BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi)

Avalahalli, Yelahanka, Bengaluru 560064

Bachelor of Engineering

Department of Electronics and Communication Engineering

VII Semester Scheme and Syllabus
2021 Scheme – Autonomous
AY 2024-2025

Approved in the BoS meeting held on 20.07.2024

Vision and Mission of the Department

Vision

Be a pioneer in providing quality education in electronics, communication, and allied engineering fields to serve as a valuable resource for industry and society

Mission

1. Impart sound theoretical concepts and practical skills through innovative pedagogy

2. Promote Interdisciplinary Research

3. Inculcate Professional Ethics

Program Educational Objectives (PEOs)

1. Work as Professionals in the area of Electronics, Communication and Allied Engineering Fields.
2. Pursue Higher Studies and involve in Interdisciplinary Research Work.
3. Exhibit Ethics, Professional Skills and Leadership Qualities in their Profession.

Program Specific Outcomes (PSOs)

1. Demonstrate the knowledge of electronic devices, circuits, micro-nano electronics and other fundamental courses to exhibit competency in the domain of VLSI design.
2. Comprehend the gathered knowledge and technological advancements in the field of communication and signal processing.
3. Exhibit the skills gathered to analyze, design, develop software applications and hardware products in the field of embedded systems and allied areas.

Program Outcomes (POs)

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that

meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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BMS Institute of Technology and Management
(An Autonomous Institution, Affiliated to VTU Belagavi)
Avalahalli, Doddaballapur Main Road, Bengaluru, Karnataka – 560064

Ref.: BMSIT&M/Exam/2023-24/ 103 **Date:** 21.09.2024

CONTINUOUS INTERNAL EVALUATION
AND
SEMESTER END EXAMINATION PATTERN
(Applicable to UG students of 2021 Batch, effective from the Academic year 2024-25 onwards)

The UG students admitted during 2021-22 are hereby informed to note the following with reference to Continuous Internal Evaluation and Semester End Examination pattern:

The weightage for Continuous Internal Evaluation (CIE) is 50%, and for Semester End Examinations (SEE), it is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 out of 50), while for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50). A student will be declared to have passed the course if they secure at least 40% (40 out of 100) in the combined total of the CIE and SEE.

The details below summarize the CIE and SEE Pattern for the courses of 2021 scheme of various credits:

4 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- **Internal Assessment (IA) Tests:** 2 IAs to be conducted for **40 Marks** (90 minutes each). Total of 2 tests will be 80 and the same can be scale down to **30 Marks.**
- **Alternate Assessment Tool (AAT):** 2 AATs each of **10 Marks**, total **20 Marks.** Any Two AATs can be used from the list. If it is project based, one AAT shall be given.
- **Total CIE Marks** = 30 + 20 = **50 Marks**
- Student has to score a minimum of **20 Marks** (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

- SEE is conducted for 100 Marks (3 hours).
- **Question Paper Pattern:**
  - **Part - A:** Comprises 20 objective type questions carrying 1 Mark each with a total 20 Marks.
  - **Part - B:** There will be **5 modules**. Each module will have **TWO questions carrying 16 marks** each. There will be a maximum of three sub section for each question. **Student has to answer any ONE full question.**

- **SEE Marks = 20 + 80 = 100 marks and can be scale down to 50 marks.**

3 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- **Internal Assessment (IA) Tests:** 2 IAs to be conducted for **40 Marks** (90 minutes each). Total of 2 tests will be 80 and the same can be scale down to **30 Marks.**
- **Alternate Assessment Tool (AAT):** 2 AATs each of **10 Marks**, total **20 Marks.** Any Two AATs can be used from the list. If it is project based, one AAT shall be given.
- **Total CIE Marks** = 30 + 20 = **50 Marks**
- Student has to score a minimum of **20 Marks** (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

- SEE is conducted for 100 Marks (3 hours).
- **Question Paper Pattern:**
  - **Part - A:** Comprises 20 objective type questions carrying 1 Mark each with a total 20 Marks.
  - **Part - B:** There will be **5 modules**. Each module will have **TWO questions carrying 16 marks** each. There will be a maximum of three sub section for each question. **Student has to answer any ONE full question.**

- **SEE Marks = 20 + 80 = 100 marks and can be scale down to 50 marks.**

2 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- Internal Assessment (IA) Tests: 2 IAs of MCQ type to be conducted for 40 Marks (60 minutes each). Total of 2 tests will be 80 and the same can be scale down to **30 marks.**
- **Alternate Assessment Tool (AAT):** 2 AATs each of 10 marks, total **20 marks.** Any Two AATs can be used from the list. If it is project based, one AAT shall be given.
- **Total CIE Marks** = 30 + 20 = **50 Marks**
- Student has to score a minimum of 20 marks (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

SEE is conducted for 100 Marks (2 hours).

Question Paper Pattern:

- The pattern of the question paper is MCQ.
- SEE question paper will be set for 100 questions each of 01 marks. The same is scale down to 50 marks. Minimum SEE Marks: 40% (i.e. 20 Marks out of 50)

1 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- **Internal Assessment (IA) Tests:** 2 IAs of MCQ type to be conducted for 40 Marks (60 minutes each). Total of 2 tests will be 80 and the same can be scale down to **30 marks.**
- **Alternate Assessment Tool (AAT):** 2 AATs each of 10 marks, total **20 marks.** Any Two AATs can be used from the list. If it is project based, one AAT shall be given.
- **Total CIE marks** = 30 + 20 = **50 Marks**
- Student has to score a minimum of **20 Marks** (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

- SEE is conducted for **50 Marks** (1 hours).
- **Question Paper Pattern:**
  - The pattern of the question paper is MCQ.
  - SEE question paper will be set for 50 questions each of 01marks. The same is scale down to **50 Marks**.

1 CREDIT LABORATORY COURSE / PROFESSIONAL CORE LABORATORY / ABILITY ENHANCEMENT COURSE

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- **Cumulative Assessment (CA)** of each experiment is 20 Marks (Conduction 10 marks + Records 5 marks +Viva 5marks). The average of all the experiments to be taken for **20 Marks.**
- **Open Ended Experiments (OE) 10 Marks.**
- **2 IAs Test** to be conducted for 100 marks. General rubrics suggested for SEE are: Writeup 20 marks, Conduction of the experiments, calculations, graphs, results, etc.: 60 marks and Viva: 20 marks. The average of 2 IA marks is scale down to **20 Marks**.
- **CIE marks** =20 (CA) +10 (OE) + 20 (IA test) = **50 Marks**.
- Student has to score a minimum of **20 Marks** (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

- SEE is conducted for 100 Marks.
- Examinations to be conducted jointly by Two examiners.
- All the experiments are to be included for practical examination.
- General rubrics suggested for SEE are: Writeup 20 marks, Conduction of the experiments, calculations, graphs, results, etc.,: 60 marks and Viva: 20 marks.

