Academic Program: UG

Academic Year 2024-25

Syllabus

V & VI Semester B.E.

Department of Electronics & Communication Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Accredited by NBA under Tier-1 2023-2026

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for V & VI semester of UG program in Electronics and Communication Engineering is recommended by Board of Studies of Electronics and Communication Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2024-25 till further revision.

Chairman BOS & HOD Principal

SDM College of Engineering & Technology, Dharwad-02

Department of Electronics & Communication Engineering

College – Vision and Mission

VISION:

To develop competent professionals with human values

MISSION:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

Department- Vision and Mission

Vision

Fostering excellence in the field of Electronics & Communication Engineering, showcasing innovation, research and performance with continuous Industry – Institute Interaction with the blend of Human values.

Mission

M1: To provide quality education in the domain of Electronics & Communication Engineering through state of the art curriculum, effective teaching learning process and the best of laboratory facilities.

M2: To encourage innovation, research culture and team work among students.

M3: Interact and work closely with industries and research organizations to accomplish knowledge at par.

M4: To train the students for attaining leadership with ethical values in developing and applying technology for the betterment of society and sustaining the global environment.

Program Educational Objectives (PEOs)

The Graduates, after a few years of Graduation will be able to:

I. **Apply** the latest in-depth knowledge in the field of Electronics and Communication Engineering with Mathematical applications to address real life challenges.
II. **Exhibit** the confidence for independent working and / or spirit to work cohesively with group.
III. **Readily** be accepted by the Industry globally.
IV. **Develop** design skills, fault diagnosis skills, communication skills and create research orientation.
V. **Inculcate** professional, social ethics and to possess awareness regarding societal responsibility, moral and safety related issues

Programme Outcomes (POs):

Engineering Graduates will be able to:

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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

13. Design economically and technically sound analog and / or digital systems based on the principles of signal processing, VLSI and communication Engineering (PO-13)

14. Integrate hardware – software, and apply programming practices to realize the solutions in electronics domain. (PO-14)

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD
Department of Electronics and Communication Engineering
V Semester
Scheme of Teaching and Examinations 2024 – 25

Sl. No	Course	Course code	Course Title	TD/PSB	Teaching Hours/Week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HSMS	22UECC500	Management, Economics and Entrepreneurship		3	0	0	03	50	100	100	3
2	PCC	22UECC501	CMOS VLSI Design		4	0	0	03	50	100	100	4
3	PCC	22UECC502	Digital Signal Processing		3	2	0	03	50	100	100	4
4	PEC	22UECE5XX	Program Elective Course -I		4	0	0	03	50	100	100	4
5	PCCL	22UECL503	Digital Signal Processing Laboratory		0	0	2	03	50	50	100	1
6	PCCL	22UECL504	System Design Laboratory		0	0	2	03	50	50	100	1
7	PROJ	22UECL505	Minor Project-I		0	0	4	03	50	50	100	2
8	MC	22URMK506	Research Methodology and IPR		2	0	0	02	50	50	100	2
9	MC	22UESK507	Environmental studies		1	0	0	01	50	50	100	1
10	HSMS	22USSK508	Soft Skills-I		0	0	2	-	50	-	50	Audit
11	MC	22UNSK509	National Service Scheme		0	0	2	-	50	-	50	Audit
Total											**1000**	**22**
Program Elective Course –I												
1	PEC-I	22UECE521	MEMS		4	0	0	03	50	100	100	4
2	PEC-I	22UECE522	Operating Systems		4	0	0	03	50	100	100	4

HSMS: Humanity and management Science course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, AEC: Ability Enhancement course, MC: Mandatory Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K: This letter in the course code indicates common to all the stream of engineering. PEC: Program elective course, PROJ: Project. TD: Teaching department, PSB: Paper setting Board.

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 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.

Minor-Project-I: The students are expected to identify the state-of-the-art technology in his/her domain of interest by an extensive literature survey and select

a topic from an emerging area relevant to their branch/interdisciplinary and define the problem for the project work. The problem could be defined to develop prototypes for industrial needs. A team consisting of not more than 2-4 students shall be guided by a faculty member. This project work is to supplement and prepare the students to take up major project work at higher semesters. A committee constituted by HOD consisting of minimum 2 faculty members shall evaluate for CIE with suitable rubrics. The weightage of marks shall be 50% for the committee and 50% for the guide. There is a SEE (viva voce) examination which shall be examined by two internal examiners recommended by the HoD.
Soft Skills-I: Training on communication skills, proficiency in English language and aptitude ability is arranged involving external resource. The external resource person shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 50 marks. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.
National Service Scheme: All students have to register for the courses namely National Service Scheme (NSS) with the concerned course coordinator during the first week of respective semester. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS activities. This course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.
AICTE activity point: Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the program. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case student fails to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD
Department of Electronics and Communication Engineering
VI Semester
Scheme of Teaching and Examinations 2024 – 25

Sl. No	Course	Course code	Course Title	TD/PSB	Teaching Hours/Week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	22UECC600	Analog and Mixed Mode VLSI Design		4	0	0	03	50	100	100	4
2	PCC	22UECC601	Computer Communication Networks		4	0	0	03	50	100	100	4
3	PCC	22UECC602	Embedded Systems Design		3	0	0	03	50	100	100	3
4	PEC	22UECE6XX	Program Elective Course – II		3	0	0	03	50	100	100	3
5	PEC	22UECE6XX	Program Elective Course -III		3	0	0	03	50	100	100	3
6	OEC	22UECO6XX	Open Elective Course-I		3	0	0	03	50	100	100	3
7	PCCL	22UECL603	VLSI Laboratory		0	0	2	03	50	50	100	1
8	PCCL	22UECL604	Embedded Systems Laboratory		0	0	2	03	50	50	100	1
9	PROJ	22UECL605	Minor Project-II		0	0	4	03	50	50	100	2
10	HSMS	22USSK606	Soft Skills-II		0	0	2	-	50	-	50	Audit
11	MC	22UNSK607	National Service Scheme		0	0	2	-	50	-	50	Audit
								Total			**1000**	**24**
Program Elective Course -II												
1	PEC-II	22UECE621	Digital Image Processing		3	0	0	03	50	100	100	3

2	PEC-II	22UECE622	Microwave and Antennas		3	0	0	03	50	100	100	3
Program Elective Course – III												
1	PEC-III	22UECE631	Information Theory and Coding		3	0	0	03	50	100	100	3
2	PEC-III	22UECE632	Data Structures using C++		3	0	0	03	50	100	100	3
Open Elective Course-I												
1	OEC-I	22UECO641	Automotive Electronics		3	0	0	03	50	100	100	3
2	OEC-I	22UECO642	Cryptography		3	0	0	03	50	100	100	3

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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 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 numbers of students' strength for offering Open Elective Course are as prescribed by the DAP.

Open Elective Courses (OEC): Students belonging to a particular stream of Engineering and Technology are entitled to opt for the open electives offered by their parent Department and other departments provided that 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 are as prescribed by the DAP.

Minor-project-II: It is either a continuation of Minor-Project-I or a new project. The students are expected to identify the state-of-the-art technology in his/her domain of interest by an extensive literature survey and select a topic from an emerging area relevant to their branch/interdisciplinary and define the problem for the project work. The problem could be defined to develop prototypes for industrial needs. A team consisting of not more than 2-4 students shall be guided by a faculty member. This project work is to supplement and prepare the students to take up major project work at higher semesters. A committee constituted by HOD consisting of minimum 2 faculty members shall evaluate for CIE with suitable rubrics. The weightage of marks shall be 50% for the committee and 50% for the guide. There is a SEE (viva voce) examination which shall be examined by two internal examiners recommended by the HoD.

