+ | QS I-GAUGE GOLD | INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

AICTE Approved, Accredited by NBA(CSE, ISE, ECE, ME, CV) and NAAC with 'A+' grade, QS – I Gauge Gold Rated

SCHEME OF TEACHING AND EXAMINATION – B.E. – Branch Name ECE

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

7th Semester

Electronics and Communication Engineering													
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**TD/ PSB**	**Teaching Hours / Week**			**Examination**					
					L	**T**	**P**	**SEE Duration**	**CIE Marks**	**SEE Marks**	**Total Marks**	**Credits**
1	BEC701	RF Engineering and Antenna Theory	IPCC	ECE	3	0	2	**3**	**50**	**50**	**100**	**4**
2	BEC702	Computer Networks and Protocols	IPCC	ECE	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BEC703	Wireless Communication Systems	PCC	ECE	4	0	0	**3**	**50**	**50**	**100**	**4**
4	BEC724x	Professional Elective Course – IV	PEC	ECE	3	0	0	**3**	**50**	**50**	**100**	**3**
5	BEC745x	Open Elective Course – II	OEC	ECE	3	0	0	**3**	**50**	**50**	**100**	**3**
6	BEC736	Major Project Phase - II	PROJ	ECE	0	0	12	**3**	**100**	**100**	**200**	**6**
7	BCR737	Career Readiness and Industry Integration	NCMC	CDCAC	0	2	0	-	**100**	-	**100**	**0**
									450	**350**	**800**	**24**

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Professional Elective Course – IV

Course Code	Course Name	Course Code	Course Name
BEC724A	Application Specific Integrated Circuit	BEC724C	Biomedical Signal Processing
BEC724B	Cryptography and Network Security	BEC724D	Real-Time System

Open Elective Course – II

Course Code	Course Name	Course Code	Course Name
BEC745A	Applied Materials	BEC745C	Embedded System Application
BEC745B	Automotive Electronics	BEC745D	Sensors and Actuators

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2024-25 may please be referred.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Work: The objective of the Project work is to:

i) Encourage independent learning and the innovative attitude of the students.
ii) Develop interactive attitude, communication skills, organization, time management, and presentation skills.
iii) Impart flexibility and adaptability.
iv) Inspire team working.
v) Expand intellectual capacity, credibility, judgment and intuition.
vi) Adhere to punctuality, setting and meeting deadlines.
vii) Install responsibilities to oneself and others.
viii) Train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

Semester: VII						
Course Title: RF Engineering and Antenna Theory						
Course Code	:	BEC701		**Credits**	:	4
Hours/Week(L:T:P)	:	3:0:2		**CIE**	:	50 Marks
Total Hours	:	40 + 12 Hrs		**SEE**	:	50 Marks
Course Type	:	IPCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Electromagnetic Theory
Knowledge on Fundamental Concepts	Circuit analysis techniques, Passive components and semiconductor devices, Maxwell's equations
Knowledge on Connected Tools (If any)	MATLAB

Course Learning Objectives: This course will enable the students to	
CLO1	Describe the RF & microwave properties and its transmission media.
CLO2	Interpret the microwave devices for several applications.
CLO3	Understand the basic concepts of antenna theory.
CLO4	Identify antenna types for specific applications.
CLO5	Learn emerging trends in RF and antenna engineering

Module–1	**08 Hrs**

Introduction to RF and Transmission lines theory:
Microwave frequencies, Microwave devices, Microwave systems. Transmission line equations and solutions, Reflection Coefficient and Transmission Coefficient. Standing wave and standing wave ratio. Smith chart, Single stub matching, Gunn Diode.
Text Book 2: Ch.0: 0.1, 0.2, 0.3, Ch.3: 3.1, 3.2, 3.3, 3.5, 3.6, Ch.7: 7.1, 7.1.1, 7.1.2

Module–2	**08 Hrs**

Microwave Network Theory and Passive Devices:
Introduction, S matrix representation of multi-port networks, Coaxial connectors and Adapters, Attenuators, Phase shifters, Waveguide Tees, Magic Tee, Circulator, Isolator.
Text Book 1: Ch.6: 6.1, 6.3, 6.3.1, 6.3.2, 6.4.2, 6.4.14, 6.4.15, 6.4.16, 6.4.17 A, B

Module–3	08 Hrs
Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam efficiency, Directivity and Gain, Antenna Aperture Effective height, Bandwidth, Radio communication Link, Antenna Field Zones. **Text Book 3: Ch.2: 2.1-2.7, 2.9-2.11, 2.13**	
Module–4	**08 Hrs**
Point sources and arrays: Introduction, Point Sources, Power patterns, Power theorem, Radiation Intensity, Arrays of 2 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). **Text Book 3: Ch.5: 5.1-5.6, 5.9, 5.13, Ch.6: 6.1-6.5**	
Module–5	**08 Hrs**
Loop and Horn antenna: Introduction: Small loop, Comparison of far fields of small loop and short dipole, The Loop antenna, Small loop as a special case, Radiation resistance of small loop, Directivity of circular loop antenna with uniform current, Horn Antennas, Rectangular antennas. **Antenna Types**: Yagi Uda array, Parabolic Reflector, Microstrip Antennas, Features of Microstrip Antennas. **Text Book 3: Ch.7: 7.1, 7.2, 7.3, 7.4, 7.6, 7.7, 7.8, 7.19, 7.20, Ch.8: 8.8, Ch.9: 9.5, Ch.14: 14.1, 14.2**	

PRACTICAL COMPONENT OF IPCC

Sl.No.	Experiments
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.	To measure unknown impedance using Smith chart through test bench setup.
4.	Study of characteristics of E plane Tee/H 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 micro strip 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 completing the course, the students will be able to	
CO1	Interpret the microwave, transmission line concepts.
CO2	Explain the behavior of microwave passive devices and fundamental concepts of antenna.
CO3	Apply microwave and antenna principles to solve transmission line and antenna system design problems.
CO4	Analyze characteristics of point sources, electric dipole0 and different antenna types.
CO5	Evaluate emerging trends in micro wave and antenna engineering to identify areas for ongoing professional development.

Text Books	
1	Microwave Engineering -Annapurna Das, Sisir K Das, TMH Publication, 2ndEdition, 2010.
2	Microwave Devices and Circuits–Samuel Y Liao, Pearson Education.
3	Antennas and Wave Propagation-John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.
Reference Books	
1	Microwave Engineering -David M Pozar, John Wiley India Pvt Ltd., Pvt Ltd., 3rd edition, 2008.
2	Microwave Engineering-Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.
3	Antennas and Wave Propagation-Harish and Sachidananda, Oxford University Press, 2007.