Learning Activities for AATs:

A faculty member may choose the following AATs based on the needs of the course:

1. Course project
2. Literature review
3. MOOC
4. Case studies
5. Tool exploration
6. GATE-based aptitude test
7. Open book tests
8. Industry integrated learning
9. Analysis of Industry / Technical / Business reports
10. Programming assignments with higher Bloom level
11. Group discussions
12. Industrial / Social / Rural projects

CoE 21/09/2024

Dean AA 21.09.24

Principal 21/9/2024

Copy To:

1. The Vice-Principal, Deans, HoDs, and Associate HoDs
2. All faculty members and students of 2021 batch.
3. Examination Section

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute affiliated to VTU)

B. E. in Electronics & Communication Engineering

Scheme of Teaching and Examination -2021 Scheme AY 2024-2025

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

UG PROGRAM: Electronics and Communication Engineering (ECE) — **Semester: VII**

Sl. No.	Course Category	Course Code	Course Title	Teaching Dept.	Teaching Hours /Week				Credits	Examination			
					L	T	P	PW		Duration in Hours	CIE Marks	SEE Marks	Total Marks
1	HS	21HSS71	Research Methodology	EC	2	0	0	0	2	2	50	50	100
2	AEC	21EC72	Computer Networks Lab	EC	For Theory Course: 1	0	0	0	1	1	50	50	100
					For Practical course: 0	0	2	0		2			
3	PE	21EC73X	Professional Elective III	EC	3	0	0	0	3	3	50	50	100
4	PE	21EC74X	Professional Elective IV	EC	3	0	0	0	3	3	50	50	100
5	OE	21EC75X	Open Elective II	EC	3	0	0	0	3	3	50	50	100
6	PW	21ECP76	Project Work Phase I	EC	0	0	0	10	5	-	100	-	100
TOTAL					**12**	**0**	**2**	**10**	**17**		**350**	**250**	**600**

Professional Elective - Group III

Course Code	Course Title
21EC731	Real Time Systems
21EC732	Satellite Communication
21EC733	Optical Fiber Communication
21EC734	DSP Algorithms and Architecture
21EC735	Biomedical Signal Processing

Professional Elective - Group IV

Course Code	Course Title
21EC741	Wireless Sensor Networks
21EC742	Network Security and Cryptography
21EC743	Advanced Computer Networks
21EC744	Operating system
21EC745	Low Power VLSI

Open Elective (OE) - Group II

Course Code	Course Title
21EC751	Biomedical Engineering
21EC752	Nano Engineering
21EC753	Unmanned Aerial Vehicles (UAV)
21EC754	Automotive Electronics

BMS Institute of Technology and Management, Bengaluru 560064
B.E ELECTRONICS AND COMMUNICATION ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - VII

Research Methodology (2:0:0)2
Common to all Branches
(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21HSS71**	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:0:0	SEE Marks	50
Total Number of Lecture Hours	26	Exam Hours	02

CREDITS: 02

Course objectives:
This course will enable students to
1. Give an overview of the research methodology, research problem.
2. Gain knowledge on research design.
3. Design of sampling survey and measurement & scaling.
4. Understand data collection and data preparation.
5. Familiarize interpretation and writing research reports.

Module – 1

Introduction: Importance of Research and Development (R&D) for development of Nation, Introduction to research and research methodology.
Meaning of Research, objectives of Research, Types of research, Research Approaches, Significances of Research, Research Process, Criteria of Good Research.

Defining the Research Problem: What is a Research Problem? Selecting the Research Problem, Necessity of Defining the Problem, Techniques Involved in Defining a problem. **(6 Hours)**

Module – 2

Research Design: Meaning of Research Design, need for Research design, Feature of a Good design, Important concepts relating to Research Design: Dependent, independent and extraneous variable, Control, Confounded relationship. Research Design in case of exploratory research studies, in case of descriptive and diagnostic research studies Basic Principles of Experimental Designs. **(5 Hours)**

Module – 3

Design of sampling survey: Sample Design: Objective, sampling units and frame, size of sample, parameter of interest, selection of proper sample design, pilot survey and budgetary constraints.

Sampling errors, non-sampling errors, Sample survey vs. census survey, on-probability samplings.

Measurement and scaling: Quantitative and qualitative data, Classification of measurement scales. Goodness of measurement scales: Techniques of developing measurement tools, scaling, Scale classification bases, scaling techniques. **(5 Hours)**

Module – 4

Data Collection: Experiments and Surveys, collection of primary data: observation method, Interview method. Collection of data through questionnaires, Collection of data through schedules. Collection of secondary data. Selection of appropriate method for data collection, case study method.

Data Preparation: Questionnaire checking, editing, coding, tabulation, data cleaning, data adjusting, problems in preparation process, missing values and outliers, type of analysis. **(5 Hours)**

Module – 5

Interpretation and Report Writing
Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of Research Report, Types of Reports: Technical report, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research. **(5 Hours)**

Course outcomes:
The students will be able to:

CO1	Acquire some basic concepts of research and its methodologies.
CO2	Describe the different types of research design methods
CO3	Explain the various sampling, measurement and scaling techniques.
CO4	Analyse ethical practices in conducting the research and dissemination of results in different forms using data collection and data preparation methods.
CO5	Apply Various methods to interpret research reports.

Text Book:

1. CR Kothari and Gaurav Garg, Research Methodology, New Age International Publishers, 2020.

References:

1. Panneerselvam R, Research Methodology, Prentice Hall of India, New Delhi, 2004.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U K, An introduction to Research Methodology, RBSA Publishers, 2002.
3. Ranjit Kumar, Research Methodology, 4th Edition, SAGE Publications Ltd. 2014.

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Computer Networks Lab (0:0:2) 1

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC72**	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	50
Total Number of Contact Hours	14	Exam Hours	02

Course objectives:

This course will enable students to:

1. Apply the networking fundamentals to create the simulations on various concepts and algorithms.
2. Demonstrate the working of various network concepts and algorithms using simulations.

Preamble:

This is the lab course, designed to get practical exposure to computer communication networks. This lab involves demonstrating various concepts of computer networking with the help of simulation.

List of experiments.

PART-A: Simulation experiments using NSZ/ 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, nl-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between nl-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 ESS with transmission nodes in Wireless LAN and obtain the

performance parameters.

PART-B: Implement the following in C/C++ programming language

1. Write a program for a HLDC flame to perform the following.
i) Bit stuffing
ii) Character stuffing.

2.Implement Dijkstra's algorithm to compute the shortest routing path.

3. For the given data, use CRC-CCITT polynomial to obtain CRC code.
Verify the program for the cases
a. Without error
b. With error

4. Write a program for congestion control using leaky bucket algorithm.

Course outcomes: The students will be able to:

CO1: Apply the networking fundamentals for real time application

CO2: Conduct an experiment to demonstrate the working of various network concepts and algorithms

C03: Record the observed results for the conducted experiments.

Alternate Assessment Tools (AATs) suggested:

- Open-ended lab experiments

Textbooks

1. B.Forouzan "Data Communications and Networking" 5th Edition, McGraw Hill, 2020

References

1. James J Kurose, Keith W Ross, Computer Networks, 3rd Edition, Pearson Education, 2013
2. Wayarles Tomasi , Introduction to Data Communication and Networking , 3rd Edition, Pearson Education ,2007.

Web link and e-resources:

- https://www.nsnam.org/

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Choice Based Credit System (CBCS)

SEMESTER - VII

Real Time System (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC731**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students:

1. To study the basic of Real time systems and computer control systems
2. To understand real time operating system and real time databases
3. To analyze real time algorithms
4. To design Real-Time Systems for applications in real-time modeling
5. To understand Real time applications

Preamble:

This course is designed to get insight knowledge of Real-time processing, which is a method of processing data at a near-instant rate, requiring a constant flow of data intake and output to maintain real-time insights

Module – 1

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.
Introduction to computer control, Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control, Hierarchical Systems. (Text-1: 1.1to 1.6 and 2.1 to 2.6)

(8 hours)

Module – 2

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-1: 3.1 to 3.8)

(8 Hours)

Module – 3

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-1: 6.1 to 6.11)(8 Hours)

Module – 4

Real Time Databases: Basic Definition, Real time Vs General purpose databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Two-phase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time System.
Ref. 1 (8 Hours)

Module – 5

Real-Time Modeling and Case Studies: Petrinets and applications in real-time modeling, Air traffic controller system – Distributed air defense system. Ref. 3
(8 Hours)

Course outcomes: The students will be able to:

CO1	Understand the fundamentals of Real time systems and their classifications.
CO2	Familiarize the concepts of computer control and the suitable computer hardware requirements for real-time applications.
CO3	Apply the knowledge of operating systems to develop Real-Time Systems.
CO4	Analyse the concepts of real time databases to develop applications in real-time modeling.

Text Books:

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

References:

1. C.M. Krishna, Kang G. Shin, "Real Time Systems", Tata McGraw - Hil, 2010.
2. Giorgio C. Buttazzo , "Hard real-time computing systems: predictable scheduling algorithms and applications", Springer, 2008.
3. C. Siva Ram Murthy, G. Manimaran, "Resource management in real-time systems and networks", PHI, 2009.
4. Real-Time Systems Design and Analysis, Phillip. A. Laplante, second edition, PHI, 2005.