Soft Skills-II: Training on communication skills, proficiency in English language and aptitude ability is arranged involving external resource. The external resource person shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 50 marks. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

National Service Scheme: All students have to register for the courses namely National Service Scheme (NSS) with the concerned course coordinator during the first week of respective semester. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS activities. This course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

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V Semester

22UECC500 Management, Entrepreneurship and Economics (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focuses on concepts of Entrepreneurship, concepts of Management and about the Intellectual Property Rights. Entrepreneurship part discusses about meaning of Entrepreneurship, Business ideas, family business and doing business in India. Management part discusses about Planning, Forecasting, Organizing & Staffing, Motivating and Controlling. Engineering Economics part is introduced to highlight the role of engineers in business and to understand economic decisions in engineering.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Understand** the concept of Entrepreneurship and Business ideas.	12	6	-
CO-2	**Describe** about family business in India and doing business in India	12	6	-
CO-3	**Discuss** Management principles/process and illustrate Planning and decision making.	-	11	-
CO-4	**Analyse** aspects of Organizing, Staffing, Motivating and Controlling functions of Management.	-	6	-
CO-5	**Understand** the role of engineers in business and economic decisions in engineering.	8	12	7

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	-	-	-	-	-	2.0	1.0	3.0	-	-	2.0	2.7	**-**	**-**

Contents:

Unit-I

Understanding Entrepreneurship: Introduction, Definition, Role of an Entrepreneur, Reasons for growth of Entrepreneurship, Age of an Entrepreneurial firm, Why start a business, Entrepreneurial Characteristics & Skills, Types of

Entrepreneurs, Entrepreneurial failure. **Growth of a Business Idea:** Introduction, New Business Idea, Pre-selection process, Sources of Business Ideas, Preliminary Research, Business Idea Evaluation. **08 Hrs**

Unit-II

Family Business: Introduction, Family Business in India, The Founder, The Next Generation, Entry of Family Members, Non-family Managers, Succession, Best Practices. **Doing Business in India:** Introduction, Major Issues, Types of Organizations, Legal Compliances. **Entrepreneurial Support:** Policies, Business Incubation, Business Clusters. **08 Hrs**

Unit-III

Management: Management Planning, Forecasting and Decision Making: Nature of Planning, the foundation of planning, some planning concepts, forecasting, nature of decision making, management science, tools for decision-making. **07 Hrs**

Unit-IV

Organizing and staffing: Nature of organizing, traditional organizational theory, technology and modern organization structures, staffing technical organization, authority and power; delegation, meeting & committees. **Motivating:** Motivation, leadership, motivating and leading technical professionals. **Controlling:** Process of control, financial controls, & non-financial controls. **08 Hrs**

Unit-V

Engineering Economic Decisions: The Rational Decision-Making Process, The Engineer's Role in Business, Types of Strategic Engineering Economic Decisions, Fundamental Principles in Engineering Economics. **08 Hrs**

Reference Books:

1) Rajeev Roy, "Entrepreneurship", 2nd Edition, 2011, Oxford University Press, New Delhi.
2) Daniel L Babcock, Lucy C Morse, "Managing Engineering and Technology" Third Edition, 2005, Prentice Hall of India Pvt. Ltd., New Delhi.
3) Chan S. Park, Pravin Kumar, Nand Kumar, "Fundamentals of Engineering Economics", Third Edition, International Edition, Pearson.

22UECC501	**CMOS VLSI Design**	**(4-0-0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the theory, fabrication and design principles of CMOS devices and circuits. The course concentrates on the study and analysis of various combinational and sequential MOS logic circuits for digital VLSI applications.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the theory, construction and the characteristics of MOS structures and logic circuits.	-	-	1,2,13
CO-2	**Elaborate** the steps and processes involved in the VLSI fabrication technology.	-	-	1,2,4
CO-3	**Apply** design rules to design layout of various digital VLSI circuits.	5	1,2	3,9
CO-4	**Estimate** the parasitics for various MOS layouts.	-	1	2
CO-5	Perform a **comparative** study of different MOS circuit technologies.	2	4,13	1,5,9

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.4	1.6	1	1.5	2	-	-	-	1	-	-	-	1.5	-

Pre-requisites:
Semiconductor Devices, Analog Electronic circuits, Digital Electronic circuits

Contents:

Unit-I

MOS Transistor: Metal Oxide Semiconductor (MOS) Structure, MOS System under External Bias, Structure and Operation of MOS Transistor, MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, FINFETs. **MOS Inverters:** Static Characteristics: Introduction, Resistive-Load Inverter, CMOS Inverter
12 Hrs

Unit-II

Fabrication Technology: Introduction, Czochralski growth process, Fabrication processes: Thermal oxidation, Diffusion, Ion implantation, Photo lithography, Epitaxy, Metallization and interconnections, Ohmic and Schottky contacts, fabrication of resistors and capacitors. **Basic CMOS Technology**: Basic CMOS

technology: P-Well / N-Well / Twin Well process, MOS mask layer, stick diagrams, Lambda based design rules, Schematic and Layouts **12 Hrs**

Unit-III

Basic Circuit Concepts: Sheet resistance, standard unit capacitance, concepts delay unit time, Inverter delays, driving capacitive loads, Propagation delays, PVT analysis and Process corners, RC delay, Elmore Delay, Logical Effort, Electrical Effort, Parasitic delay, Non-ideal delay, Examples. **09 Hrs**

Unit-IV

Combinational MOS Logic Circuits & Sequential MOS Logic Circuits: Introduction, MOS logic circuits with depletion nMOS loads, CMOS logic circuits, complex logic circuits, CMOS Transmission gate, Introduction to sequential MOS logic circuits, Behavior of bi-stable elements, SR latch circuit, clocked latch and flip flop circuits **09 Hrs**

Unit-V

Dynamic Logic Circuits: Introduction, Basic principles of Pass transistor circuits, voltage bootstrapping, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, high performance dynamic CMOS circuits, introduction to semiconductor memories. **10 Hrs**

Reference Books:

1) Sung Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, 3/e, McGraw-Hill, 2008.
2) Kanaan Kano, “Semiconductor Devices”, 3/e,Pearson education, 2004.
3) Douglas A Pucknell & Kamran Eshragian, “Basic VLSI Design”, 3/e, PHI, 2005.
4) Michael John Sebastian Smith “Application Specific Integrated Circuits”, Pearson Publication, 2013.

22UECC502	Digital Signal Processing	(3-2-0) 4

Contact Hours: 52 Hrs

Course Learning Objectives (CLOs):

The course focuses on transforms, their properties and applications. It deals with the design of analog and digital filters using various methods and hardware structure for implementation of digital filters. It explains some of the optimization techniques of signal processing and multi-rate signal processing applications.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Compute** transforms and inverse transforms of a signal and **apply** the properties of DFT to **solve** signal processing problems	1,2	-	13
CO-2	**Optimize** the computation of DFT and **Compare** with direct computations.	2, 3,	13, 12	-
CO-3	**Design** analog and digital IIR filters to satisfy the given specifications and realize the hardware structure	2, 3	12	-
CO-4	**Design** digital FIR filters to satisfy the given specifications and realize the hardware structure**.**	2, 3	12	-
CO-5	**Design** of filters using pole-zero concept and to **understand** the fundamentals of multirate signal processing and its applications.	2, 3	12	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1	3	3	-	-	-	-	-	-	-	-	2	1.5	-

Prerequisites: Engineering Mathematics-3

Contents:

Unit-I

Discrete Fourier Transform (DFT): Introduction, frequency domain sampling and reconstruction of discrete time signals, Discrete Fourier Transform, DFT as a linear transformation, relationship of DFT to other transforms, Properties of DFT, Linear Filtering Methods based on DFT: use of DFT in linear filtering, filtering of long data sequences, frequency analysis of signals using DFT **10 Hrs**

Unit-II

Efficient Computation of the DFT: Radix-2 Fast Fourier Transform (FFT) algorithms for the computation of DFT and IDFT: Decimation-In-Time (DIT) and Decimation-In-Frequency (DIF) algorithms, comparison of direct computation and FFT computation of DFT, applications of FFT algorithms: efficient computation of DFT of two real sequences, efficient computation of DFT of 2N point real sequences. Discrete Cosine Transform(DCT): Forward DCT, Inverse DCT, DCT as an orthogonal transform. **10 Hrs**

Unit-III

Design of Analog IIR Filters: Introduction, design of IIR Butterworth and Chebyshev type–I filters . **Design of Digital IIR Filters:** IIR filter design by Approximation of Derivatives, Impulse Invariance Transformation, frequency transformations in digital domain, structures for the realization of IIR filters. **12 Hrs**

Unit-IV

Design of Digital FIR Filters: Symmetric and Anti-symmetric FIR filters, Design of Linear phase FIR filters using windows method and frequency sampling method, Design of FIR Differentiators, Design of Hilbert Transformers, structures for the realization of FIR filters. **10 Hrs**

Unit-V

Pole-Zero Placement Method for the Design of Simple Filters: Ideal filter characteristics, Simple IIR & FIR digital filters, Notch filters, Comb filters, All-pass filters, Digital Resonators. **Multirate Digital Signal Processing:** Introduction, Decimation, Interpolation, sampling rate conversion, applications of multirate signal processing. **10 Hrs**

Reference Books:

1) Proakis & Monalakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4/e, Pearson Education, New Delhi, 2007.
2) Sanjit K. Mitra, “Digital Signal Processing”, 2/e Tata Mc-Graw Hill, 2004.
3) Li Tan, “Digital Signal Processing Fundamentals and Applications”, Elsevier,2003.
4) Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, Pearson Education,2/e, 1999.
5) P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Pearson, 1992.