Web links and Video Lectures(e–Resources)	
1	https://www.tutorialspoint.com/antenna_theory/index.htm
2	http://www.antenna-theory.com/antennas/smallLoop.php

CO–PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PS02
CO1	3	2	1								1	2	
CO2	3	2									1	2	1
CO3	3	2	2	2							1	3	
CO4	3	3	2	2	2	1		1	2	2	2	3	
CO5	1					1	1	1	1	1	3	2	2

Semester: VII						
Computer Network And Protocols						
Course Code	:	BEC702		**Credits**	:	4
Hours/Week(L:T:P)	:	3:0:2		**CIE**	:	50 Marks
Total Hours	:	40 +12 Hrs		**SEE**	:	50 Marks
Course Type	:	IPCC		**SEE Duration**	:	03 Hours

Pre-requisites:	
Courses	IOT, Communication system
Knowledge on Fundamental Concepts	Network fundamentals, Network architecture and Network security
Knowledge on Connected Tools (If any)	C/C++

Course learning Objectives: This course will enable the students to	
CLO1	Know the Fundamentals of Computer networks, Including Network topologies, Architecture and Protocol.
CLO2	Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
CLO3	Interpret common network security threats and vulnerabilities.
CLO4	Learn the different networking architectures and their representations.
CLO5	Know the various routing techniques and the transport layer services

Module - 1	**08 Hrs**
Introduction: Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet. 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. Data-Link Layer.	
Module - 2	**08 Hrs**
Data Link Control (DLC) services: Framing, Flow and Error Control. Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Connecting Devices: Hubs, Switches, Virtual LANs: Membership, Configuration, Communication between Switches, Advantages. Wired and Wireless LANs: Ethernet Protocol, Standard Ethernet. Introduction to wireless LAN: Architectural Comparison, Characteristics, Access Control.	
Module - 3	**08 Hrs**
Network Layer: 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 Datagram's. IPv6 addressing and Protocol. Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing.	

Module - 4	08 Hrs
Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-BackN Protocol, Selective repeat protocol, Piggy backing ransport-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, Window sin TCP, Error control ,TCP congestion control.	
Module - 5	**08 Hrs**
Application Layer: 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.	

PRACTICAL COMPONENTOF IPCC

Sl.No.	Experiments
Simulation experiments using NS2/NS3/OPNET/NCTUNS/ NetSim/ QualNet or any other equivalent tool	
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
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 completing the course, the students will be able to	
CO1	Understand different Network Architectures and Protocols.
CO2	Analyze various networking protocols, such as TCP, UDP, and IP, and understand their roles in data communication.
CO3	Infer the use of routers, switches, and other networking hardware.
CO4	Identify different network vulnerabilities and apply network security measures to protect data integrity and privacy.
CO5	Develop skills to diagnose and resolve network issues, utilizing tools and methodologies for effective trouble shooting.

Text Books	
1	Data Communications and Networking, Forouzan,5th Edition, McGraw Hill, 2016 ISBN: 1-25-906475-3

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

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PSO2
CO1	3	3	2	2	2						1	2	3
CO2	3	3	2	2	1						2	2	3
CO3	3	2	2	1	2						2	2	3
CO4	3	3	2	2	1						2	2	3
CO5	3	3	2	2	3	1			2	2	2	2	3

Semester: VII						
Wireless Communication Systems						
Course Code	:	BEC703		**Credits**	:	4
Hours/Week(L:T:P)	:	4:0:0		**CIE**	:	50 Marks
Total Hours	:	50 Hrs		**SEE**	:	50 Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Principles of Communication Systems, Digital Communication, Digital Signal Processing
Knowledge on Fundamental Concepts	Electromagnetic waves
Knowledge on Connected Tools (If any)	NS-3, MATLAB with Simulink, OMNeT++

Course Learning Objectives: This course will enable the students to	
CLO1	Illustrate the concepts of signal propagation over wireless channels
CLO2	Understand the multiple access techniques used in cellular communications standards
CLO3	Develop the system architecture and layers of LTE based on the use of OFDMA and SCFDMA principles
CLO4	Infer the design and coding of MIMO wireless systems
CLO5	Know the concepts 5G Mobile Technology.

Module – 1	**08 Hrs**

Principles of Wireless Communications: The Wireless Communication Environment, Modeling of wireless systems, System model for narrowband Signals, Rayleigh fading Wireless Channel.

The Wireless Channel: Basics of Wireless Channel Modeling, Average Delay Spread in Outdoor Cellular Channels, Coherence bandwidth, Relation between ISI and Coherence Bandwidth, Doppler fading, Doppler Impact on a wireless Channel, Coherence Time.

Text Book 1: Ch.3: 3.1 - 3.4, Ch.4: 4.1 - 4.7

Module – 2	**08 Hrs**

Code Division for Multiple Access (CDMA): Basic CDMA Mechanism, Fundamentals of CDMA codes, Spreading Codes based on PN sequences, Correlation Properties of Random CDMA Spreading Sequences, Advantages of CDMA.

Orthogonal Frequency Division Multiplexing (OFDM): Introduction, Motivation and Multicarrier basics, OFDM basics, OFDM Example, MIMO OFDM, OFDM Peak to Average Power ratio, SC-FDMA.

Text Book 1: Ch.5: 5.1 - 5.5, 5.7, Ch.7: 7.1, 7.2, 7.3, 7.5, 7.7, 7.8

Module – 3	**08 Hrs**

Evolution of Cellular Technologies: First Generation Cellular Systems, 2G Digital cellular systems – GSM and its Evolution, 3G Broadband Wireless Systems, Key Enabling Technologies and features of LTE, LTE Network Architecture.

Frequency Domain Multiple Accesses: Multiple Access for OFDM Systems, Orthogonal Frequency Division Multiple Access, Single Carrier Frequency Division Multiple Access.

Text Book 2: Ch.1:1.2.1, 1.2.1.1, 1.2.2, 1.2.2.1, 1.2.3 (Only the mentioned sections and subsections), 1.4, 1.5, Ch.4:4.1, 4.2, 4.3

Module – 4	08 Hrs
Multiple Input Multiple Output Wireless Communications: Introduction to MIMO Communications, MIMO system Model, MIMO Zero Forcing Receiver, MIMO MMSE Receiver, Singular Value decomposition of MIMO Channel, SVD and MIMO capacity, Alamouti and Space-Time Codes, Nonlinear MIMO receiver: V-Blast, MIMO Beam forming. **Text Book 1: Ch.6: 6.1,6.2, 6.3, 6.4, 6.5, 6.6, 6.8, 6.9, 6.10**	
Module – 5	**08 Hrs**
5G Mobile Technology: Introduction, 5G applications and requirements,5G use Cases and Sys- tem Concept, 5G architecture, 5G Spectrum, 5G Enabling Technologies - Device to Device and Machine to Machine communication, mm-wave communications, massive MIMO, Multi RAT, Carrier aggregation, relaying, Small cell networks (only concepts). **Text Book 3:**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the wireless channel models for slow and fast fading environment.
CO2	Analyze the various different multiple access technologies used in wireless communications.
CO3	Develop the system architecture and the functional standard specified in LTE 4G and 5G Networks
CO4	Infer the MIMO transmitter and receiver process using coding examples.
CO5	Engage in self-study to design and demonstrate the applications of Wireless communication system.