Alternate Assessment Tools (AATs) suggested:

Technical group presentation related to recent trends in real time systems and their applications by selecting a suitable case study.

Web links/e-resources:

Real-Time Systems - Course (nptel.ac.in)
https://www.geeksforgeeks.org/real-time-systems/

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Satellite Communication (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC732**	CEE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Study the history of satellites, frequency bands used, basic principle of satellite orbits and trajectories.
2. Analyze the electronic systems associated with a satellite and the earth station.
3. Analyze the various technologies associated with the satellite communication.
4. Summarize on a communication satellite and the national satellite system.
5. Discuss the satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation.

Preamble:

This course of satellite communication deals with the concepts and principles of satellite orbits, different modulation adopted in satellite communication. it deals with the architecture involved in constructing the satellites.

Module – 1

Introduction: History of the scientific developments in this field, significance and scope of the course, impact of the course on sustainable solutions and national economy, career perspective, innovations and state of the art (for 2-3 hours)

Introduction to Satellite Communication: Introduction: Overview of Satellite Communications, GEO, MEO and LEO satellite systems, frequency bands.

Orbital Mechanics: Orbit Equations, Locating the satellite w.r.t. the earth, Orbital elements, Look Angles, Orbital perturbation, Effects of earth's oblate ness, moon and sun, Satellite eclipse, sun transit outage, Coverage angle, slant range, satellite launching (Text1)

Module – 2

Satellite subsystems: Attitude and Orbit Control System(AOCS), Telemetry, Tracking and Command System(TT&C), Power System, Satellite antennas, Communications subsystem, transponders. **(Text1)**

Module – 3

Modulation and Multiplexing: FM with multiplexed telephone signals, Analog FM SCPC, PSK, QPSK, Multiple Access Schemes: FDM/FM/FDMA, TDMA, and Frame structure, frame acquisition, synchronization, TDMA in VSAT network, CDMA, Spread spectrum transmission and reception.

Satellite Link Design: Basic transmission theory, System noise temperature and G/T ratio, CNR, CIR, ACI, IMI, Down link design, Up link design, System design examples **(Text 1)**

Module – 4

Error Control for Digital Satellite Links: Error control coding, Block codes, Convolution codes, - Implementation of error detection on satellite links

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 2)**

Module – 5

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 2).**

Case study: A case study on educational satellite, commercial satellite, satellite phone working, WCDMA, link to DTH connections and Power level, Direct cables, Satellite connections and CNR. Students can explore Airtel DTH, ATM Banking/VSAT, Satellite radio, Radio Broadcasting.

Summary of the Course

Course outcomes:

The students will be able to:

CO1	Understand the satellite orbits and its trajectories with the defintions of parameters associated with it.
CO2	Describe the electronic hardware system associated with the satellite subsystem and earth station
CO3	Describe the communication satellites with the focus on national satellite system
CO4	Compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques
CO5	Eludicate the applocations of satellites in remote sensing, weather forecasting and navigation

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition
Textbooks				
1	Satellite Communications,	Timothy Pratt, Charles Bostian Jermey Allnutt	John Wiley, Singapore, 2013.	2e
2	Satellite Communications,	Anil K. Maini, Varsha Agrawal.	Wiley India Pvt. Ltd	2015
Reference Books				

1.	Satellite Communication Systems Engineering	Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson	Prentice Hall/Pearson	2007
2.	The Satellite Communication Applications	Bruce R. Elbert,	Hand Book, Artech House Bostan London	2e

Alternate Assessment Tools (AATs) suggested:

- Poster presentation on recent advancements adapted in satellite communication

Web links / e – resources:

- https://onlinecourses-archive.nptel.ac.in/noc17_ec14/preview
- https://archive.nptel.ac.in/courses/117/105/117105131/

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Optical Fiber Communication (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC733**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. Understand working principle and characteristics of optical fibers and connectors.
2. Explain the construction and operation of optical sources, detectors and devices.
3. Describe the concept of optical networking and various optical networks.

Preamble:

This course provides students with a comprehensive understanding of the principles, technologies, and applications of optical fiber communications. As the backbone of modern telecommunications and data networks, optical fiber communication plays a crucial role in enabling high-speed, high-capacity, and long-distance transmission of information.

Module – 1

Overview of Optical Fiber Communication:

Introduction: Historical development, 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 (no derivations in article 2.4.4), Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers. (Text 1)

Module – 2

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. (Text 1)

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. (Text 1)

Module – 3

Optical sources:

Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation of an LED. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant Frequencies. (Text 2)

Photodetectors:

Physical principles of Photodiodes, Photo detector noise, Detector response time. (Text 2)

Optical Receiver:

Optical Receiver Operation: Error sources, Front End Amplifiers, Receiver sensitivity, Quantum Limit. (Text 2)

Module – 4

WDM Concepts and Components:

Overview of WDM: Operational Principles of WDM, WDM standards, Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings. Optical amplifiers: Basic application and Types. Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers, Raman Amplifiers, Wideband Optical Amplifiers. (Text 2)

Module – 5

Optical network evolution and concepts: Optical networking terminology, Optical network node and switching elements, Wavelength division multiplexed networks, public telecommunication network overview. (Text 1)

Optical network transmission modes, layers and protocols: Synchronous networks, Asynchronous transfer mode, OSI reference model, Optical transport network, Internet protocol, Wavelength routing networks: Routing and wavelength assignment, Optical switching networks: Optical circuit switched networks, packet switched networks, Multiprotocol Label Switching, Optical burst switching networks. (Text 1)

Course outcomes: The students will be able to:

CO1: Classify and describe working of optical fiber with different modes of signal propagation.

CO2: Analyze the transmission characteristics and losses in optical fiber communication.

CO3: Describe the constructional features and working principle of optical active and passive devices.

CO4: Illustrate the networking aspects of optical fiber and describe various standards associated with it.

Alternate Assessment Tools (AATs) suggested:

- Technical presentation in a group on Emerging Technologies and Applications in optical finer communication

Textbooks

1. John M. Senior, "Optical Fiber Communications Principles and Practice", Third Edition, Pearson Education, 2010,ISBN:978-81-317-3266-3.
2. Gerd Keiser, "Optical Fiber Communication", Fifth Edition, McGraw Hill Education (India) Private Limited, 2015.ISBN:l-25-900687-5.

References

1. P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited.

Web links/e-resources:

- https://nptel.ac.in/courses/115107095
- https://archive.nptel.ac.in/courses/108/106/108106167/

- https://en.wikipedia.org/wiki/Fiber-optic_communication

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VII

DSP Algorithms and Architecture (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC734**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. Figure out the knowledge and concepts of digital signal processing techniques.
2. Understand the computational building blocks of DSP processors and its speed issues.
3. Understand the various addressing modes, peripherals, interrupts and pipelining structure of the TMS320C54xx processor.
4. Learn how to interface the external devices to the TMS320C54xx processor in various modes.
5. Understand basic DSP algorithms with their implementation.

Preamble: DSP Algorithms and Architecture course will equip with the knowledge of exploring powerful algorithms that transform analog signals into a digital signals computers can understand. The subject deals about specialized architectures designed to handle these computations efficiently. By the end the skills required to design and implement digital signal processing solutions, unlocking the power of digital signals in various applications will be gained.

Module – 1

Introduction:

Introduction to DSP systems, significance and scope of Digital signal processors in current scenario, industry applications, research and innovations related to digital signal processors, impact on course on societal problems.

Introduction to Digital Signal Processing: Introduction, A Digital Signal — Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.