22UECL503	Digital Signal Processing Laboratory	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs):

The laboratory course enables students to get practical experience of the subject learnt in
theory. Students will learn to process the signals in transform domain, verify the properties, design of filters and their realization and multi-rate signal processing applications.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Perform** signal manipulations and **Compute** response of LTI systems	-	1,2,5, 12	13,14
CO-2	**Compute** DFT and inverse DFT and **Verify** the properties.	1,2	5,12	13,14
CO-3	**Apply** properties of DFT to **solve** signal processing problems	1,2	5,12	-
CO-4	**Design** of filters to meet the given specifications	2, 3	5,12	-
CO-5	**Implement** DCT and multi-rate signal processing applications	2, 3	5,12	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.66	2.8	3	-	2	-	-	-	-	-	-	2	1	1

Prerequisites: Engineering Mathematics-3

Contents

1. Basic signal processing operations and manipulations and illustration of Nyquist sampling theorem
2. Linear and circular convolution of two given sequences.
3. Computation of DFT/IDFT and verification of its properties.
4. Efficient computation of DFT.
5. Frequency analysis of signals using DFT.
6. Design of analog IIR filters for the given specifications and their realization.
7. Design digital IIR filters for the given specifications and their realization.
8. Design digital FIR filters for the given specifications and their realization.
9. Comparison of DFT and DCT in terms of energy compaction
10. Illustration of decimation and interpolation process and sample rate conversion.

Reference Books:

1) Proakis & Monalakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4/e, Pearson Education, New Delhi, 2007.
2) Sanjit K. Mitra, “Digital Signal Processing”, 2/e Tata Mc-Graw Hill, 2004.
3) Li Tan, “Digital Signal Processing Fundamentals and Applications”, Elsevier, 2003.
4) Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, 2/e, Pearson Education, 1999.

22UECL504	System Design Laboratory	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs):

This laboratory course focuses on the simulation of various concepts of digital, communication and control systems using MATLAB Simulink. The students will be able to design digital circuit problems and verify the same using simulink. They will learn to generate various analog /digital/pulse modulation signals and understand their signal constellation diagrams. They will get exposure to analyse the control systems by modelling them and understand the working of the system by making various changes in parameters using various software tools.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Develop** troubleshooting and debugging skills for digital logic circuits implemented in Simulink.	13,14	1,2,3,5	-
CO-2	**Enhance** their understanding of control flow structures in programming by applying if-else blocks to solve mathematical problems.	13,14	1,2,3,5	-
CO-3	**Demonstrate** competency in implementing various analog/ digital/pulse modulation schemes and **analyze** the signal constellation diagrams	13,14	1,2,3,5	-
CO-4	**Design** second orders systems and **analyze** their performance.	13,14	1,2,3,5	-

CO-5	**Simulate** second order systems and obtain the time domain response.	13,14	1,2,3,5	

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	2	2	-	2	-	-	-	-	-	-	-	3	3

List of Experiments:

1. a. Implement and verify the truth table of basic gates and universal gates.

b. Realize Half adder and full adder using basic gates.

2. a. Implement the following function using if-else block,

$$f(x,y) = \begin{cases} x-y, if\ x<y \\ y-x, if\ x>y \\ x=y, if\ x=y \end{cases}$$

Where x and y are positive integers.

b. Design an automated system to manage water lifting motor from a sump to overhead tank. The system must optimize water usage, prevent overflow, and protect the motor from running dry by adhering to the following conditions:

Activation Conditions:

The motor should automatically turn on when the overhead tank is empty if there is sufficient water in the sump.

Deactivation Conditions:

The motor should turn off when the overhead tank is full.

The motor should also turn off if there is no water in the sump.

Hint: Use if-else block

3. a. Consider two 2 x 2 matrices,

$$A = \begin{matrix} 3 & 2.5i \\ -2i & 3.2 \end{matrix} \text{ and } = \begin{matrix} \sqrt{-3i} & \sqrt{2.2} \\ \sqrt{2.5} & \sqrt{5.4} \end{matrix}.$$

Build a Simulink model to perform the following Matrix Operations:

$$X = 2 * A + \frac{B}{6} \qquad\qquad Y = A^T * \frac{1}{5} + B^{-1}$$

b. Find the DFT and IDFT of given sequence x=[1 3 4 -1] using matrix

method.

4. Design a simple up, down and up-down counter.
5. Generation of analog/digital/pulse modulation schemes.
6. Demonstrate Pulse Code Modulation and Demodulation.
7. Demonstrate QPSK modulation and Demodulation and its signal constellation diagram
8. Demonstration of Time Division Multiplexing
9. Design and performance analysis of second order system.
10. Obtaining the frequency response of second order system & sketch its Bode plot.
11. Simulation of 3rd order system to obtain Phase Margin & Gain Margin with the help of Bode plot.
12. Simulation of 2nd order system & obtaining time domain response.

Reference Books:

1) Donald D. Givone, "Digital Principles and Design", McGraw Hill Education, 2017
2) Simon Haykin " Digital Communications", Wiley – India Edition, 2006.
3) I. J. Nagrath and M. Gopal, "Control Systems Engineering", 3/e, Wiley Eastern ltd., 2003.
4) K. Ogata, "Modern Control Engineering", 4/e, PHI,2004.

22UECL505	**Minor Project-I**	**(0-0-4) 2**

Contact Hours: 52

Course Learning Objectives (CLOs):

Minor project-I focuses on an exposure to the project work in the domain of their interest by selecting a problem definition from an emerging area. The problem could be defined to develop prototypes for industrial needs.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** and **justify** the technical aspects of the chosen project with a	1	2,4	6,7

	comprehensive and systematic approach.			
CO-2	**Reproduce** and **refine** technical aspects for engineering projects.	2	13	-
CO-3	**Work** as an individual or in a team in development of projects	9	8	-
CO-4	**Implement** the solution in hardware and / or software	3,5	13,14	11
CO-5	**Present** the work in a systematic manner	10	12	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	2.5	3	2	3	1	1	2	3	3	1	2	2	2

Prerequisites: System Design, Circuit Building, Programming techniques, System Configuring, Instrumentation, Tool Usage, Testing and Debugging

Guidelines for Conduction Spirit of the Course:

To ensure that undergraduates successfully apply the knowledge they have gained in different courses and integrate material learnt at different stages of the curriculum up to the 4th semester so as to complete the project work within the stipulated time duration following guidelines are framed:

1. Project groups are formed with 3-4 students in each team.
2. Project coordinators instruct student project batches to submit synopsis in the prescribed format in the field of their choice.
3. Project coordinators allot guides based on their field of specialization. However students can have further discussions on the project topic and can modify their project title.
4. Students are instructed to report to their respective guides on weekly basis for discussion.
5. Students are instructed to maintain separate project diary/notebook to show the progress work while having discussion with guide and review committee members.
6. Two reviews are fixed in a semester to monitor the progress of the project.

Assessment: CIE: 40 marks are allotted by reviewers conducting two reviews and project guide evaluates for 10 marks. Hence, 50 marks allotment under CIE. **SEE:** Minor project-I has SEE component and marks allotted for SEE is 50, where students need to demonstrate the project and present it in the presence of examiners.

Note:

- Designated committee is constituted with 2-4 committee members to monitor the process of Minor Project-I
- An internal guide is allotted per group who guides and monitors the project progress.
- Problem statements can be derived from industry, society, etc., after interacting with them.
- Course outcomes (4 or more) are written and mapped to program outcomes and program specific outcomes. In addition to that other POs can also be included if those POs are deemed suitable.
- At the end of the course, students are required to document the project in the form of report.