Text Books	
1	Principles of Modern Wireless Communication systems, Theory and Practice, Aditya K Jagannatham, Mc Graw Hill Education (India) Private Limited, 2017, ISBN 978-81- 265-4231-4.
2	Fundamentals of LTE, Arunabha Ghosh, Jun Zhang, Jeffrey G. Andrews, Rias Muhamed, Pearson India Education Services Private Limited, 2018, ISBN: 978-93-530-6239-2.
3	5G Mobile and Wireless Communication Technology, Afif Osseiran ,Jose F Monser- rat, Cambridge University Press, 2016
Reference Books	
1	Wireless Communications, T L Singal, Mc Graw Hill Education (India) Private Limited, 2016, ISBN:978-0- 07-068178-1
2	Wireless Communications: Principles and Practice, Theodore Rappaport ,2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
3	Introduction to Wireless Telecommunications Systems and Networks, Gary Mullet, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/117104099

CO – PO MAPPING

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

Semester: VII						
Application Specific Integrated Circuit						
Course Code	:	BEC724A		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 Hrs		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	VLSI Design
Knowledge on Fundamental Concepts	Combinational, Sequential Logic, Clocking and Timing, Synthesis, Simulation
Knowledge on Connected Tools (If any)	CADENCE

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the ASIC design methodologies and programmable logic cells to implement a function on IC.
CLO2	Interpret the back-end physical design flow, including partitioning, floor-planning, placement, and routing.
CLO3	Know the performance evaluation parameters in FPGA and ASIC VLSI chip designs.
CLO4	Recognize the need for programmable devices
CLO5	Relate design and implementation flow for PLDs

Module – 1	**08 Hrs**
Introduction to ASICs: Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries. **CMOS Logic:** Data path Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells, Cell Compilers. **Text book 1: Ch.1: 1.1 - 1.2,1.5, Ch.2: 2.6 - 2.8**	
Module – 2	**08 Hrs**
ASIC Library Design: Logical effort: Predicting Delay, Logical area and logical efficiency, Logical paths, Multi-stage cells, Optimum delay and number of stages, library cell design. **Programmable ASIC Logic Cells:** MUX as Boolean function generators, Acted ACT: ACT 1, ACT 2 and ACT 3 Logic Modules, Xilinx LCA:XC3000 CLB, Altera FLEX and MAX, Programmable ASIC ,I/O Cells: Xilinx and Altera I/O Block . **Text book 1: Ch.3: 3.3 - 3.4, Ch.5: 5.1 - 5.4**	
Module – 3	**08 Hrs**
Low-level design entry: Schematic entry: Hierarchical design, The cell library, Names, Schematic Icons & Symbols, Nets, Schematic Entry for ASICs, Connections, vectored instances & buses, Edit in place, attributes, Netlist screener. **ASIC Construction:** Physical Design, CAD Tools System partitioning, Estimating ASIC size. Partitioning: Goals and objectives, Constructive Partitioning, Iterative Partitioning Improvement, KL, FM and Look Ahead algorithms. **Text book 1: Ch.9: 9.1, Ch.15: 15.2 - 15.4,15.7**	
Module – 4	**08 Hrs**
Floor planning and placement: Goals and objectives, Measurement of delay in Floor planning, Floor planning tools, Channel definition, I/O and Power planning and Clock planning.	

Placement: Goals and Objectives, Min-cut Placement algorithm, Iterative Placement Improvement, Time driven placement methods, Physical Design Flow. **Text book 1: Ch.16: 16.1 - 16.3**
Module – 5 **08 Hrs**
Routing: Global Routing - Goals and objectives, Global Routing Methods, Global routing between blocks, Back-annotation. Detailed Routing - Goals and objectives, Measurement of Channel Density, Left-Edge Algorithm, Area-Routing Algorithms, Multilevel routing, Timing – Driven detailed routing, Final routing steps, Special Routing, Circuit extraction and DRC. **Text book 1: Ch.17: 17.1 - 17.4**

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate the concepts of ASIC design methodology, data path elements, logical effort
CO2	Analyze the design of ASICs suitable for specific tasks, perform design entry and explain the physical design flow.
CO3	Design data path elements for ASIC cell libraries and compute optimum path delay.
CO4	Develop floor plan including partition, routing using algorithms and EDA tools
CO5	Design CAD algorithms and explain how these concepts interact in ASIC design.

Text Books	
1	Application - Specific Integrated Circuits, Michael John Sebastian Smith, Addison-Wesley Professional, 2005, ISBN - 0-201-50022-1.
2	Physical Design Essentials An ASIC Design Implementation Perspective, Khosrow Golshan Conexant Systems, Inc. 2007 Springer Science Business Media

Reference Books	
1	CMOS VLSI Design: A Circuits and Systems Perspective, Neil H.E. Weste, David Harris, and Ayan Banerjee, Addison Wesley/ Pearson education 3rd edition, ISBN: 978-93-325-4288-4, 2011 **.**
2	VLSI Design: A Practical Guide for FPGA and ASIC Implementations, Vikram Arkalgud Chandrasetty, Springer, ISBN: 978-1-4614-1119-2. 2011
3	An ASIC Low Power Primer, Rakesh Chadha, Bhasker J Springer, ISBN: 978-146144270-7.

Web links /Video Lectures (e – Resources)/online course	
1	https://nptel.ac.in/ https://nptel.ac.in/courses/108106191

CO – PO MAPPING

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

Semester: VII						
Cryptography and Network Security						
Course Code	**:**	BEC724B		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Computer Networks
Knowledge on Fundamental Concepts	Mathematical concepts required for cryptography, Number theory Foundations, protocols
Knowledge on Connected Tools (If any)	NS2/NS3

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the cryptographic algorithms of encryption and decryption process.
CLO2	Know the basic foundation of Cryptography by delivering the basics of symmetric key and public key cryptography.
CLO3	Prepare students with fundamental knowledge/ overview in the field of Network Security with knowledge of security mechanisms and services.
CLO4	Learn the working of transport layer security protocols including SSL, TLS, HTTPS, and SSH.
CLO5	Gain knowledge on IP Security.

Module – 1	**08 Hrs**
Introduction: Computer Security Concepts, A Model for Network Security (Text 1: Chapter 1) **Classical Encryption Techniques:** Symmetric cipher model, Substitution techniques, Transposition techniques **Text Book 1: Ch.1**	
Module – 2	**08 Hrs**
Block Ciphers: Traditional Block Cipher structure, Data encryption standard (DES) **Text Book 1: Ch.2: Section1, 2** The AES Cipher. **Text Book 1: Ch.4: Section 2, 3, 4** **More on Number Theory:** Prime Numbers, Fermat's and Euler's theorem, discrete logarithm. **Text Book 1: Ch.7: Section 1, 2, 5** **ASYMMETRIC CIPHERS:** Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography **Text Book 1: Ch.8, Ch.9: Section 1, 3, 4**	
Module – 3	**08 Hrs**
Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks. **Text Book 3: Ch.1** Security Mechanisms, Services and Attacks, A model for Network security **Text Book 2: Ch.1: 3, 4, 5, 6**	

Module – 4	08 Hrs
Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) **Text Book 2: Ch.15**	
Module – 5	**08 Hrs**
IP Security: Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange. **Text Book 2: Ch.19**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the role of encryption and decryption in maintaining data confidentiality and integrity.
CO2	Apply cryptographic techniques and network security protocols to design secure solutions for basic security challenges.
CO3	Analyze the characteristics of symmetric and asymmetric encryption techniques and evaluate their suitability in various scenarios
CO4	Apply cryptographic techniques and security protocols to solve basic security-related problems in computer networks.
CO5	Examine the architecture and operation of IP Security (IPSec) and Secure Sockets Layer (SSL) protocols.