Computational Accuracy in DSP Implementations: Number Formats for Signals and Coefficients in DSP Systems, Dynamic Range and Precision, Sources of Error in DSP Implementation

(9 Hours)

Module – 2

Architectures for Programmable Digital Signal — Processing Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing. (7 Hours)
Module – 3
Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS320C54XX, Memory Space of TMS320C54xx Processors, Program Control. Detail Study of TMS32OC54X & 54xx Instructions and Programming, On — Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54xx Processor. (9 Hours)
Module – 4
Implementation of Basic DSP Algorithms: Introduction, The Q — notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). **Implementation of FFT Algorithms:** Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit — Reversed Index. Generation & Implementation on the TMS320C54xx. (7 Hours)
Module – 5
Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/ Direct Memory Access (DMA). **Interfacing and Applications of DSP Processors:** Introduction, Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System. (8 Hours)
Course outcomes: The students will be able to:
CO1: Comprehend the knowledge and concepts of digital signal processing techniques.
CO2: Apply the knowledge of DSP computational building blocks to achieve speed in DSP architecture or processor.
CO3: Apply knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C54xx processor.
CO4: Develop basic DSP algorithms using DSP processors
C05: Discuss about synchronous serial interface and multichannel buffered serial port (McBSP) of DSP device and demonstrate the programming of CODEC interfacing.

Textbooks

1.Digital Signal Processing", Avatar Singh and S. Srinivasan, Thomson Learning, 2004.

Reference Books:

1. Digital Signal Processing: A practical approach", Ifeachor E. C., Jervis B. W Pearson-Education, PHI,2002.
2. "Digital Signal Processors", B Venkataramani and M Bhaskar, TMH, 2nd, 2010
3. "Architectures for Digital Signal Processing", Peter Pirsch John Wiley, 2008

Alternate Assessment Tools (AATs) suggested:

Mini Project: Students have to take up mini project in a team to design and implement a complete digital signal processing system using learned algorithms and architectures. This could involve filtering real-world audio data, analyzing medical signals, or developing a software tool for a specific DSP application. The evaluation of AAT is based on project work demonstration and Report submission.

Web links / e – resources:

- https://archive.nptel.ac.in/courses/108/101/108101174/
- https://www.ti.com/microcontrollers-mcus-processors/digital-signal-processors/overview.html
- https://www.mdpi.com/2079-9292/12/4/1012
- https://in.mathworks.com/products/dsp-system.html
- https://www.ti.com/lit/ug/spru352g/spru352g.pdf?ts=1720770252127&ref_url=https%253A%252F%252Fwww.google.com%252F

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Biomedical Signal Processing (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	21EC735	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. Describe the origin, properties and suitable models of important biological signals such as ECG and EEG.
2. Know the basic signal processing techniques in analyzing biological signals.
3. Acquire mathematical and computational skills relevant to the field of biomedical signal processing.
4. Know the complexity of various biological phenomena.
5. Describe the basics of ECG signal compression techniques.

Preamble:

This course, Biomedical Signal Processing, delves into the signals generated by the human body, exploring their origin, characteristics and analysis. This course teaches about common biomedical signals like ECG (heart) and EEG (brain), along with techniques for filtering noise, extracting key features, and interpreting the information they carry. By the end, the skills to process these signals and unlock valuable insights into human health and disease will be gained, paving the way for advancements in medical diagnosis, treatment, and monitoring.

Module – 1

Introduction to Biomedical Signals: The nature of biomedical signals, objectives of biomedical signal analysis, difficulties encountered in biomedical signal analysis, Computer aided diagnosis. Case study on Neuralink's brain-machine interface system.

Neurological Signal processing: Brain and its potentials, Electrophysiological origin of Brain waves, EEG signal and its characteristics, EEG analysis, Linear prediction theory, Autoregressive (AR) method, Recursive Estimation of AR parameters, Spectral error measure, Adaptive segmentation. (8 Hours)

Module – 2

Filtering for Artifacts Removal: Random noise, structured noise and physiological interference, stationary versus non-stationary processes, typical case study, time domain filters with application: Synchronized averaging, moving-average filters Frequency domain filters with examples, removal of high frequency noise by Butterworth low pass filters, removal of low frequency noise by Butterworth high pass filter, removal of periodic artifacts by notch and comb filters. Weiner filter. (8 Hours)

Module – 3

Basics of signal averaging: Signal averaging as a digital filter, A typical average, Software for signal averaging, Limitations of signal averaging.
Acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of Sleep-wave Transitions, Hypnogram Model Parameters. (8 Hours)

Module – 4

Cardiological Signal processing: ECG signal characteristics, ECG Parameters and their estimation, A review of wiener filtering problem, Principle of an adaptive filter, the steepest descent algorithm, Adoptive noise canceller, Cancellation 60Hz Interference in ECG, Cancelling Donor heart Interference in Heart-transplant ECG, Cancellation of Electrocardiographic signals from the electrical activity of chest muscles, Cancelling of maternal ECG in Fetal ECG, Cancellation of higher frequency noise in electro-surgery. (8 Hours)

Module – 5

Data compression: Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Other data compression techniques, Data compression techniques comparison.

Biomedical Equipment: Role of biomedical equipment in healthcare, safety standards for the bio-medical equipment. (8 Hours)

Course outcomes: The students will be able to:

CO1: Analyze the nature of Biomedical signals and related concepts

CO2: Apply filters and signal compression on biomedical signals.

CO3: Interpret averaging technique on biomedical signals and extract the features of EEG signals.

CO4: Evaluate various event detection techniques for the analysis of the EEG and ECG

Textbooks

1. Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley (IEEE Press)-2005
2. Biomedical Signal Processing- Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2005.
3. Biomedical Digital Signal Processing-Willis J.Tompkins, PHI, 2000.

References

1. Biomedical Signal Processing -Akay M, , Academic: Press 1994
2. Biomedical Signal Processing (Vol. I Time & Frequency Analysis) - Cohen.A,, CRC Press, 1986.

Alternate Assessment Tools (AATs) suggested:

Mini Project: The students have to take up mini projects on biomedical signal processing applications in a team (not more than 4 students) preferably ideas from intelligent signal acquisition, clinical decision support, ML/DL. The evaluation of AAT is based on project work demonstration and Report submission.

Web links / e – resources:

- https://www.jmir.org/2019/10/e16194/
- https://www.researchgate.net/publication/328275221_Running_head_BIOMEDICAL_EQUIPMENT_TECHNOLOGY_1_Biomedical_Equipment_Technology
- http://ocw.utm.my/pluginfile.php/1102/mod_resource/content/0/SEB4223/01_Physiological_Origin_of_Biomediical_Signal.pdf
- http://ocw.utm.my/pluginfile.php/1103/mod_resource/content/0/SEB4223/02-_Physiological_origin_part_2.pdf
- http://ocw.utm.my/pluginfile.php/1109/mod_resource/content/0/SEB4223/07_ECG_Analysis_1_-_QRS_Detection.ppt%20%5BCompatibility%20Mode%5D.pdf
- http://ocw.utm.my/pluginfile.php/1112/mod_resource/content/0/SEB4223/10_EEG_Processing.pdf
- http://ocw.utm.my/pluginfile.php/1113/mod_resource/content/0/SEB4223/11_EEG_Analysis_1-Newborn_Seizure_Detection.pdf
- https://in.mathworks.com/discovery/biomedical-signal-processing.html
- https://library.oapen.org/bitstream/20.500.12657/41663/1/9781439870341.pdf
- https://ieeexplore.ieee.org/book/5264168
- https://www.youtube.com/watch?v=4ktGkqq2PCw
- https://github.com/topics/biomedical-signal-processing?l=matlab

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Wireless Sensor Networks (2:1:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC741**	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:1:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. Understand challenges, technologies, architectures for wireless networks.
2. Describe the communication, energy efficiency, computing, storage and transmission
3. Establish infrastructure and simulations
4. Explain the concept of programming the in WSN environment

Preamble:

This Course, Wireless Sensor Networks involves exploring their architecture, communication protocols, power management strategies, and security challenges. This subject delves into highlighting the latest research trends and practical applications. By comprehensively examining WSNs, the challenges associated with their deployment and operation can be addressed.

Module – 1

Introduction: Evolution of wireless sensor networks, Significance and Scope of the course in economic growth of Nation, Impact of the course on Societal Problems, Career Perspective, Innovations, Research status/trends.