22URMK506	Research Methodology & IPR	(2-0-0) 2

Contact Hours: 26

Course Learning Objectives (CLOs):

The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing. Also expected to learn about the importance of IPR and trade mark.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Formulate the research problem, carryout literature survey and decide the methodology.	-	1	-
CO-2	Use measurement and scaling and carryout data collection.	-	1	-
CO-3	Test the hypothesis, interpret & analyze the results and write the report.	2	3	-
CO-4	Explain the need for IPR and trademark		2	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	2.2	2	-	-	-	-	-	-	-	-	-	-	-

Pre-requisites:

Branch specific course on problem analysis (Preferred)

Contents:

Unit-I

Research Methodology: Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology. Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. **05 Hrs**

Unit-II

Reviewing the literature: Importance of the literature review in research, How to review the literature, searching the existing literature, reviewing the selected literature and writing about the literature reviewed. Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design. **05 Hrs**

Unit-III

Data Collection: Collection of primary data, observation method, interview method, collection of data through questionnaires. Testing of Hypotheses: What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses Interpretation and Report Writing: Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing

06 Hrs

Unit-IV

Meaning and conception of IPR, competing, rationale for protection, international conventions, world court. Copy right: Historical evolution of the law on copy right, meaning, content, Patents: Meaning of Patent, purpose and policy object of patent law, gains to inventor, application of patents, joint application, discovery and invention, patentable and non-patentable inventions **05 Hrs**

Unit-V

Industrial Design, Trademarks: Definitions and conceptions of Trademark, advantages of registration, marks which are not registrable, known and well-known trade marks, application for registration and procedure for registration, procedure and certification of Trademarks The Information Technology Act: Definitions, certifying authority, meaning of compromise of digital signature, offences and penalties, applicability of IPRs, cybercrimes, adjudicating officer, violation,

damages and penalties, Cyber regulation appellate tribunal, World Wide Web and domain names and cyber flying, Self study.
05 Hrs

Reference Books:

1) C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4 th Edition, 2018.
2) Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rdEdition, 2011.
3) Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
4) N. K. Acharya, Text book on Intellectual Property Rights, 4 th Edition, Asia Law House, Hyderabad.

22UESK507 Environmental Studies (1-0-0) 1

Contact Hours: 13

Course Learning Objective (CLO):
The Students are to learn in this course about the need of balanced ecosystem, effects of human activities on environment, optimized use of natural resources including energy extraction and current Environmental issues.

Course Outcomes (Cos):

Description of the Course Outcome: At the end of the course the student will be able to		**Mapping to POs (1-12) /PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss the concept of ecosystem and effects of human activities on environment.		7	
CO-2	Describe the adverse effects on health and society due to erratic exploitation of natural resources.			6
CO-3	Understand various types of energy, sources of energy.		6	
CO-4	Explain different types of Pollution and concept of Global warming,		7	

	Ozone layer depletion.			
CO-5	Discuss the current developments towards NGO to protect environment.		6	

Pos	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	-	-	-	-	-	1.6	2	-	-	-	-	-	-	-

Course contents:

Unit – I

Environment and Effects of Human activities on Environment: Introduction, Ecosystem – Types & Structure of Ecosystem, Impacts of Agriculture & Housing, Mining & Transportation. Environmental Impact Assessment, Sustainable Development. **03 Hrs**.

Unit - II

Natural Resources : Introduction Water resources – Availability & Quality aspects, Water borne diseases, Fluoride problem in drinking water. Material Cycles - Carbon cycle and Nitrogen cycle. **03 Hrs**

Unit - III

Energy in Ecological System: Different types of energy, Conventional sources & Non Conventional sources of energy. Solar energy, Hydro electric energy, Wind energy, Nuclear energy, Biomass & Biogas, Fossil Fuels, Hydrogen as an alternative energy.
03Hrs

Unit - IV

Environmental Pollution: Water Pollution, Land Pollution, Air Pollution, Global Warming, Ozone layer depletion. **02 Hrs**

Unit – V

Current Environmental Issues & Environmental Protection: Environmental Acts & Regulations, Role of Nongovernmental Organizations (NGOs). Introduction to GIS & Remote Sensing, Applications of GIS & Remote Sensing.
02 Hrs

Reference Books:

1. P. Meenakshi, " Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi, 2006.
2. Benny Joseph " Environmental Studies", Tata McGraw – Hill Publishing Company Limited, 2010.
3. Raj Gopalan " Environmental Studies" Oxford University press, New Delhi, 3rd Edition, 2016.
4. Kaushik and Kaushik " Perspectives in Environmental Studies ", New Age International Private Limited, 2005.
5. D. L. Manjunath " Environmental Studies ", Pearson, Noida, 2016.

22USSK508	Soft Skills – I	(0-0-2) Audit

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the significance of communication in the profession.	-	10	-
CO-2	**Use** the Number System Solving with proficiency	-	10	12
CO-3	**Solve** Aptitude related problems	-	9	12
CO-4	**Demonstrate** the competency in the placement activities.	-	9	-

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	-	-	-	-	-	-	-	-	2	2	-	1	-	-

Contents:

Training on communication skills, proficiency in English language Analytical Puzzles ▪ Classification Puzzles ▪ Mathematical Puzzles ▪ Human Relations ▪ Directional tests ▪ Coding and decoding ▪ Series completion – Verbal and Non-verbal **06 Hrs**

Number System, Linear Equations + Assessment Test ▪ HCF and LCM, Ratios & Proportions + Assessment Test ▪ Percentage, Profit & Loss + Assessment Test ▪ Time, Work & Distance + Assessment Test **06 Hrs**

Simple and compound Interest, Averages and Mixtures + Assessment Test ▪ Permutations, Probability + Assessment Test ▪ Data analysis **06 Hrs**

Understanding Discussions ▪ Parameters measured in GDs ▪ Video Analysis of GDs ▪ Knowledge base and Ideas ▪ Taking the initiative **06 Hrs**

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

22UNSK509	National Service Scheme	(0-0-2) Audit

Contact Hours: 24

Course Learning Objectives:

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

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Understand the importance of his / her responsibilities towards society.	12	6	8
CO2	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.	12	6	8
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.	12	6	8,
CO4	Implement government or self-driven projects effectively in the field.	12	6	8

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	-	-	-	-	-	2	-	1	-	-	-	3

Activity list:

1. Waste management– Public, Private and Govt organization.
2. Setting of the information imparting club for women leading to contribution in social and economic issues.
3. Water conservation techniques – Role of different stakeholders– Implementation.
4. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
5. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.
6. Developing Sustainable Water management system for rural areas and implementation approaches.
7. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.
8. Spreading public awareness under rural outreach programs. (minimum 2 programs).
9. Social connect and responsibilities.
10. Plantation and adoption of plants. Know your plants.
11. Organize National integration and social harmony events /workshops/ seminars. (Minimum 02 programs).
12. Govt. school Rejuvenation and helping them to achieve good infrastructure.

Students have to take up at least three activities on the above said topics and have to prepare content for awareness and technical contents for implementation of the projects and have to present strategies for implementation of the same.

Note: Activities must be unique (Not repeat) across semesters for each student.

CIE will be evaluated based on their presentation, approach and implementation strategies.

Reference Books:
NSS Course Manual, Published by NSS Cell, VTU Belagavi

ASSESSMENT AND EVALUATION PATTERN		
	Time Schedule	CIE (50)
Presentation: on Selected topic	Before the IA-3	50 Marks

Note: Implementation strategies of the project with report duly signed by the Department NSS Coordinator and HoD

22UECE521	**MEMS**	**(4-0-0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the study of various micro-electromechanical systems. The course discusses different fabrication techniques, modelling aspects and transduction principles of various electromechanical sensors, actuators at micro and nanoscale.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Appreciate the significance of MEMS, as an emerging area in the field of electronics.	1	-	2
CO-2	Identify various micro sensors and actuators used for electromechanical	2	-	4

	applications.			
CO-3	Discuss the processes involved in the fabrication of different micro sensors and micro actuators.	-	2	5
CO-4	Design simple micro sensors and actuators using CAD Tools and perform simulation.	5	2,3	13
CO-5	Classify various micro system packaging technologies related to MEMS.	2	3	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	2	2	1	2	-	-	-	-	-	-	-	1	-

Pre-requisites: Physics, Electronics, Engineering Mathematics, Material Science

Contents:

Unit-I

Overview of MEMS & Microsystems: MEMS & Microsystems, typical MEMS and micro system products — features of MEMS, multidisciplinary nature of Microsystems, design and manufacture, applications of microsystems. **Scaling Laws in Miniaturization:** Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling in electrostatic forces, electromagnetic forces, electricity.