Text Books	
1	Cryptography and Network Security Principles and Practice, William Stallings, Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3
2	Cryptography and Network Security, Atul Kahate, TMH, 2003

Reference Books	
1	Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007
2	Applied Cryptography Protocols, Algorithms, and Source code in C, Bruce Schneier, Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106105031
2	https://nptel.ac.in/courses/128106006

CO – PO MAPPING

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

Semester: VII						
Biomedical Signal Processing						
Course Code	:	BEC724C		**Credits**	:	3
Hours/Week (L: T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 Hrs		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Signals and Systems, Digital Signal Processing, Linear Algebra
Knowledge on Fundamental Concepts	Fundamentals of biology concepts, Measuring instruments
Knowledge on Connected Tools (If any)	MATLAB, Python

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts and types of biomedical signals, and the challenges associated with their acquisition and analysis.
CLO2	Explore the principles of electrocardiography (ECG) and the characteristics of ECG signals.
CLO3	Learn the concepts of signal enhancement techniques used in biomedical applications
CLO4	Study the data compression techniques and frequency domain signal processing techniques for biomedical data analysis.
CLO5	Examine cardiological and neurological signal processing techniques for the analysis and interpretation of ECG and EEG signals.

Module-1	**08 Hrs**

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis.

Text Book 1: Ch.1: 1.1 - 1.4

Electrocardiography: Techniques used in electrocardiography, ECG Electrodes, the cardiac equivalent generator, genesis of the ECG, the standard and augmented limb leads, ECG Leads, ECG signal characteristics.

Text Book 2: Ch.2: 2.1, 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.2, 2.3

Module-2	**08 Hrs**

Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits: D to A converters, A to D converters, Sample and Hold circuit, Analog Multiplexer.

Adaptive Filters: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, Applications: Maternal ECG in fetal ECG, Cardiogenic artifact, detection of ventricular fibrillation and tachycardia

Text Book 2: Ch.3: 3.2, 3.3, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5, Ch.8: 8.1, 8.2, 8.3.1, 8.3.2, 8.3.3.

Module– 3	**08 Hrs**
Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, Software for signal averaging. **Data Reduction Techniques:** Introduction, turning point algorithm, AZTEC algorithm, Fano algorithm, Huffman coding: Static coding, Modified coding, Adaptive coding, Residual differencing, Run length coding. **Text Book 2: Ch.9: 9.1, 9.2, 9.3, 9.4, Ch.10: 10.1, 10.2, 10.3, 10.4.1, 10.4.2, 10.4.3, 10.4.4, 10.4.5**	
Module– 4	**08 Hrs**
ECG QRS detection: Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques: Template cross correlation, template subtraction, automata-based template matching, a QRS detection algorithm. **ECG Analysis Systems:** Interpretation of the 12 lead ECG, ST segment analyzer, Portable arrhythmia monitor: Holter recording, software and hardware design, arrhythmia analysis. **Text Book 2: Ch.12: 12.1 - 12.5, Ch.13: 13.1.2,13.2,13.3.1,13.3.2,13.3.3**	
Module– 5	**08 Hrs**
Neurological signal processing: The brain and its potentials, origin of brain waves, the EEG signal and its characteristics, EEG analysis, Linear prediction theory, The Autoregressive method, Recursive estimation of AR parameters, Spectral error measure. **Text Book 3: Ch.4: 4.1 - 4.8** **Event detection and waveform analysis:** EEG rhythms, waves and transients, Detection of EEG rhythms, Template matching for EEG spike and wave detection, the matched filter **Text Book 1: Ch.4: 4.2.4, 4.4.1, 4.4.2, 4.6**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the various biomedical signal characteristics and signal conversion parameters relevant to biomedical instrumentation.
CO2	Apply the concepts of signal averaging and adaptive noise cancellation techniques for enhancing the quality of biomedical signals.
CO3	Analyze the various biomedical signals using data compression techniques.
CO4	Utilize QRS detection methods to analyze ECG signals and infer cardiac events.
CO5	Interpret the EEG signals to detect brain rhythms and transients.

Text Books	
1	Biomedical Signal Analysis, Rangaraj M Rangayyan, John Wiley & Sons 2nd Edition-2015, ISBN-9780470911396.
2	Biomedical Digital Signal Processing, Willis J Tompkins, EEE, PHI, 2004.
3	Biomedical Signal Processing: Principles and Techniques, D C Reddy, Tata McGraw-Hill Publishing Co. Ltd, 2005.

Reference Books	
1	Medical Instrumentation: Application & Design, J G Webster, John Wiley & Sons Inc., 2001
2	Principles of Medical Electronics and Biomedical Instrumentation, C Raja Rao, S K Guha, Universities Press, 2001
3	Discrete-time Signal Processing, AV Oppenheim and RW Shafer, Prentice Hall, Englewood Cliffs, NJ, 1989.
Web links and Video Lectures (e-Resources)	
1	https://onlinecourses.nptel.ac.in/noc20_ee41/preview
2	http://www.biomedicahelp.altervista.org/
3	https://www.mathworks.com/discovery/biomedical-signal-processing.html
4	https://www.youtube.com/playlist?list=PLeefXVKiX48qqPwldtml_rzjCqKBKoRFa

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2									2	3	
CO2	3	3									2	3	
CO3	3	3	2	2	2						2	3	
CO4	3	3	3	3	2						2		2
CO5	3	3	2								2		2

Semester: VII						
Real Time System						
Course Code	:	BEC724D		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 Hrs		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Operating System
Knowledge on Fundamental Concepts	Basics of Computer Organization
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Discuss the historical background of Real-time systems and its classifications
CLO2	Learn the concepts of computer control and hardware components for Real-Time Application
CLO3	Discuss the languages to develop software for Real-Time Applications.
CLO4	Understand the concepts of operating system and RTS development methodologies
CLO5	Outline the process of real-time systems from specification to implementation.

Module – 1	**08 Hrs**
Introduction to Real-Time Systems: Historical background, Elements of a Computer Control System, RTS Definition, Classification of Real-time Systems, Time Constraints, Classification of Programs. Concepts of Computer Control: Introduction, Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control, Hierarchical Systems. **Text Book 1: Ch.1: 1.1 - 1.6, Ch.2: 2.1 - 2.6**	
Module – 2	**08 Hrs**
Computer Hardware Requirements for Real-Time Applications: Introduction, General Purpose Computer, Single Chip Microcomputers and Microcontrollers, Specialized Processors, Process-Related Interfaces, Data Transfer Techniques, Communications, Standard Interface. **Text Book 1: Ch.3: 3.1 - 3.8**	
Module – 3	**08 Hrs**
Languages for Real-Time Applications: Introduction, Syntax Layout and Readability, Declaration and Initialization of Variables and Constants, Cutlass, Modularity and Variables, Compilation of Modular Programs, Data types, Control Structures, Exception Handling, Low-level facilities, Co-routines, Interrupts and Device Handling, Concurrency, Real-Time Support, Overview of Real-Time Languages. **Text Book 1: Ch.5: 5.1 - 5.14**	
Module – 4	**08 Hrs**
Operating Systems: Introduction, Real-Time Multi-Tasking OS, Scheduling Strategies, Priority Structures, Task Management, Scheduler and Real-Time Clock Interrupt Handler, Memory Management, Code Sharing, Resource Control, Task Co-Operation and Communication, Mutual Exclusion. **Text Book 1: Ch.6: 6.1 - 6.11**	

Module – 5	08 Hrs
Design of RTS – General Introduction: Introduction, Specification Document, Preliminary Design, Single Program Approach, Foreground/Background System. **RTS Development Methodologies**: Introduction, Yourdon Methodology, Ward and Mellor Method, Hately and Pirbhai Method. **Text Book 1: Ch.7: 7.1 - 7.5, Ch.8: 8.1, 8.2, 8.4,8.5**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the fundamentals and classifications of real-time systems along with their key characteristics.
CO2	Identify different types of hardware used in real-time applications, including general-purpose computers, microcontrollers, and specialized processors.
CO3	Apply the features of real-time programming languages such as syntax rules, data types, control structures, and exception handling to develop modular programs.
CO4	Implement memory management techniques, mutual exclusion mechanisms, and task communication methods used in real-time operating systems..
CO5	Apply basic design steps and approaches used in real-time system development.