Overview of wireless sensor networks: Introduction, Single Node Architecture Hardware Components Network Characteristics unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks Types of wireless sensor networks. (8 Hours)

Module – 2

Architectures: Network Architecture Sensor Networks Scenarios Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments introduction to Tiny OS and nesC Internet to WSN Communication.

(8 Hours)

Module – 3

Networking sensors: MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – SMAC, BMAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy Efficient Routing, Geographic Routing. (8 Hours)

Module – 4

Infrastructure establishment: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

(8 Hours)

Module – 5

Sensor Network Platforms and Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node level software platforms, Node level Simulators, State centric programming.

Summary of the Course: Course covers the fundaments of WSN, different types of WSN. The concepts sensor node, architecture, infrastructures, platforms and tools are dealt in detail. (8 Hours)

Course outcomes: The students will be able to:

CO1	Understand the evolution, challenges, technologies, architectures and protocols for wireless networks.
CO2	Apply the knowledge of physical layer concepts and transceiver to design wireless sensor modules
CO3	Implement the MAC and routing protocols in WSN modules
CO4	Design topology control, clustering and sensor tracking using hardware modules

Alternate Assessment Tools (AATs) suggested:

Mini Project: The students have to take up mini projects on WSN protocols or application in a team (not more than 4 students). The evaluation of AAT is based on project work demonstration and Report submission.

Textbooks

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks An Information Processing Approach", Elsevier, 2007.
3. Waltenegus Dargie , Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley & Sons Publications, 2011

References

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor NetworksTechnology, Protocols, and Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003

Web links / e – resources:

- https://nptel.ac.in/courses/106105160,
- https://archive.nptel.ac.in/courses/106/105/106105160/

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Network Security and Cryptography (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC742**	CIE Marks	50
Teaching Hours/Week(L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

Course objectives:

This course will enable students to;

1. Understand the basics of symmetric key and public key cryptography.
2. Acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. Design various key distribution and management schemes and Digital signature, Authentication codes
4. Study intruders, Virus, Malicious software and firewalls.

Preamble:

This course of network security and cryptography deals with the concepts of computer network security. It involves basics required to understand network security basics such as encryption algorithms, viruses, firewall etc.

Module – 1

Introduction to network security: Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks. Security services. The OSI security architecture, A model for network security. (7 Hours)

Module – 2

Symmetric Cipher Model: Substitution Techniques: Transposition Techniques **(Text 1: chapter 1)**

Data encryption standard (DES) **(Text 1: chapter 2)** (9 Hours)

Module – 3

The **AES Cipher**: (**Text 1: chapter 2)**

Basic concepts of Number theory:

Number theory, Euclidean algorithm, Modular arithmetic, Prime Numbers, Fermat's and Euler's theorem, (9 Hours)

Module – 4

Asymmetric ciphers: Principles of public key cryptosystems, RSA algorithm, Key Management, Diffie -Hellman Key Exchange

Pseudo-Random Sequence generators and Stream ciphers: Linear Congruential generators and Linear Feedback Shift Registers, Design and analysis of stream ciphers: A5, Gifford, PKZIP **(Text 2:chapter 16)** (7 Hours)

Module – 5

Intruders: Intruders, intrusion techniques, Intrusion Detection, statistical anomaly detection, Password Management.
Viruses: Viruses and Related Threats, The Need for Firewalls (8 Hours)

Course outcomes: The students will be able to:

CO1:Understand basics of Network security, attacks and services and mechanisms.

CO2: **Apply** the knowledge of network security concepts to various security algorithms.

CO3: **Analyse** the security mechanisms such as RSA and Diffie- Hellman

CO4: Apply the various Network security algorithms for security applications.

Textbooks

1. William Stallings, "Cryptography and Network Security Principles and Practice", 6th Edition, Pearson Education Inc, 2014.
2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C", 2nd Edition, Wiley Publications

Reference

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

Alternate Assessment Tools (AATs) suggested:

Mini project related to cryptography and network security implemented in a group of 3-4 students which demonstrates the understanding of the course and implementation in any modern tools.

Web links / e – resources:

- https://onlinecourses.nptel.ac.in/noc21_cs16
- https://onlinecourses.nptel.ac.in/noc22_cs03

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Advanced Computer Networks (2:1:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC743**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. Understand challenges, technologies, architectures for advanced computer networks
2. Describe the data communication model and ATM networks
3. Establish different routing protocols
4. Explain the concept of Traffic Engineering and its parameters

Preamble:

Advanced Computer Networks encompass a wide range of topics, including network architecture, protocols, performance optimization, security, and the integration of cutting-edge technologies. This course aims to provide a comprehensive understanding of these critical areas, equipping students with the knowledge and skills necessary to design, implement, and manage complex network infrastructures.

Module – 1

Introduction: Evolution of Advanced Networks, Significance and Scope of the course in economic growth of Nation, Impact of the course on Societal Problems, Career Perspective, Innovations, Research status/trends.

Overview of data communication model – Internet Multicasting, NAT, VPN – Routing Algorithms – BGP, RIP, OSPF – Differentiated and Integrated Services – SONET, ATM – MPLS -Next generation Internet architectures, Green Communication Networks, and Data Center Networking. (8 Hours)

Module – 2

ATM: The WAN Protocol: Introducing ATM Technology, Introducing Faces of ATM, Explaining the basic concepts of ATM Networking, Exploring the B-ISDN reference model, Explaining the Physical Layer, Explaining the ATM Layer, Explaining the ATM Adaptation Layer, Exploring ATM Physical interface, Choosing an Appropriate ATM Public service (8 Hours)

Module – 3

Packet Switching Protocols: Introduction to Packet Switching, Introduction to Virtual Circuit Packet Switching, Introduction to X.25, Introducing switched multimegabit data service

Protocols and Interfaces in Upper Layers of TCP/IP: Introducing TCP/IP suite, Explaining Network Layer Protocols, Explaining Transport Layer Protocol, Explaining Application Layer Protocol (8 Hours)

Module – 4

Routing in the Internet: Introduction to Intra-domain and inter-domain routings, Unicast Routing Protocols, Multicast Routing Protocols

Other Routing Techniques: Introduction to traffic Engineering, IP over ATM, Multiprotocol Label Switching, Storage Area Networks (8 Hours)

Module – 5

Traffic Engineering Basics: Introduction to traffic Engineering, Requirement Definition for Traffic Engineering, Traffic Sizing, Traffic Characteristics, Protocols, Time and Delay Consideration, Connectivity, Availability, Reliability, and Maintainability, Throughput Calculation

Summary of the Course: Course covers the advanced features of computer network, routing in internet and traffic engineering basics are dealt in detail. (8 Hours)

Course outcomes: The students will be able to:

CO1: **Understand** advanced concepts and next generation networks

CO2: **Analyze** TCP/IP variants, network Algorithm's, Protocols and their functionalities

CO3: **Apply** the knowledge of computer networks to find the traffic parameters

CO4: Apply the routing protocols using **modern tools for networking application**.

Textbooks

1. Tanenbaum AS, Wetherall DJ. Computer Networks. Fifth edition, Pearson Education, Inc. 2011.
2. Advance Computer Network, By Dayan and Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, Wiley India
3. 2. High-Speed Networks and Internets, Performance and Quality of Service, Second Edition, William Stallings, Pearson
4. TCP/IP Protocol Suite by Behrouz A. Forouzan

Alternate Assessment Tools (AATs) suggested:

Mini Project: The students have to take up mini projects on CAN protocols or application in a team (not more than 4 students) . The evaluation of AAT is based on project work demonstration and Report submission.

Web links / e – resources:

- https://nptel.ac.in/courses/106106243
- https://archive.nptel.ac.in/courses/106/106/106106243/
- https://nptel.ac.in/courses/106106091

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Operating System (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC744**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. Understand the services provided by an operating system.
2. Explain how processes are synchronized and scheduled.
3. Understand different approaches of memory management and virtual memory management.
4. Describe the structure and organization of the file system
5. Understand inter-process communication and deadlock situations.

Preamble:

Basic computer literacy and familiarity with computer hardware and software concepts.