10 Hrs

Unit-II

Transduction Principles in MEMS & Microsystems: Introduction, micro sensors, electromechanical transducers, micro actuation principles, MEMS with micro actuators, Micro accelerometers, MEMS switches, micro relays, MEMS inductors and capacitors. **12 Hrs**

Unit-III

Microsystems Fabrication Process: Introduction, photolithography, ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, MEMS fabrication processes: Surface micro-machining, Bulk micromachining, LIGA process.

10 Hrs

Unit-IV

Micro System Design and Modelling: Introduction, Design considerations: Process design, Mechanical design, Modelling using CAD tools: Multiphysics/ Intellisuite / MEMS CAD, Features and Design considerations of RF MEMS, Design considerations of Optical MEMS. Design and Modelling: Case studies- i) Cantilever beam ii) Micro switches **10 Hrs**

Unit-V

Micro system packaging: Overview of mechanical packaging of micro electronics, micro system packaging, interfaces in microsystem packaging, packaging technologies in MEMS. **10 Hrs**

Reference Books:

1) Tai Ran Hsu, "MEMS and Micro Systems: Design and Manufacture", Tata McGraw Hill, 2002.
2) Boca Raton, "MEMS and NEMS: Systems, Devices and Structures", CRC Press, 2002.
3) J. W. Gardner and V. K. Varadan, "Micro Sensors MEMS and SMART Devices", John Wiley, 2002 N. Maluf, "Introduction to Micro Mechanical Systems Engineering, Artech House", Norwood, MA, 2000.
4) V.K.Varadan, K.J.Vinoy and K.A.Jose, "RF MEMS and their Applications", Wiley India Pvt Ltd, Reprint 2011.

22UECE522 Operating Systems (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on basic components of a computer operating system, and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the services, system calls, process, inter process communication and should be able to solve process scheduling problems	3	1,2	-

CO-2	Understand the process synchronization, critical section, deadlock and solve related problems.	-	1,2,3	14
CO-3	Illustrate various ways of main memory organization, techniques of Memory allocation and Paging.	-	3,12	-
CO-4	Elaborate the demand paging, File accessing methods, directory structure and solve page replacement problems.	-	3,14	-
CO-5	Summarize the disk allocation, scheduling and space management.	-	2	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	2	2.25	-	-	-	-	-	-	-	-	2	-	1.45

Pre-requisites: Computer organization, Programming fundamentals.

Contents:

Unit-I

System Structures : Introduction, OS Services, User and Operating System Interface, System calls ,Types of System Calls, System Programs, Operating System Design and Implementation, Operating System Structures, **Process Scheduling**:Process concept, Process scheduling, Operation on processes, cooperating processes, Inter process communication, Communication in client /server system CPU scheduling- Basic concepts, scheduling criteria, scheduling algorithms. **12 Hrs**

Unit-II

Synchronization: The Critical section problem, Peterson's Solution Synchronization hardware, Mutex locks, Semaphores, problems of synchronization, Critical regions, Monitors, **Deadlock** - System model, Deadlock characterization, Methods for handling deadlocks - Deadlock prevention, deadlock avoidance, Deadlock detection and solution for deadlock, Recovery from deadlock.
12 Hrs

Unit-III

Main Memory Management Strategies: Overview, Main memory management-Background, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging, Structure of Page table. **10 Hrs**

Unit-IV

Virtual memory: Background, Demand paging, Process creation, Copy on Write, Page replacement algorithms, Allocation of frames, thrashing, Memory mapped files.**File System** : File concept, Access methods, Directory structure, File system mounting, File Sharing, Protection, File system structure, file system implementation, Directory implementation, Allocation methods and free space management **10 Hrs**

Unit-V

Mass storage structures: Disk structure, Disk Attachment Disk scheduling methods, Disk management, Swap space management. **I/O Systems:** I/O hardware, Application I/O interface, Kernel I/O sub system
08 Hrs

Reference Books:

1) Abraham Silberschatz, Peter Baer Galvin, Greg Gagne – "Operating System Concepts", 6thedition, John Wiley & Sons.
2) Milan Milankovic, "Operating system concepts and design", 2ndEdition, McGraw- Hill.
3) Harvey M. Deital , "Operating systems", Addison Wesley Publications.
4) D.M Dhamdhere, "Operating systems - A concept based Approach", Tata McGraw-Hill the Operating systems.

VI Semester

22UECC600	**Analog and Mixed Mode VLSI Design**	**(4-0-0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the basic requirements of circuit design, difficulties in the design phase and various circuit examples. The course considers widely used analog circuits such as OPAMP, ADC, DAC, current source and sinks, mirrors and PLL as examples for the discussion.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	**Mapping to POs(1-12)/ PSOs (13,14)**		
	Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**

CO-1	**Explain** the characteristics and short channel effects of MOS devices	-	-	1
CO-2	**Analyze and design** various configurations (CS, CD, CG) of single stage amplifiers.	2,3,13	-	1
CO-3	**Design** the analog circuits such as op-amps, current sources, current sinks and current mirrors.	2,3,13	-	-
CO-4	**Compare** data converter characteristics and **build** data converter architectures.	13,14	4,5	-
CO-5	**Explain** PLL and its applications.	1,13	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.66	3	3	2	2	-	-	-	-	-	-	-	3	3

Pre-requisites: Analog Electronics, Network Analysis, Digital circuits & Basics of CMOS VLSI Design.

Contents:

Unit-I

Introduction to Analog Design: Introduction to MOS, MOS V/I characteristics, second order effects, MOS device models. **Common source single stage amplifiers**: Basic concepts, common source stage with resistive load, diode connected load, current source load, triode load and source degeneration. **12 Hrs**

Unit-II

Other single stage amplifiers: source follower, Common gate stage, Cascode stage. **Current Sinks, Current Sources and Current Mirrors:** Current sinks and sources, techniques to improve performance of current sinks and sources, current mirrors, effects to cause current mirror to be different from ideal situation. **10 Hrs**

Unit-III

Operational Amplifiers: General considerations, Single stage Op-Amps, two stage Op-Amps, gain boosting, comparison, common mode feedback, slew rate, power supply rejection ratio, Comparator.
09 Hrs

Unit-IV

Data Converter fundamentals and architectures: Introduction, sample and hold characteristics, digital to analog converter (DAC) specifications, analog to digital

converter (ADC) specifications, DAC architectures: Resistor string, R-2R ladder network, Charge scaling DACs, ADC architectures: Pipeline ADC, Successive Approximation ADC. **12 Hrs**

Unit-V

Phase Locked Loops: Simple PLL, Basic PLL Topology, Dynamics of Simple PLL, Charge Pump PLLs, Non ideal effects in PLLs, Delay Locked Loops and Applications. **09 Hrs**

Reference Books:

1) Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw-Hill Edition 2008.
2) R. Jacob Baker, Harry W. LI, David E. Boyce, "CMOS Circuit Design, lay out and Synthesis", IEEE press, 2005.
3) Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", 2/e, New York Oxford, Oxford University.
4) Adel S. Sedra, Kenneth C. Smith, "Microelectronic Circuits Theory and Applications", 5th edition Oxford University Press, 2013.

22UECC601 Computer Communication Networks (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the process of data communication in computer network through the layered architecture. It also deals with the IEEE standards and various protocols at different layers.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** and **Design** the physical layer aspects of Computer Communication Networks.	-	1	-
CO-2	**Analyze** and **Design** the Data link layer aspects of Computer Communication Networks.	1,2	3,14	-

CO-3	**Analyze** and **Design** the physical and Datalink Layer aspects of Wired and Wireless Local Area Networks.	-	1,3	2
CO-4	**Analyze** and **Design** the Network layer aspects of Computer Communication Networks.	2,3	1	-
CO-5	**Analyze** and **Design** the Transport layer aspects of Computer Communication Networks.	-	2,3	4

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.25	2.25	2.25	1.0		-	-	-	-	-	-	-	-	2

Pre-requisites: Analog and Digital Communication

Contents:

Unit-I

Data Communications: Components, Data Representation**,** Data Flow, Network Criteria, Physical Structures, Local Area Network, Wide Area Network, Internet, **Network Models:** Principles of Protocol Layering, Layers in TCP/IP Protocol Suite and Description of each, Encapsulation and Decapsulation, Addressing, OSI v/s TCP/IP, **Switching:** Three methods of Switching, Circuit Switched Networks, Packet Switching in Datagram Networks.