Text Books	
1	Real-Time Computer Control, Stuart Bennet, 2nd Edn., Pearson Education. 2008

Reference Books	
1	Real – Time Systems, C.M. Krishna, Kang G. Shin, McGraw –Hill International Editions, 1997
2	Real-Time Systems Design and Analysis, Phillip. A. Laplante, second edition, PHI, 2005.
3	Embedded Systems, Raj Kamal, Tata McGraw Hill, India, third edition, 2005.

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/courses/106/105/106105214/
2	https://onlinecourses.nptel.ac.in/noc20_cs04/preview

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2										2	2	
CO2	3	3									3	3	
CO3	3	3	2	2							3	3	
CO4	3	2	2								2	2	
CO5	3	3	3								3	3	

Semester: VII						
Applied Materials						
Course Code	:	BEC745A		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 Hrs		**SEE**	:	50 Marks
Course Type	:	OEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Basic Electronics, Electronic Devices
Knowledge on Fundamental Concepts	Semiconductor Devices like Diode, Transistor
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Make the students to understand the basics of crystallography and its importance in studying materials properties.
CLO2	Inculcate the knowledge of phase relationships for the understanding of material properties.
CLO3	Understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
CLO4	Instill knowledge on physics of semiconductors, determination of charge carriers and device applications.
CLO5	Establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications.

Module – 1	**08 Hrs**
CRYSTALLOGRAPHY: Crystal structures: BCC, FCC and HCP – directions and planes - linear and planar densities – crystal imperfections- edge and screw dislocations – grain and twin boundaries - Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials - Polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation. **Text Book 1**	
Module – 2	**08 Hrs**
PHASE DIAGRAMS: Phase equilibrium – solubility limit – solid solution (interstitial and substitution) – intermediate phases – inter metallics – electron compound – Gibbs phase rule – Unary phase diagram (iron) – Binary phase diagrams: Isomorphous systems (Cu-Ni) – determination of phase composition and phase amounts – tie line and lever rule – binary eutectic diagram with no solid solution and limited solid solution (Pb-Sn) – eutectoid and peritectic reactions – other invariant reactions – microstructural development during the slow cooling: eutectic, hypereutectic and hypoeutectic compositions. **Text Book 1**	

Module – 3	08 Hrs
ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS: Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory: Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices. **Text Book 2**	
Module – 4	**08 Hrs**
SEMICONDUCTORS AND TRANSPORT PHYSICS: Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode. **Text Book 3**	
Module – 5	**08 Hrs**
OPTICAL PROPERTIES OF MATERIALS: Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state – Electro-optics and nonlinear optics: Modulators and switching devices – plasmonics. **Text Book 4 & 5**	
Course Outcomes: After completing the course, the students will be able to	
CO1	Outline the basics of crystallography and its importance for varied materials properties.
CO2	Interpret the properties of materials through the study of phase relationships.
CO3	Comprehend the electrical and magnetic properties of materials and their applications
CO4	Infer semiconductor physics and functioning of semiconductor devices
CO5	Apply the optical properties of materials and working principles of various optical devices.

Text Books	
1	Materials Science and Engineering: A First Course, V.Raghavan, Prentice Hall India Learning Private Limited, 2015.
2	Principles of Electronic Materials and Devices, Safa Kasap, Mc-Graw Hill, 2018.
3	Semiconductor Devices: Basic Principles, Jasprit Singh, Wiley (India), 2007.
4	Semiconductor Optoelectronics: Physics and Technology, Jasprit Singh, Mc-Graw Hill India, 2019
5	Optoelectronics & Photonics: Principles and Practices, Pearson, 2013

Reference Books	
1	Materials Science and Engineering, R.Balasubramaniam, Callister's, Wiley (Indian Edition), 2014.
2	Essentials of Materials Science and Engineering, Wendelin Wright and Donald Askeland, CL Engineering, 2013.
3	Semiconductor Device Fundamentals, Robert F.Pierret, Pearson, 2006.
4	Semiconductor Devices: Physics and Technology, Simon Sze and Ming-kwei Lee, Wiley, 2015.
5	Semiconductor Optoelectronic Devices, Pallab Bhattacharya, Pearson, 2017.

Web links and Video Lectures (e – Resources)	
1	**https://www.youtube.com/watch?v=o3mpbZ_FRd0**
2	**https://www.youtube.com/watch?v=xCDGFqdw7jU**

CO – PO MAPPING

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

Semester:VII						
Automotive Electronics						
Course Code	**:**	BEC745B		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
TotalHours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	OEC		**SEEDuration**	**:**	3 Hours

Prerequisites:	
Courses	Basic Electronics, Introduction to Electronics & Communication, Fundamentals of Electrical Engineering, and Control Systems.
Knowledge on Fundamental Concepts	Fundamentals of Control Systems, Types of sensors and actuators, Basics of communication networks used in vehicles.
Knowledge on Connected Tools (If any)	MATLAB/Simulink

CourseLearning Objectives: This course will enable the students to	
CLO1	Gain knowledge of the evolution and advancements in automotive electronics.
CLO2	Learn the fundamentals of electronic engine control systems.
CLO3	Classify different types of sensors and actuators used in automotive control systems.
CLO4	Study diagnostic systems to identify and resolve automotive issues
CLO5	Understand emerging automotive electronic systems.