Module – 1

Introduction to Operating Systems: Operating system basics, Goals of an OS, Operation of an OS, Computational Structures, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes operating System.

(8 Hours)

Module – 2

Process Management: OS View of Processes, PCB, Fundamental State Transitions of a process, Threads, Kernel and User level Threads, Non- preemptive scheduling- FCFS and SRN, Preemptive Scheduling- RR and LCN, Scheduling in Unix and Scheduling in Linux

Case study on Dining philosopher problem, Barbershop problem.

(8 Hours)

Module – 3

Memory Management: Contiguous Memory allocation, Non-Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, VM handler, FIFO, LRU page replacement policies, Virtual memory in Unix and Linux.

Case study on type1 and type2 hypervisors. 8 Hours)

Module – 4

File Management: File systems and IOCS, File Operations, File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of disk space, Implementing file access.

Case study on file system viz FAT32, NTFS, Ext2/Ext3. (8 Hours)

Module – 5

Message Passing and Deadlocks: Overview of Message Passing, implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling deadlocks, Deadlock detection algorithm, Deadlock Prevention.

Summary of the Course: Course covers the fundaments of Operating system, different classes of Operating system from batch processing till real time Operating systems. The concepts on different management of an Operating system.

(8 Hours)

Course outcomes: The students will be able to:

CO1	Elucidate the basics of operating systems, its goals, structure, operation and classes.
CO2	Apply scheduling techniques to find performance factors.
CO3	Interpret organization of memory and its file systems.
CO4	Analyze the various deadlock that occur in an operating system and its effects.

Textbooks

- Operating Systems — A Concept based Approach, by Dhamdhere, TMH,2nd edition.

References

1. Operating Systems Concepts, Silberschatz and Galvin, John Wiley India Pvt. Ltd, 5th edition,2001.
2. Operating System—Internals and Design System, William Stalling, Pearson Education, 4th ed,2006.
3. Operating Systems - Design and Implementation, Tanenbaum, TMH, 2001.
4. Godbole, "Operating Systems", Tata McGraw Hill, 3rd edition, 2014

Alternate Assessment Tools (AATs) suggested:

(1) Implement operating system scripts for any mechanism using any OS.

Web links / e – resources:

- https://onlinecourses.swayam2.ac.in/cec22_cs23/preview,
- https://onlinecourses.nptel.ac.in/noc24_cs108/preview,
- https://www.coursera.org/specializations/codio-introduction-operating-systems

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Low Power VLSI (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC745**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students:

1. To learn various sources of power dissipation in CMOS based circuits.
2. To study concepts of power estimation and analysis
3. To focus on architectural, Behavioural and circuit level low power transforms.
4. To study switched capacitance and leakage minimization techniques
5. To study low energy computing techniques for digital circuits

Preamble:

This course aims to equip students with comprehensive knowledge and skills in low-power design methodologies for CMOS-based circuits. Through theoretical study and practical exercises, students will gain proficiency in designing energy-efficient electronic systems suitable for contemporary applications

Module – 1

Power Dissipation in CMOS: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits - Dynamic Power Dissipation, Short Circuit Power, Switching Power, Glitching Power, Static Power Dissipation, Degrees of Freedom, Unified Power Format, Voltage islands, power islands.

Emerging Low power approaches, Physics of power dissipation in CMOS devices, Device & Technology Impact on Low Power: Transistor sizing & gate oxide thickness, Leakage current in Deep sub-micron transistors, Impact of technology Scaling, Technology & Device innovation.

(8 hours)

Module – 2

Power estimation, simulation power analysis : Simulation based techniques, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation, Probabilistic power analysis, statistical methods

(8 Hours)

Module – 3

Synthesis for Low Power: Behavioural, Logic and Circuit level approaches, Algorithm level transforms, Power-constrained Least squares optimization for adaptive and non-adaptive filters, Circuit activity driven architectural transformations, Device feature size scaling, Multi-Vdd Circuits, Architectural level approaches: Parallelism, Pipelining, Voltage scaling using high-level transformations, Dynamic voltage scaling, Power Management, Simulation with Spice tools.

(8 Hours)

Module – 4

Switched Capacitance Minimization Approaches: Hardware Software Tradeoff, Bus Encoding, Architectural optimization, Clock Gating, Logic styles.

Leakage Power minimization Approaches: Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach, Power gating, Transistor stacking, Dual-Vt assignment approach (DTCMOS)., Simulation with spice tools

(8 Hours)

Module – 5

Low Energy Computing: Energy recovery circuit design, designs with reversible and partially reversible logic, energy recovery in adiabatic logic, MOS Memories, Design of peripheral circuits – address decoder, level shifter and I/O Buffer, supply clock generation. Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip& package co design of clock network. Battery driven system design

(8 Hours)

Course outcomes: The students will be able to:

CO1: **Identify** the different sources of power dissipation in CMOS based circuits

CO2: **Summarize** the power analysis using simulation-based approaches and probabilistic analysis.

CO3: **Apply** logic-level and architecture-level techniques in various designs to optimize power consumption of the VLSI circuits.

CO4: **Utilize** logic simulation methods to design Low Power VLSI circuits.

CO5: **Explain** and **construct** the low energy computing techniques for digital circuits

Text Books:

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002.
2. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic, 1997.

References:

1. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.
2. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-Interscience, 2000.
3. Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata McGraw Hill, 1999.
4. Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint), 1993.

5. A. Bellamour, and M. I. Elmasri, Low Power VLSI CMOS Circuit Design, Kluwer Academic Press, 1995.
Alternate Assessment Tools (AATs) suggested: Simulation of low power circuits using LTSPICE
Web links/e-resources: https://archive.nptel.ac.in/courses/106/105/106105034/

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VII

Biomedical Engineering (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC751**	CIE Marks	50
Teaching Hours/Week (L: T: P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. Gain a comprehensive understanding of the fundamental principles and key concepts central to biomedical engineering disciplines.
2. Develop the ability to analyze the design, functionality, and limitations of diverse biomedical devices and technologies through quantitative and qualitative reasoning.
3. Utilize acquired knowledge to formulate and propose creative solutions to real-world biomedical engineering challenges.
4. Understand the ethical considerations and potential societal impacts associated with biomedical engineering research and practice.

Preamble:

This course is designed to equip students with the knowledge and skills to bridge the gap between medicine and engineering. Through engaging lectures, hands-on activities, and critical thinking exercises, students will gain a comprehensive understanding of the fundamental principles that govern the creation and application of innovative medical technologies. By the end of this course, they will be prepared to not only analyze existing biomedical devices but also creatively solve real-world challenges and contribute to the future of healthcare.

Module – 1

Introduction: Foundations of Biomedical Engineering, Definition, history, scope, and impact of biomedical engineering., Morality and ethics, beneficence and nonmaleficence, Human experimentation, informed consent, regulation of medical device innovation.

Biomaterials: Types of biomaterials (metals, ceramics, polymers, composites), Properties and applications of biomaterials in medical devices and implants, Biocompatibility and tissue engineering. (Textbook 1: Chapter 1,5)

(8 Hours)

Module – 2

Biomechanics: Basic principles of mechanics (forces, stresses, strains), Biomechanical properties of tissues (bone, cartilage, muscle, tendons), Applications of biomechanics in orthopedics, rehabilitation, and sports medicine**.**

Bio transport: Fluid mechanics and mass transfer in physiological systems, Blood flow, oxygen transport, and drug delivery, Artificial organs and bioreactors. (Textbook 1: Chapter 6, 7)

(8 Hours)

Module – 3

Bioelectricity: Cellular electrophysiology (resting and action potentials), Bioelectric signals (ECG, EMG, EEG), Neuromuscular systems and neural prosthetics.