11 Hrs

Unit-II

Data Link Layer: Services, Sub-layers, Link-Layer Addressing, **Data Link Control (DLC):** Framing, Flow and Error Control, Simple Protocol, Stop and Wait Protocol, **Media Access Control:** Random Access, Controlled Access, Channelization.

11 Hrs

Unit-III

Wired LANs - Ethernet: IEEE Project 802, Standard Ethernet, Fast Ethernet, **Wireless LANs:** Architectural Comparison, Characteristics, Access Control, IEEE 802.11 Project, Bluetooth, **Connecting Devices:** Hubs, Link-layer Switches, Routers **10 Hrs**

Unit-IV

Network Layer: Network Layer Services, Packet Switching, IPv4 Address space, Classful Addressing, Classless Addressing, Network Address Translation, Packet forwarding based on Destination Address. **Network Layer Protocols:** IPv4 Datagram format, Fragmentation**, Unicast Routing:** Least-Cost Routing, Distance vector Routing, Link-State Routing, Path-Vector Routing **10 Hrs**

Unit-V

Next Generation IP: IPv6 Address Representation, Address Space, Address Space Allocation, IPv6 Packet format, Extension Header. **Transport layer**-Transport Layer Services, Connectionless and Connection Oriented Protocols, Go-back N protocol, Selective Repeat Protocol, **Transport Layer Protocols**: UDP User Datagram, UDP Services, TCP Services, TCP Features, TCP Segment

10 Hrs

Reference Books:

1) Behrouz A. Forouzan, **"Data Communication and Networking"**, 5th Edition, McGraw Hill, 2012.
2) James F. Kurose, Keith W. Ross "**Computer Networks"**, Pearson Education, 3rd Edition, 2007.
3) Wayne Tomasi, **"Introduction to Data communication and Networking"**, Pearson Education, 2007.
4) Andrew S. Tanenbaum, "**Computer Networks**", 5th Edition, Pearson Education, 2013.

22UECC602	**Embedded System Design**	**(3-0-0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on the design of embedded systems exploring requirements such as embedded processors, peripherals, programming languages and tool chains along with the optimisation techniques.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify and describe** the advantages of RISC architecture and **defend** RISC architectural issues of ARM Processor. **Discuss** the architecture, processor modes, instruction types and programming model of ARM7TDMI.	3,14	5,12	1
CO-2	**Distinguish** between ARM and THUMB instruction set architecture and **assess** the performance measure of an application developed using these instruction set architectures.	-	1,2	13

CO-3	**Demonstrate** programming skills using Assembly Level Language and High Level Language such as C. **Extrapolate** Interrupt Service Routine (ISR) for various sources of interrupts.	2,3	4,5,14	1
CO-4	**Develop** the hardware software co-design and firmware design approaches.	5	3,13	1,2
CO-5	**Demonstrate** the need of real time operating system	5	2,12	14

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.3	2.3	2.6	2	2.5	-	-	-	-	-	-	2	1.5	1.3

Pre-requisites: Basic Semiconductor Physics, Basic Electronics

Contents:

Unit-I

ARM Embedded Systems: The RISC Design Philosophy, The ARM Design Philosophy , Embedded System Hardware, Embedded System Software, ARM Processor Fundamentals, Registers, Current Program Status Register, Pipeline ,Exceptions, Interrupts, and the Vector Table, Core Extensions , Architecture Revisions, ARM Processor Families **08 Hrs**

Unit-II

Introduction to the ARM Instruction Set : Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, Conditional Execution , Assembler Rules and Directives **08 Hrs**

Unit-III

Introduction to the Thumb Instruction Set: Thumb Register Usage, ARM-Thumb Interworking, Other Branch Instructions, Data Processing Instructions, Single-Register Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction. **Exception and Interrupt Handling:** Exception Handling, Interrupts, Interrupt Handling Schemes. LPC2148 ARM CPU, Peripherals: GPIO, PLL & Timers Features. **08 Hrs**

Unit-IV

Program Design and Analysis: Components for Embedded Programs, Models of Programs ,Assembly, Linking, and Loading , Basic Compilation Techniques , Program Optimization ,Program-Level Performance Analysis, Software

Performance Optimization, Program-Level Energy and Power Analysis and Optimization, Analysis and Optimization of Program Size, Program Validation and Testing **07Hrs**

Unit-V

Processes and Operating Systems: Multiple Tasks and Multiple Processes, Pre-emptive Real-Time Operating Systems, Priority-Based Scheduling, Inter-process Communication Mechanisms ,Evaluating Operating System Performance, Power Management and Optimization for Processes, Design Example: Telephone Answering Machine **08Hrs**

Reference Books:

1) Andrew N. Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide", Morgan Kaufmann Publishers, An imprint of Elsevier,2004.
2) Wayne Wolf , "Computers as Components Principles of Embedded Computing System Design", second edition, Morgan Kaufmann Publishers, An imprint of Elsevier,2008
3) Trevor Martin**, "**The Insider's Guide Philips ARM®7 based Microcontrollers An Engineer's Introduction To The LPC2100 Series" Hitex (UK) Ltd.,2005.
4) Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt. Ltd. Publications, 2005.

22UECL603	VLSI Laboratory	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs):

The course focuses on exploring the theoretical concepts studied as part of subjects, CMOS VLSI Design and Analog and Mixed Mode VLSI Design in practical with the help of Cadence tool framework. The lab introduces the complete custom IC design flow and Analog and Mixed Signal (AMS) flow for Analog circuits, Digital circuits and Analog and mixed signal circuits design respectively.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	**Mapping to POs(1-12)/ PSOs (13,14)**		
	Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**

CO-1	**Demonstrate** the working of digital and analog circuits and **apply** the design steps of VLSI flow to build the schematic and layouts of VLSI circuits.	1, 2	5	13
CO-2	**Design** and **perform** the DC and transient analysis on combinational & sequential VLSI circuits.	2	1,5	-
CO-3	**Design** and **Perform** the DRC, LVS and RC extraction of layout designs of combinational & sequential VLSI circuits.	2	1,5	-
CO-4	**Design** analog and mixed signal circuits **and Evaluate their** performance**.**	3,5	13	-
CO-5	**Compare and evaluate** the performance of VLSI circuits.	2	10,13	1,4,14

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.5	3	3	1	2.25	-	-	-	-	2	-	-	1.6	1

List of Experiments:

Draw the Schematic and Layout for the following digital and analog circuits mentioned below with the help of Cadence tool frame work and verify the following.

a. Schematic: i) DC Analysis ii) Transient Analysis iii) Parametric analysis

b. Layout: i) DRC ii) LVS iii) RCX

1. Design CMOS Inverter with given specifications.
2. Design CMOS two input NAND and NOR gates.
3. Design Transmission gate & Multiplexer using transmission gates.
4. Design XOR, AND & OR gates using transmission gates.
5. Design D F/F, SR F/F sequential circuits.
6. Design 2-bit up-down counter using D F/Fs.
7. Design a Common Source Amplifier with resistive load for given specifications.
8. Design a source follower circuit.
9. Design single stage Differential Amplifier with given specifications.
10. Design single stage OPAMP using common source amplifier with resistive load.
11. Design 4 bit R-2R DAC using Op-amp with given specifications.

Reference Books:

1) Sung Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, 3/e, McGraw-Hill, 2008.
2) Douglas A Pucknell& Kamran Eshragian, “Basic VLSI Design”, 3/e, PHI, 2005.

3) Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw-Hill Edition 2008.
4) R. Jacob Baker, Harry W. LI, David E. Boyce, "CMOS Circuit Design, lay out and Synthesis", IEEE press, 2005.

22UECL604 Embedded Systems Laboratory (0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs):

The course focuses on embedded systems design and development. Hardware-software co design process is explored in real-time system design.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Realize** embedded system design using Integrated Development Environment (IDE).	-	1,5	3,7
CO-2	**Develop** simple embedded C applications using RTOS-APIs.	2,5	3	7,12
CO-3	**Construct** embedded systems using sensors and actuators.	2,13,14	4,5	7,9, 12
CO-4	**Execute** basic IoT applications on embedded platform.	1,2,14	4,5,13	9,6
CO-5	**Realize** communication protocols used in embedded systems.	5	13,14	4

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.5	3	1.5	1.6	2.4	1	1	-	1	-	-	1	2.3	2.6

List of Experiments:

1. Sample Embedded C-programs.
2. Develop Embedded C-Program for the following interfacing examples
    a. ADC and DAC.
    b. LED and PWM.
    c. Real time clock and serial port.
    d. Keyboard and LCD.
    e. EPROM and interrupt.
3. Demonstrate Inter-Process Communication using Mailbox.