Module-1	**08 Hrs**
Automotive Fundamentals Overview: – Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive systems, The Engine- Engine Block, Cylinder Head, four stroke Cycle, Engine Control, Ignition System- Spark plug, High voltage circuit and distribution, spark pulse generation, ignition timing, diesel engine, Drive Train – Transmission, drive shaft, differential, suspension, brakes, steering system, starter battery operating principle. **Text Book 1: Ch.1, Text Book 2: Pg. 407-410**	
Module-2	**08 Hrs**
The Basics of Electronic Engine Control - Motivation for Electronic Engine, control exhaust emissions, fuel economy, concept of an electronic engine control system, definition of general terms, definition of engine performance terms, engine mapping, effect of air/fuel ratio on performance, spark timing and EGR on performance, control strategy, electronic fuel control system, analysis of intake manifold pressure, electronic ignition. **Text Book 1: Ch.5**	
Module-3	**08 Hrs**
Automotive Sensors and Engine Control Actuators: Automotive control system applications of sensors and Actuators, Variables to be measured, airflow rate sensor, strain gauge MAP sensor, Hall Effect position sensor, Magnetic Reluctance Crankshaft position sensor, Throttle angle sensor, Engine coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2 /EGO) Lambda sensors, piezoelectric Knock sensor. **Automotive Engine Control Actuators** – Solenoid, Fuel Injector, EGR actuator, Ignition system **Text Book 1: Ch.6**	
Module-4	**08 Hrs**
Automotive Diagnostics and safety systems: – Typical Cruise Control System, Antilock Brake System (ABS), Timing Light, Engine Analyzer, On-Board diagnostics, Off-Board diagnostics, Expert Systems, Occupant Protection Systems – Accelerometer-based Air Bag Systems. Safety: Collision Avoidance Radar Warning Systems, Low tire pressure warning systems. **Text Book 1: Ch.8, Ch.10, Ch.11** **Overview of Automotive Network Protocols:** CAN Bus, LIN Bus, MOST Bus, Flex Ray and Bluetooth Diagnostic Interfaces. **Text Book 2: Pg.92-151**	

Module-5	08 Hrs
Future Automotive Electronic Systems: Voice Recognition Cell phone Dialing, Advanced Cruise Control, Automatic Driving Control **Text Book 1: Ch.11** **Electric and Hybrid Electric Vehicles:** Configuration of Electric Vehicles, Performance of Electric Vehicles, Tractive Effort in Normal Driving, Energy Consumption, Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. **Text Book 3: Ch.4:4.1-4.4, Ch.5:5.1-5.2**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the evolution of automotive electronics.
CO2	Analyze the impact of various parameters on engine performance.
CO3	Illustrate the principles of operation for various automotive sensors and actuators.
CO4	Interpret diagnostic data to identify faults in automotive subsystem and resolve the issues.
CO5	Evaluate advanced automotive electronics and electric/hybrid vehicle architectures.

Text Books:	
1	Understanding Automotive Electronics, William B Ribbens, 6th Edition, Elsevier Publishing.
2	Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, Robert Bosch GmbH (Ed.), 5th edition, John Wiley & Sons Inc., 2007.
3	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, M.Ehsani, Y. Gao, S. Gay and Ali Emadi, CRC Press, 2005.

CO – PO MAPPING

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

Semester: VII						
Embedded System Applications						
Course Code	:	BEC745C		**Credits**	:	03
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 Hrs		**SEE**	:	50 Marks
Course Type	:	OEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Embedded system Design, Microcontrollers
Knowledge on Fundamental Concepts	Basic Electronics and Digital Logic, Microprocessors and Microcontrollers, Programming Languages (C/C++ and Assembly).
Knowledge on Connected Tools (If any)	Keil, Arduino IDE

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts, key characteristics, and application areas of embedded systems across various domains.
CLO2	Learn the architectural components of embedded systems, including microcontrollers, memory units, and techniques for low-power design.
CLO3	Explore the role and functionality of sensors, actuators, and analog-to-digital converters (ADCs), and their interfacing with digital systems.
CLO4	Know the embedded system design principles to real-world applications such as mobile communication devices, automotive electronics, RFID-based systems, and biomedical instrumentation.
CLO5	Understand the embedded system design from a systems perspective by breaking down the stages of product design, the design process, testing methodologies, and bulk manufacturing strategies using a typical design example.

Module – 1	**08Hrs**

Introduction to embedded systems: Application domain of embedded systems, desirable features and general characteristics of embedded systems, model of an embedded system, microprocessor Vs microcontroller, example of a simple embedded system, figure of merit for an embedded system, classification of MCUs: 4/8/16/32 bits, history of embedded systems, current trends.

Text Book 1: Ch.1: 1.1 - 1.9

Module – 2	**08 Hrs**

Embedded systems-The hardware point of view: Microcontroller unit (MCU), The Processor, The Harvard Architecture, A popular 8-bit MCU: General Purpose I/O (GPIO), Clock; Memory for embedded systems: Semiconductor Memory, Random Access Memory (RAM), Static RAM (SRAM), An SRAM Chip. Low Power Design, Pull up and Pull Down Resistors.

Text Book 1: Ch.2: 2.1 - 2.2.2, 2.3 - 2.3.2.2, 2.4, 2.5

Module – 3	**08 Hrs**

Sensors, ADCs and Actuators Sensors: Temperature Sensor, Light Sensor, Proximity/range Sensor; Analog to digital converters: ADC Interfacing, Control Interface, Data Interface; Actuators: Displays, Light Emitting Diodes (LED), Seven Segment LED; Motors: Stepper Motors, DC Motors.

Text Book 1: Ch.3: 3.1.1 - 3.1.3, 3.2 - 3.2.1.2, 3.3 - 3.3.1.2, 3.3.2 - 3.3.2.2)

Module – 4	**08 Hrs**

Examples of embedded systems: Mobile phone, Automotive electronics, Radio Frequency Identification (RFID), Wireless Sensor Networks (WISENET), Robotics, Biomedical applications, Brain machine-interface.

Text Book 1: Ch.4: 4.1 - 4.7

Module – 5	08 Hrs
Embedded Design-A Systems Perspective: A Typical Example, Product Design, The Design Process, Testing, Bulk Manufacturing. **Text Book 1: Ch.18: 18.1 - 18.5**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts, characteristics, and applications of embedded systems across various domains.
CO2	Analyze the hardware components of embedded systems, including microcontrollers, memory, and low-power design techniques
CO3	Explore the role of sensors, ADCs, and actuators in embedded systems, and their interfacing with digital systems.
CO4	Apply embedded systems design principles in real-world applications such as mobile phones, automotive electronics, RFID, and biomedical systems.
C05	Analyze the steps in designing an embedded system with a focus on product design, testing, and manufacturing.
Text Books	
1	Embedded Systems: An Integrated Approach, Das, LyLa B, Pearson Education India, ISBN 9788131787663, 2013.
Reference Books	
1	Introduction to Embedded Systems, Shibu K V, Tata McGraw Hill Education
2	ARM System Developers Guide, Andrew N Sloss, Dominic System and Chris Wright, Elsevier, Morgan Kaufman publisher, 1st Edition, 2008.

Web links and Video Lectures (e – Resources)	
1	Embedded Systems: https://nptel.ac.in/courses/108102045
2	Embedded Systems Design: https://onlinecourses.nptel.ac.in/noc20_cs14/preview Android Mobile Application Development
3	Android Mobile Application Development: https://onlinecourses.swayam2.ac.in/nou24_ge66/preview

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2										2	
CO2	3	3	2	2	2							2	
CO3	3	2	3	2	3							2	
CO4	3	3	3	2	3	2			2	2	2	3	
CO5	3	3	2	2	2				2	2	2	2	

Semester: VII						
Sensors and Actuators						
Course Code	:	BEC745D		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50Marks
Total Hours	:	40 Hrs		**SEE**	:	50Marks
Course Type	:	OEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses:	IoT
Knowledge on Fundamental Concepts	Transducers, Sensors and Actuators
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Provide the fundamental knowledge about sensors and measurement system.
CLO2	Impart the knowledge of static and dynamic characteristics of instruments and understand the factors in selection of instruments for measurement.
CLO3	Discuss the principle, design and working of transducers for the measurement of physical time varying quantities.
CLO4	Learn the basics of signal conditioning and signal conditioning equipment.
CLO5	Demonstrate the skill set using modern tool for simulation of virtual instrumentation.