Bioinstrumentation: Sensors and transducers for physiological measurements, Amplifiers, filters, and signal processing techniques, Medical imaging modalities (X-ray, CT, MRI, ultrasound) (Textbook 1: Chapter 8,9) (8 Hours)

Module – 4

Modeling of Physiological Systems: Mathematical modelling of biological processes, Compartmental modeling and systems analysis, Applications in pharmacokinetics and drug design, Feedback control mechanisms in the human body, Modeling and analysis of cardiovascular, respiratory, and endocrine systems, medical devices for monitoring and control of physiological functions. (Textbook 1: Chapter 10-11)

(8 Hours)

Module – 5

Applications of Biomedical Engineering: Medical devices and implants (pacemakers, artificial joints, etc.), Regenerative medicine and tissue engineering, Telemedicine and wearable health technologies

Future Directions in Biomedical Engineering: Emerging technologies and trends (nanotechnology, gene therapy, AI in medicine), Ethical, social, and economic implications of biomedical engineering innovations, Discussions and case studies of current challenges and opportunities. (Textbook 1: Chapter 12-15)

(8 Hours)

Course outcomes: The students will be able to:

CO1: **Demonstrate** a foundational knowledge of the key concepts, principles, and tools in biomedical engineering.

CO2: **Analyze** the design and functionality of medical devices and implants based on biomaterial properties and biomechanical considerations.

CO3: **Apply** principles of bioinstrumentation and physiological modeling to analyze and interpret physiological data

CO4: **Interpret** medical data/images and discuss their clinical relevance.

Textbooks

1. Enderle J, Bronzino J. Introduction to biomedical engineering. Academic press; 2011 Apr 13.
2. Bronzino, Joseph D., and Donald R. Peterson. Biomedical engineering fundamentals. CRC press, 2014.

References

1. Bronzino, Joseph D. Biomedical engineering handbook 2. Vol. 2. Springer Science & Business Media, 2000.
2. Webster, John G., ed. medical instrumentation: application and design. John Wiley & Sons, 2009.

Alternate Assessment Tools (AATs) suggested:

Case Studies: Course coordinator will present real-world biomedical engineering challenges and ask students to analyze them. They should propose solutions, explain their reasoning, and

consider ethical and societal implications. This assesses their critical thinking, problem-solving, and ability to integrate knowledge from various modules.
Web links / e – resources: https://ocw.mit.edu/courses/3-051j-materials-for-biomedical-applications-spring-2006/ https://www.embs.org/ - Offers resources on cutting-edge advancements and future trends in biomedical engineering.

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Nano Engineering (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC752**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. To provide a comprehensive overview of synthesis and characterization of nanoparticles.
2. To provide the engineering students with necessary background for understanding various.
3. To develop an understanding of the basis of the choice of material for device applications.
4. To give an insight into complete systems where nanotechnology can be used to improve our everyday life.

Preamble:

Nanoengineering is a multidisciplinary field that merges principles of engineering, physics, chemistry, and biology to manipulate materials at the nanoscale level (one billionth of a meter). At this scale, unique phenomena enable novel applications that are not possible with bulk materials. The field of nanoengineering is pivotal in the development of new technologies and solutions across various industries, including medicine, electronics, energy, and environmental science. By the end of this course, students will have gained the skills necessary to contribute to the advancement of nanotechnology and its integration into practical solutions.

Module – 1

Introduction to Nanomaterials: Nanotechnology, Variation of physical properties from bulk to thin films to nanomaterials, Confinement of electron in 0D, 1D, 2D and 3D systems, Surface to Volume Ratio. Synthesis of Nanomaterials: Bottom-Up approach- Sol-gel, Precipitation, Solution Combustion synthesis, Hydrothermal, Chemical Bath Deposition. Top-Down approach- Ball milling technique, Sputtering, Laser Ablation. **(9 Hours)**

Module – 2

Characterization of Nanomaterials: Basic principles and instrumentations of Electron Microscopy –Transmission Electron Microscope, Scanning Electron Microscope, Scanning Probes- Atomic Force Microscope. Basic working principle of X-ray diffraction and Debye-Scherrer equation. Optical Spectroscopy- Instrumentation and application of UV/VIS Spectroscope. **(8 Hours)**

Module – 3

Carbon Based Materials: Introduction, Properties (electrical, Electronic and Mechanical), and Applications of Graphene, SWCNT, MWCNT, Fullerenes and other Carbon Materials: Carbon nanocomposites and nanofibers **(8 Hours)**

Module – 4

Nanotechnology in Energy storage and conversion:

Solar cells: First generation, second generation and third generation solar cells: Construction and working of Dye sensitized and Quantum dot sensitized solar cells.

Batteries: Nanotechnology in Lithium-ion battery- working, Requirements of anodic and cathodic materials, classification based on ion storage mechanisms.

Fuel Cells: Introduction, construction, working of fuel cells and nanotechnology in hydrogen storage and proton exchange membranes. **(9 Hours)**

Module – 5

Applications of Nanotechnology: Introduction, Medicine and Healthcare Applications, Biological and Biochemical Applications, Electronic Applications, Computing Applications, Chemical Applications, Optical Applications, Agriculture and Food Applications. Recent Major Breakthroughs in Nanotechnology. **(6 Hours)**

Summary of the Course: Course covers the fundaments of nanotechnology and nanomaterials. Students will be able to learn and explain the basic synthesis procedures of nanomaterials, carbon-based nanomaterials and its application in energy storage and conversion. It also covers the overall applications of nanotechnology in different fields.

Course outcomes: The students will be able to:

CO1: **Understand** the concept of nanotechnology and the synthesis of nanoparticles by various techniques.

CO2: **Explain** working of basic instruments used in characterization of nanomaterials.

CO3: **Discuss** the carbon-based nanomaterials and application of nanotechnology in energy storage and conversion.

CO4: **Assess** the suitability of nanomaterials for various device applications.

Textbooks

1. Nano Materials – A.K. Bandyopadhyay/ New Age Publishers.
2. Nanocrystals: Synthesis, Properties and Applications – C.N.R. Rao, P. John Thomas and G. U. Kulkarni, Springer Series in Materials Science.
3. Peter J. F. Harris, Carbon nanotube science: synthesis, properties, and applications. Cambridge University Press, 2011

References

1. Nano Essentials- T. Pradeep/TMH
2. M.A. Shah, K.A. Shah, "Nanotechnology: The Science of Small", Wiley India, ISBN 13: 9788126538683

Alternate Assessment Tools (AATs) suggested:

Quiz: Students will write the quizzes to enhance the understanding of subject and which will be further helpful for different standard competitive exams.

Web links / e – resources:

- https://nptel.ac.in/courses/118104008
- https://www.digimat.in/nptel/courses/video/118104008/L16.html
- https://archive.nptel.ac.in/courses/113/106/113106099/
- https://nptel.ac.in/courses/112107283

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Unmanned Aerial Vehicles (2:1:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC753**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

- To explore drones technology through their significant learning of the Components, Assembly and Calibrations.
- Understand fundamental concepts of UAV Technology
- Understand the different Sensors required for UAV

1. Explain the configuring and calibration of Drone

Preamble:

The syllabus is designed to provide students with a comprehensive understanding of UAV technology, including calibration, operation, and application. Studying Unmanned Aerial Vehicles (UAVs) at the undergraduate (UG) level can be valuable for several reasons, particularly in relation to job opportunities. Studying UAVs can position students at the forefront of a cutting-edge field with significant potential for innovation, making it a strategic choice for enhancing job prospects and career growth.

Module – 1

Introduction: Evolution of UAV, Significance and Scope of the course in economic growth of Nation, Impact of the course on Societal Problems, Career Perspective, Innovations, Research status/trends.