4. Interrupt performance characteristics of ARM Controllers.
5. Write a C program to blink LEDs on ARM Controller board.
6. Develop a system to rotate a stepper motor by 180^0 when temperature is above set threshold.
7. Develop a system to rotate a DC motor with different rpm depending upon temperature.
8. Implement Communication protocol on ARM Controllers.
9. Local processing on the sensor nodes
10. Develop a sample IoT application by connecting devices to the cloud and vice Versa

Reference Books:

1) Andrew N. Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide", Morgan Kaufmann Publishers, An imprint of Elsevier,2004.
2) Wayne Wolf , "Computers as Components Principles of Embedded Computing System Design", second edition, Morgan Kaufmann Publishers, An imprint of Elsevier,2008
3) K.V. K. K Prasad ,"Embedded real time systems", Dreamtech publications, 2003.
4) William Hohl & Christopher Hinds, "ARM ASSEMBLY LANGUAGE Fundamentals and Techniques", second edition, CRC Press 2015.

22UECL605	Minor Project-II	(0-0-4) 2

Contact Hours: 52

Course Learning Objectives (CLOs):

Minor project-II focuses on an exposure to the project work in the domain of their interest by selecting a problem definition from an emerging area. The problem could be defined to develop prototypes for industrial needs.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** and **justify** the technical aspects of the chosen project with a comprehensive and systematic approach.	1	2,4	6,7
CO-2	**Reproduce** and **refine** technical aspects for engineering projects.	2	13	-

CO-3	**Work** as an individual or in a team in development of projects	9	8	-
CO-4	**Implement** the solution in hardware and / or software	3,5	13,14	11
CO-5	**Present** the work in a systematic manner	10	12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2.5	3	2	3	1	1	2	3	3	1	2	2	2

Prerequisites: System Design, Circuit Building, Programming techniques, System Configuring, Instrumentation, Tool Usage, Testing and Debugging

Guidelines for Conduction Spirit of the Course:

To ensure that undergraduates successfully apply the knowledge they have gained in different courses and integrate material learnt at different stages of the curriculum up to the 5th semester so as to complete the project work within the stipulated time duration following guidelines are framed:

1. Project groups are formed with 3-4 students in each team.
2. Project coordinators instruct student project batches to submit synopsis in the prescribed format in the field of their choice.
3. Project coordinators allot guides based on their field of specialization. However students can have further discussions on the project topic and can modify their project title.
4. Students are instructed to report to their respective guides on weekly basis for discussion.
5. Students are instructed to maintain separate project diary/notebook to show the progress work while having discussion with guide and review committee members.
6. Two reviews are fixed in a semester to monitor the progress of the project.

Assessment: CIE: 40 marks are allotted by reviewers conducting two reviews and project guide evaluates for 10 marks. Hence, 50 marks allotment under CIE. **SEE:** Minor project-II has SEE component and marks allotted for SEE is 50, where students need to demonstrate the project and present it in the presence of examiners.

Note:

- Designated committee is constituted with 2-4 committee members to monitor the process of Minor Project-II
- An internal guide is allotted per group who guides and monitors the project progress.
- Problem statements can be derived from industry, society, etc., after interacting with them.
- Course outcomes (4 or more) are written and mapped to program outcomes and program specific outcomes. In addition to that other POs can also be included if those POs are deemed suitable.
- At the end of the course, students are required to document the project in the form of report.

22USSK606	**Soft Skills-II**	**(0-0-2) Audit**

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12) / PSO(13-14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the significance of communication in the profession.	-	10	-
CO-2	**Use** the English language with proficiency	-	10	12
CO-3	**Solve** Aptitude related problems	-	9	12
CO-4	**Demonstrate** the competency in the placement activities.	-	9	-

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	-	-	-	-	-	-	-	-	2.0	2.0	-	1.0	-	-

Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents

22UNSK607	National Service Scheme	(0-0-2) Audit

Contact Hours: 24

Course Learning Objectives:

6. Understand the community in which they work.
7. Identify the needs and problems of the community and involve them in problem-solving.
8. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
9. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
10. Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Understand the importance of his / her responsibilities towards society.	12	6	8
CO2	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.	12	6	8
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.	12	6	8,
CO4	Implement government or self-driven projects effectively in the field.	12	6	8

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	-	-	-	-	-	2	-	1	-	-	-	3

Activity list:

13. Waste management– Public, Private and Govt organization.
14. Setting of the information imparting club for women leading to contribution in social and economic issues.
15. Water conservation techniques – Role of different stakeholders– Implementation.
16. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
17. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.
18. Developing Sustainable Water management system for rural areas and implementation approaches.
19. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.
20. Spreading public awareness under rural outreach programs. (minimum 2 programs).
21. Social connect and responsibilities.
22. Plantation and adoption of plants. Know your plants.
23. Organize National integration and social harmony events /workshops/ seminars. (Minimum 02 programs).
24. Govt. school Rejuvenation and helping them to achieve good infrastructure.

Students have to take up at least three activities on the above said topics and have to prepare content for awareness and technical contents for implementation of the projects and have to present strategies for implementation of the same.

Note: Activities must be unique (Not repeat) across semesters for each student.

CIE will be evaluated based on their presentation, approach and implementation strategies.

Reference Books:

NSS Course Manual, Published by NSS Cell, VTU Belagavi

ASSESSMENT AND EVALUATION PATTERN		
	Time Schedule	CIE (50)
Presentation: on Selected topic	Before the IA-3	50 Marks

Note: Implementation strategies of the project with report duly signed by the Department NSS Coordinator and HoD

22UECE621	Digital Image Processing	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course introduces to the fundamental concepts of image processing. Topics covered include color image processing, various image enhancement techniques, detection of discontinuities, edge linking and boundary detection.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Describe** image acquisition system, its representation, sampling and quantization.	-	1	12
CO-2	**Apply** suitable image enhancement techniques in spatial domain.	2	1,3	12
CO-3	**Analyze** Color image processing and frequency filtering techniques.	2	1,13	12
CO-4	**Analyze** and **Compare** various restoration techniques in spatial and frequency domain.	2	1,3	-
CO-5	**Understand** various morphological image processing and image segmentation techniques	-	1,13	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	3	2	-	-	-	-	-	-	-	-	1	2	**-**

Pre-requisites: Digital signal processing

Contents:

Unit-I

Digital Image Fundamentals: Digital Image Fundamentals: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and

Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels.

08 Hrs

Unit-II

Intensity Transformation: Basic intensity transformation functions, Image negatives, Contrast stretching, Histogram processing, Histogram equalization, Enhancement using arithmetic and Logic operations, Geometric transformations. **Spatial Filtering:** Spatial Filter Masks, smoothing spatial filters, sharpening spatial filters, Unsharp Masking and High-boost Filtering, Combining spatial enhancement methods. **08 Hrs**

Unit-III

Frequency Filtering: Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters, Homomorphic filtering, Selective Filtering. **Color Image Processing:** Color Fundamentals, Color Models, Pseudocolor Image Processing, Basics of Full-Color Image Processing. **08 Hrs**

Unit-IV

Fundamentals of Image Restoration: Introduction, noise models, Restoration in the presence of noise, Linear position invariant degradation, Degradation function. **Image Restoration Filters:** Spatial filtering, Periodic noise reduction by frequency domain filtering, Inverse filtering, Minimum mean square error filtering, Constrained least squares filtering, Geometric mean filter. **08 Hrs**

Unit-V

Morphological Image Processing: Preliminaries, Erosion and Dilation. **Image Segmentation:** Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region-based segmentation. **07 Hrs**

Reference Books:

1) Rafel C. Gonzalez and Richard E. Woods, “Digital Image Processing”, PHI 3rd Edition 2010.
2) A. K. Jain, “Fundamentals of Digital Image Processing”, Pearson 2004.
3) Milan Sonka and Roger Boile, “Image Processing analysis and Machine vision with Mind Tap”, Cengage Publications, 2018.
4) K.P. Soman, “Digital Signal & Image Processing”, 1/e, Elsevier India, 2012.