Module – 1	**08 Hrs**
Sensors and Transducers: Introduction, Definition of Sensors and Transducers, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers. **Text Book 1: Ch.16: 16.1 - 16.4** **Measurement:** Introduction to measurement and Instrumentation, Definition, significance of Measurement, Methods of measurement, Modes of measurement, Elements of generalized measurement system with example. Input-output configuration of measuring instruments and measurement systems, Applications of measurement systems. **Text Book 1: Ch.3: 3.1 - 3.7**	
Module – 2	**08 Hrs**
Static and Dynamic Characteristics of instruments: Introduction, Definition relating to measuring instruments. **Static characteristics:** Accuracy, Errors and Correction, Static calibration Range and span. Scale readability Repeatability and Reproducibility, Drift, Accuracy and Precision, Sensitivity, Linearity, Hysteresis, Threshold and Resolution, Dead Zone and Dead Time, Loading Effects and Noise. **Dynamic Characteristics:** Dynamic Response, Dynamic characteristics of a measurement system, Dynamic analysis of a measurement system, Zero, First and Second order system. **Text Book 1: Ch.3: 3.8, 3.8.1 - 3.8.4**	
Module – 3	**08 Hrs**
Measurement of Temperature: Introduction, Temperature measuring instruments, RTD, Thermistors, Thermocouple Thermometers, Radiation Pyrometers, Optical Pyrometers. **Text Book 1: Ch.21: 21.2, 21.2.1 - 21.2.7** **Measurement of Displacement:** Introduction, Principles of Transduction: Variable resistance devices, Variable Inductance Transducer, Induction Potentiometers, Synchros and Resolvers, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer. **Text Book 1: Ch.4: 4.1 - 4.3**	

Module – 4	**08 Hrs**
Measurement of Strain: Introduction, Factors affecting strain measurements, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges, Thin film Guages (principle, types & list of characteristics only), Strain gauge Circuits – Wheatstone bride circuit, Applications. **Text Book 1: Ch.5: 5.1 - 5.5, 5.8, 5.8.1, 5.10** **Measurement of Force & Torque:** Introduction, Force measuring sensor –Load cells – column types devices, proving rings, cantilever beam, pressductor. Hydraulic load cell, electronic weighing system. **Torque measurement:** Absorption type, transmission type, stress type & deflection type. **Text Book 1: Ch.10:10.1,10.2,10.2.1,10.2.2,10.2.3,10.2.6,10.7,10.8,10.9**	
Module – 5	**08 Hrs**
Signal Condition: Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Optical Amplifiers, Electrical and electronic Amplifiers. **Text Book 1: Ch.17:17.1 - 17.8** **Data Acquisition Systems and Conversion:** Introduction, Objectives and Configuration of Data Acquisition System, Data Acquisition Systems, Data Conversion. **Text Book 1: Ch.18:18.1 -18.4**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Discuss the fundamental concepts related to sensors and measurement, functional elements of measurement system, I/O Characteristics of measurement system.
CO2	Interpret and analyse the static and dynamic characteristics of instruments.
CO3	Elucidate the working principle and usage of different transducers for temperature, and displacement measurement
CO4	Discuss the principle and working of strain, force and torque measurement.
CO5	Analyze the signal conditioning and signal conditioning equipment.

Text Books	
1	Electrical and Electronic Measurements and instrumentation, R.K Rajput, S. Chand, 4th Edition, 2015.
2	Instrumentation: Devices and Systems, C S Rangan, G R Sarma, V S V Mani, 2nd Edition (32 Reprint), McGraw Hill Education (India), 2014.

Reference Books	
1	Electrical and Electronic Measurements and Instrumentation, A K Sawhney, 17th Edition, (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.
2	A Course in Electronics and Electrical Measurements and Instruments, J.B. Gupta, Katson Books, 13th Edition, 2008.

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2	https://nptel.ac.in/courses/108105376

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2									3	2
CO2	2	3	2									3	2
CO3	3	3	2									3	2
CO4	2	3	2									3	2
CO5	2	2	3	3	2							3	2

Semester: VII						
Career Readiness and Industry Integration						
Course Code	**:**	BCR737		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	4:0:0		**CIE**	**:**	100 Marks
Total Hours	**:**	60		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Prerequisites:	
Courses	Competency Enhancement Course-1,2,3&4
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools	-

Course Learning Objectives: This course will enable the students to	
CLO1	Strengthen core aptitude and reasoning skills
CLO2	Build confidence and competence for interviews and group activities
CLO3	Develop foundational and advanced problem-solving using Data Structures and Algorithms (DSA)
CLO4	Enable algorithmic thinking through pseudocode
CLO5	Apply clean coding practices in high-pressure environments

Module – 1	**12 Hrs**

Company-Specific Aptitude Practice

Solve previous year question papers from major campus recruiters. These detailed solutions help candidates familiarize themselves with the patterns, difficulty levels, and frequently asked question types of leading companies.

Textbook1, Ch1-7, Textbook 2, Ch1-5

Module – 2	**12 Hrs**

Group Discussion Mastery

Revisiting key principles of effective GDs, Abstract, current affairs, and case-based topics, Role of initiator, moderator, and conclusion leads, Multiple GD rounds with evaluation rubrics, How to stand out without dominating

Resume Writing and Linked Profiling

Effective resume writing involves a clear, results-focused format tailored to the job, highlighting key skills and quantified achievements. A strong LinkedIn profile complements this by showcasing your professional story, skills, endorsements, and active engagement to boost visibility and credibility.

Interview Skills

Quick recap of HR & Technical Interview structures, Smart resume revision techniques

Rebuilding your personal pitch for 2025 placements, Mock Q&A: Handling common & tricky questions, Feedback loops for voice tone, articulation & clarity

Mock Interviews (Technical + HR) Practice Rounds

Individual interview rounds in real-time simulation, Panel-style questioning and cross-questioning, Focused feedback on confidence, grooming, and articulation, Personalized correction pointers for improvement