Introduction of Unmanned Aerial Vehicles: Introduction, History of drones, Classification of drones based on structure- Fixed wing structure, Lighter than air systems and Rotary-wing aircraft, Application of drones, Parts of Drone system, System design, Mechanical design, hardware design, software architecture, Logistic and Operations Management. (8 Hours)

Module – 2

Dynamics and Stability: Forces of flight Principal axes and rotation of aerial systems, Longitudinal axis, Lateral(transverse) axis and Perpendicular axis, Equilibrium, Stability - Stable system, Unstable system and Neutrally stable system, Control – Roll, Pitch, Yaw and Throttle (8 Hours)

Module – 3

Sensors in Drone: Sensors – Accelerometer, Barometer, Gyro Sensor, Magnetometer, Distance sensors, Time of Flight (ToF) Sensors, Thermal sensors, Chemical Sensors and Sensor Testing – Test Philosophies and methodologies, Test equipment, Performance testing of sensors (8 Hours)

Module – 4

Gliding Drones: Glider, Lift, Drag, Airfoil and its type, Incident and decalage angle, Three axis motions (roll, pitch, and yaw), Thrust, Aspect ratio and glide ratio, Glide or dive and descent, gliding angle Climb, Center of pressure, Pitching moment, Load factor, Angle of attack, Build our own glider drone (8 Hours)

Module – 5

Drones for Mission Control Application: ESP8266, Downloading and installing APM Planner or Mission Planner, Configuring the quadcopter - Frame type selection, Compass calibration, Access calibration, Radio calibration, Flight mode calibration and Failsafe calibration, Surveying with a drone, tweaks with the Flight Plan screen. Future of Drone Systems (8 Hours)

Course outcomes: The students will be able to:

CO1: **Understand** classifications, concepts, dynamic and stability of drones.

CO2: **Analyze** the different Sensors required for UAV assembly.

CO3: **Apply** the knowledge of UAV to use drones for mission control applications

CO4: **Apply** the concepts of electronics in drone applications.

Textbooks

1. A. R. Jha, Theory, Design, and Applications of Unmanned Aerial Vehicles (1st Edition), CRC Press, 2016. ISBN 978-1315371191
2. Syed Omar Faruk Towaha, Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266, Packt Publishing, 2018.
3. Randal W. Beard and Timothy W. McLain: Small Unmanned Aircraft: Theory and Practice, Princeton University Press, 2012.

Alternate Assessment Tools (AATs) suggested:

Technical presentation in a group on Emerging Technologies and Applications in Unmanned Aerial Vehicle

Web links / e – resources:

- https://onlinecourses.nptel.ac.in/noc21_ae14/preview
- https://onlinecourses.nptel.ac.in/noc19_ae06/preview
- https://nptel.ac.in/courses/105107218

B.E ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

Automotive Electronics (3:0:0) 3

(Effective from the academic year 2024-25 for 2021 Scheme)

Course Code	**21EC754**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course objectives:

This course will enable students to:

1. To understand the concepts of Automotive Electronics and it's evolution and trends
2. Automotive systems & subsystems overview.
3. To understand sensors and sensor monitoring mechanisms aligned to Automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms
4. To understand, design and model various automotive control systems using Model based development technique
5. To understand role of Microcontrollers in ECU design and choice of appropriate Hardware and Software
6. To describe various communication systems, wired and wireless protocols used in vehicle networking
7. To understand Safety standards, advances in towards autonomous vehicles,
8. To understand vehicle on board and off board diagnostics

Preamble:

The undergraduate course in automotive electronics provides students with a comprehensive understanding of the electronic systems that are integral to modern vehicles. The curriculum covers essential topics such as vehicle communication networks, sensors and actuators, power electronics, and embedded systems. Students engage in hands-on projects, learning to design, diagnose, and troubleshoot automotive electronic systems. Emphasizing both theoretical knowledge and practical skills, the course prepares graduates for careers in automotive engineering, focusing on innovations like electric vehicles and advanced driver-assistance systems (ADAS). With the automotive industry increasingly relying on

sophisticated electronics, this program equips students to contribute effectively to future advancements in vehicle technology.

Module – 1

Automotive Systems, Design cycle and Automotive industry overview:
Overview of Automotive industry, leading players, automotive supply chain, global challenges. Role of technology in Automotive Electronics and interdisciplinary design. Tools and Processes. Spark and Compression Ignition Engines: Ignition systems, Fuel delivery systems

Automotive transmissions: Transmission fundamentals, Types-MT, AT, CVT and DCT

Vehicle braking fundamentals: Introduction to antilock braking systems

Steering Control: Steering system basics, Fundamentals of electronically controlled power steering:
Passenger Safety and Convenience occupant protection systems: Tire pressure monitoring systems.

Overview of Hybrid Vehicles.

ECU Design Cycle: V-Model development cycle, Components of ECU, Examples of ECU on Chassis, Infotainment, Body Electronics and cluster.

(9 Hours)

Module – 2

Automotive Sensors and Actuators: Systems approach to control and instrumentation: Concept of a system, Analog and Digital systems, Basic measurements systems, Analog and digital signal processing, Sensors, Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Sensor modelling, Smart Nodes.

Examples of sensors: Accelerometers, wheel speed sensors, brake pressure sensors, Seat occupancy sensor, Engine speed, Steering wheel angle, Vehicle speed sensor, Throttle position sensor, Turbine speed sensor, Temperature sensor, Mass air flow (MAF) rate sensor, Exhaust gas oxygen concentration sensor, Throttle plate angular position sensor, Crankshaft angular position/RPM sensor, Manifold Absolute Pressure (MAP) sensor, Differential exhaust gas pressure sensor, Actuators used : Solenoids, various types of electric motors, and piezoelectric force generators, Examples for actuators: Relays, solenoids and motors. Sensors in Airbag system, Chassis Control systems, Automatic transmission control system.
(8 Hours)

Module – 3

Microcontrollers/Microprocessors in Automotive domain:

a. Overview of development within the automotive context (Architecture of 8/16 bit microcontrollers with emphasis on Ports, Timer/Counters, Interrupts. Watchdog timers, PWM).

b. Automotive grade processors ex: Renesas, Quorivva, Infineon
c. Understanding and working on tool chains for different processors
d. Development of control algorithm for different automotive subsystems Look-up tables and maps, need of maps, Procedure to generate maps, Fuel maps/tables, Ignition maps/tables, Engine calibration, Torque table, Dynamometer testing.

Introduction to V2X Vehicle to Everything

(8 Hours)

Module – 4

Communication protocols: Overview of Automotive communication protocols: CAN, LIN, Flex Ray, MOST, Ethernet, D2B and DSI

Communication interface with ECUs Interfacing techniques and interfacing with infotainment gadgets, Relevance of Protocols such as TCP/IP for automotive applications

Wireless LANs standards such as Bluetooth, IEE802. 11x communication protocols for automotive applications.

Infotainment Systems: Application of Telematics in Automotive domain, Global Positioning Systems (GPS) and General Packet Radio Service (GPRS) (8 Hours)

Module – 5

Safety Systems in Automobiles and Diagnostic Systems:

Active Safety Systems: ABS, TCS, ESP, Brake assist.

Passive Safety Systems: Airbag systems, Advanced Driver Assistance Systems (ADAS): Combining computer vision techniques as pattern recognition, feature extraction. Examples of assistance applications: Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles.

Diagnostics: Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, electronic transmission checks and Diagnosis, Diagnostic procedures and sequence, On board and off board diagnostics in Automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze Frames, History memory, Diagnostic tools, Diagnostic protocols: KWP2000 and UDS. (7 Hours)

Course outcomes: The students will be able to:

CO1: Analyze the working of subsystems in an Automobile.

CO2: Analyze the principles and working of automotive sensors and actuators.

CO3: Critical review of microprocessor, microcontroller in Automotive domain.

CO4: Analyze communication protocols used automotive applications.

CO5: Analyze Safety Systems in Automobiles and Diagnostic Systems.

Textbooks

1. Ronald K Jurgen: "Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 1999
2. James D Halderman: -Automotive electricity and Electronics", PHI Publication

References

1. Tom Denton: "Advanced Automotive Diagnosis, 2nd Edition, Elsevier, 2006.
2. Uwe Kieneke and Lars Nielsen: Automotive Control Systems Engine, Driveline and Vehicle, 2nd Edition Springer Verlag, 2005
3. Iqbal Husain: "Electric and Hybrid Vehicles: Design fundamentals" CRC Press, 2003.
4. Marc Herniter: "Introduction to Model Based System Design – Rose Hulman Institute of Technology

Alternate Assessment Tools (AATs) suggested:

- poster presentation on state of art technologies and innovations

Web links/e-resources

- https://archive.nptel.ac.in/courses/107/106/107106088/