Textbook -3, Page-1-112

Module-3	12 Hrs
Importance of Competitive Coding for interviews and placements Problem decomposition & edge case identification, Basics of time and space complexity, Story-based introduction to problem-solving, Brainstorm real-world scenarios & translate to problems, Identify edge cases via mini-quizzes, Live walkthroughs (e.g., parking fee calculator), **Coding warm-up challenge** Arrays, Linked Lists, Stacks, Queues, Hashing, Trees, Graphs, Mapping DS to real-life systems (e.g., ticket booking, social feeds), Trade-offs in DS selection, Implement DS in hands-on coding labs, Real-life simulation: Airline or hospital queue system, Use case discussions, Group exercises with efficiency comparisons, Greedy, Divide & Conquer, DP, Backtracking, Practical applications with real-world stories, Efficiency and trade-offs, Debugging complex logic, Group challenge: Route optimization using Dijkstra, Hands-on: Knapsack, Fibonacci DP, Game simulations, Compare multiple approaches for the same problem, Debugging hackathons **Reference Book 1-Ch1-12**	
Module-4	**12 Hrs**
Importance of pseudocode in problem-solving and interview prep Structure and syntax of pseudocode (input/output, conditionals, loops), Translating problem statements into structured pseudocode, Converting pseudocode to actual code (dry run), Common logical mistakes in pseudocode, Aligning pseudocode with data structure & algorithm design, Write pseudocode for classic problems (e.g., factorial, palindrome, searching/sorting), Group activity: Convert real-world scenarios into pseudocode (e.g., ATM simulation, elevator logic), Peer reviews and correction of pseudocode, Dry-run pseudocode vs actual code, Challenge: Write pseudocode for unseen story-based problems **Reference Book 2-Ch1-5**	
Module-5	**12 Hrs**
Real-time coding practice under pressure Clean code and edge case handling, Explaining solutions during interviews, Final review of optimization strategies, Mock interviews with peer & trainer feedback, Solve end-to-end coding case studies, Debugging marathons, Individual reflection + feedback loop **Reference Book 3- Ch1-6**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply foundational aptitude concepts to solve quantitative, verbal and logical reasoning problems with accuracy and efficiency.
CO2	Demonstrate professional communication skills and interview readiness through mock interviews, personal pitch delivery and group discussions.
CO3	Solve coding problems using appropriate data structures and algorithms, recognizing edge cases and optimizing for time/space complexity.
CO4	Interpret real-world problems into structured pseudocode and implement clean, logical solutions in code.
CO5	Perform under interview-like coding conditions, explain approaches and apply debugging techniques to deliver optimal solutions.

Text Books	
1	Quantitative Aptitude for Competitive Examinations, R.S. Aggarwal Chand Publishing. – 2023.
2	Objective English, S.P. Bakshi, 3rd Edition, Arihant Publications – 2021, ISBN- 978-9325791718
3	Cracking the Code to a Successful Interview, Evan Pellett, Blackstone Pub- 2016, ISBN- 978-1441700537

Reference Books	
1	Data Structures and Algorithms, Narasimha Karumanchi, 5th Edition, Careermonk Publications – 2016, ISBN- 978-8193245279
2	Algorithm Design Manual, Steven Skiena, 1st Edition, SPRINGER NP EXCLUSIVE(CBS)-2017, ISBN- 978-1849967204
3	Cracking the Coding Interview, Gayle Laakmann McDowell, 6th Edition, CareerCup-2015, ISBN- 978-0984782857

Web links and Video Lectures (e – Resources)	
1	https://www.placementpreparation.io/quantitative-aptitude/
2	https://www.examsnet.com/quantitative-aptitude
3	https://www.testmocks.com/blog/reasoning-mock-test/
4	https://www.practice4me.com/verbal-ability-test/
5	https://codersdaily.in/start/verbal-aptitude-test
6	https://grow.google/certificates/interview-warmup/
7	https://course.flourish.careers/interview-essentials-toolkit
8	https://gdpiwat.com/gd-concepts/
9	https://timespro.com/online-courses/certificate-program-in-professional-grooming-and-workplace-behaviour
10	https://www.edstellar.com/course/grooming-etiquette-training
11	https://www.hackerrank.com/
12	https://www.codechef.com/practice
13	https://codeforces.com/blog/entry/23054
14	https://algocademy.com/blog/how-to-write-pseudocode-that-impresses-interviewers/
15	https://algocademy.com/blog/how-to-use-pseudocode-effectively-in-technical-interviews-a-comprehensive-guide/
16	https://codeforces.com/
17	https://leetcode.com/

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3									2
CO2								3	3		2
CO3	3	2	3	3	2						3
CO4	3	2	3	3	2						2
CO5	2	2	3					2	2		3

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

AICTE Approved, Accredited by NBA(CSE, ISE, ECE, ME, CV) and NAAC with 'A+' grade, QS – I Gauge Gold Rated

SCHEME OF TEACHING AND EXAMINATION – B.E. – Branch Name ECE

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

8th Semester

Electronics and Communication Engineering												
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**TD/ PSB**	**Teaching Hours / Week**			**Examination**				
					L	**T**	**P**	**SEE Duration (Hrs)**	**CIE Marks**	**SEE Marks**	**Total Marks**	**Credits**
1	BEC821x	Professional Elective Course - IV (Online Course) only through NPTEL / VTU MOOC / Centre of Excellence of the concerned department	PEC		3	0	0	**3**	**50**	**50**	**100**	**3**
2	BEC842x	Open Elective Course - III (Online Course) only through NPTEL / VTU MOOC / Centre Of Excellence of the concerned department	OEC		3	0	0	**3**	**50**	**50**	**100**	**3**
3	BEC833	Internship (Industry / Research / Rural) (14 – 20 weeks)	INT		0	0	12	**3**	**100**	**100**	**200**	**8**
									200	**200**	**400**	**14**

PEC: Professional Elective Course, OEC: Open Elective Course, INT: Industry Internship / Research Internship, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Professional Elective Course – IV (Online Course – only through NPTEL, suggested by BoS)

Course Code	Course Name	Course Code	Course Name
BEC821A	Artificial Intelligence: Search methods for problem solving	BEC821C	System on Chip
BEC821B	Understanding Incubation and Entrepreneurship	BEC821D	Modern Digital Communication Techniques

Open Elective Course – III (Online Course – only through NPTEL, suggested by BoS)

Course Code	Course Name	Course Code	Course Name
BEC842A	Wireless and Mobile Communication	BEC842C	Analog IC Design
BEC842B	Embedded Sensing, Actuation and Interfacing Systems	BEC842D	Power Management Integrated Circuits

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.
Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.
Elucidation: At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship / Rural Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship. Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes. The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 Weeks. The internship shall be considered as a head of passing and shall be considered for the award of a Degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements. **Research internship:** A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research. **Industry internship:** Is an extended period of work experience undertaken by students to supplement their Degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints. **Rural Internship:** Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

Credit Definition

1-hour Lecture (L) per week=1Credit	04-Credits courses are to be designed for 50 hours of Teaching-Learning Session
2-hoursTutorial(T) per week=1Credit	04-Credits (IC) are to be designed for 40 hours' theory and 12-14 hours of practical sessions
2-hours Practical / Drawing (P) per week=1Credit	03-Credits courses are to be designed for 40 hours of Teaching-Learning Session
2-hous Skill Development Actives (SDA) per week = 1 Credit	02- Credits courses are to be designed for 25 hours of Teaching-Learning Session
	01-Credit courses are to be designed for 12-15 hours of Teaching-Learning sessions

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.
- Promoting Excellence in Teaching, Training, Research and Consultancy.
- Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.
- Developing Entrepreneurial acumen to venture into Innovative areas.
- Imparting Value based Professional Education with a sense of Social Responsibility.

Department Vision

Transforming Individuals into Competent Electronics and Communication Engineers for Technological and Societal Advancements.

Department Mission

- Strengthening Fundamental Knowledge for Academic and Professional Excellence.
- Empowering innovation through Research in Emerging Technologies.
- Fostering Industry-Institute Collaboration for Technical & Entrepreneurial Progress.
- Equipping Students with Technical Skills and Ethical Values to cater Societal Needs.
- Nurturing Supportive Environment for Lifelong Learning.

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

P.B. No.20, B.B Road,

Chikkaballapur - 562 101, Karnataka