22UECE622	Microwave and Antennas	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): The course focuses on the study of propagation of microwaves through waveguide tubes and properties of various types of waveguide components. It explains the working principle of various microwave sources and their applications. The course also deals with the basics of

antenna theory, design, working principle and radiation pattern of various types of antennas and their applications

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the propagation of microwaves through free space and through rectangular waveguide	1,2	3	
CO-2	**Derive** the scattering matrix of waveguide components and **understand** the working principle of various microwave sources	1,2	3	
CO-3	**Understand** the terminologies of antennas and **derive** the fields radiated by a short dipole			1,12
CO-4	**Derive** the radiation pattern of array of n isotorpic point sources and non-isotropic but similar point sources.	1,2,3		13
CO-5	**Design** of various types of antenna and **understand** their radiation pattern	1,2,3		13

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.6	3.0	2.0	-	-	-	-	-	-	-	-	1.0	1.0	-

Pre-requisites: Engineering Physics

Contents:

Unit-I

Review of Electromagnetics: Maxwell's equations, wave equations in free space. **Introduction to Microwaves:** Microwave frequency bands, applications of microwaves. **Rectangular waveguides:** Propagation of TE and TM modes in a rectangular waveguide, dominant modes, cutoff wavelength, guide wavelength, group velocity, phase velocity physical interpretation of group and phase velocity.

08 Hrs

Unit-II

Waveguide Components: Introduction, Scattering matrix, Waveguide Tees (T-Junctions), directional coupler, circulator and isolator**. Microwave Tubes:**

Introduction, high frequency limitations of conventional tubes, microwave tubes: construction and working principle of Two cavity Klystron amplifier, Reflex Klystron oscillator, magnetron, travelling wave tube. **Transferred electron and avalanche transit time devices:** Gunn-effect diode, modes of operation, IMPATT Diode, TRAPATT Diode. **07 Hrs**

Unit-III

Antenna Basics: Introduction, Basic Antenna parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Directivity & Resolution, Antenna apertures, Effective height, Radio Communication link, Fields from oscillating dipole, Antenna Field Zones, Linear, Elliptical & Circular polarization. **Electric Dipoles:** Introduction, Short electric dipole, Fields of a short dipole, Radiation resistance of short dipole, Radiation resistance of $\lambda/2$ antenna. **08 Hrs**

Unit-IV

Point Sources and Their Arrays: Introduction, Point Source defined, Power patterns, Power theorem, Radiation intensity, Examples of Power patterns, Field patterns, Phase patterns, Arrays of two Isotropic Point sources, non-isotropic but similar Point Sources and Principle of pattern multiplication, Non-isotropic and Dissimilar Point sources, Linear Arrays of n Isotropic Point sources of equal amplitude and spacing, Tapering of arrays. **08 Hrs**

Unit-V

Antenna Types: Introduction, Small loop, Comparison of far fields of small loop and short dipole, Loop antenna general case, Far field patterns of Circular Loop, Radiation resistance of loops, Helical Antennas, Parabolic Reflectors, Log Periodic Antenna. **08 Hrs**

Reference Books:

1) W H Hayt, J A Buck, “Engineering Electromagnetics”, Tata McGraw-Hill publications, 2007
2) M. Kulkarni, “Microwave and Radar Engineering”, Umesh publications, 2003.
3) D. Kraus, Ronald J. Marhefka, Ahmad S. Khan “Antennas for all Applications”, 4/e, McGraw-Hill edition, 2010.
4) K. D. Prasad “Antenna & Wave Propagation”, SatyaPrakashana, New Delhi, 1999

22UECE631	Information Theory and Coding	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on the basic concepts of information theory and different coding techniques such as source coding, channel coding and turbo codes.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** and **evaluate** dependent model and Markoff model of information sources.	-	1,2	3
CO-2	**Construct** the code-words using different source coding algorithms.	3	1,2	5
CO-3	**Design** and **Analyze** linear Block codes and binary cyclic codes for error detection and correction capabilities.	2	3,13	1,5
CO-4	**Analyze** the convolution codes using different techniques.	3	1,2	-
CO-5	**Explain** Concatenated Codes & Turbo Codes.	-	4,5	3

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.75	2.25	2	2	1.5	-	-	-	-	-	-	-	2	-

Pre-requisites: : Probability theory, Communication Systems.

Contents:

Unit-I

Information Theory : Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Markoff Sources.

08 Hrs

Unit-II

Source Coding: Basic definitions, Encoding of the source output, Properties of codes, Prefix codes, Kraft McMillan's Inequality, Code efficiency and redundancy, Shannon's first theorem (Noiseless coding theorem), Shannon-Fano algorithm, Huffman coding. **08 Hrs**

Unit-III

Error Control Coding: Types of errors, types of codes, Linear Block Codes: Matrix description of linear block codes. Error detecting and correcting capabilities of linear block codes, Lookup table decoding using standard array, Single error correcting Hamming codes.

09 Hrs

Unit-IV

Binary Cyclic Codes: Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation, Error detection and error correction.

07 Hrs

Unit-V

Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, Viterbi Algorithm **07 Hrs**

Reference Books:

1) K. Sam Shanmugam, “Digital and analog communication systems”, John Wiley, 2005.
2) P.S. Satyanarayana. “Concepts of Information Theory & coding”, Dynaram Publications, 2005.
3) Daniel J. Costello and Shu Lin, “Error Control Coding: Fundamentals and Applications”, Pearson, Second Edition, 2011.
4) Ranjan Bose, “Information Theory, Coding and Cryptography”, Tata McGraw-Hill Publication, 2002.

22UECE632	Data Structures using C++	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course deals with the basics of data structures. Linked lists, stack, queues and trees etc. are included. An introductory chapter on pointers helps in the knowledge of data structures. Real life examples enhance the effectiveness of the course.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be	**Mapping to POs(1-12)/ PSOs (13,14)**

able to:		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Apply** various concepts of C++ such as Arrays, Strings, Structures, Unions, Files, Pointers and Functions in solving problems.	-	1,2,13	3
CO-2	**Understand and Implement** the operational aspects of linked lists (using pointers) such as creation, insertion, deletion and searching in problem solving.	-	1,2,3	5, 12
CO-3	**Realize and Implement** the operational aspects of stack in problem solving using Arrays and Pointers.	-	1,2,3	12
CO-4	**Implement** the operational aspects of queue in problem solving using Arrays and Pointers**.**	-	1,2,3	5, 12
CO-5	**Implement** the operational aspects of trees using Arrays and Pointers, and Hash concept in problem solving.	-	1,2,3	5, 12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.0	2.0	1.8	-	1.0	-	-	-	-	-	-	1.0	2.0	-

Pre-requisites: Object Oriented Programming using C++.

Contents:

Unit-I

Structure, unions and Pointer Revisit: Motivation for using structures. Pointer, access data from memory through pointer, pointer to structures. Motivation for dynamic memory requirement. Realizing arrays using pointer and dynamic memory allocation. Importance of memory management during allocation and de-allocation of memory. **07 Hrs**

Unit-II

Lists: Constructing dynamic data structures using self-referential structure (using the same realized linked Lists), operations on lists. Doubly Linked list. Application of Lists in sorting. **08 Hrs**

Unit-III

Stack: Realization of stack and its operations using static and dynamic structures. Application of stack in converting an expression from infix to postfix and evaluating a postfix expression, Heterogeneous stack using Unions. **08 Hrs**

Unit-IV

Queues: Realization of queues (FIFO, Double-ended queue, Priority queue) and its operations using static and dynamic data structures. **Hash Table:** Realizing effective hash table with proper data structure and hash function, its application. **08 Hrs**

Unit-V

Trees: Types of trees and their properties, Realization of trees using static and dynamic data structures. Operations on Binary trees and their application in searching (BST and AVL Tree), breadth-first search (BFS), depth-first search (DFS), Binary heap as priority queue.
08 Hrs

Reference Books:

1) Aaron M. Tenenbaum, Yedidyah Langsam and Moche J. Augenstein, "Data Structures using C & C ++", Pearson Education / PHI, 2006.
2) E. Balagurusamy, "Programming in ANSI C", 4th edition, Tata McGraw Hill, 2008.
3) Behrouz A. Foruzan and Richard F. Gilberg, "Computer Science: A Structured Programming Approach Using C", 2nd edition, Thomson, 2003.
4) Robert Kruse and Bruce Leung, "Data structures and Program Design in C", Pearson Education, 2007.

22UECO641	**Automotive Electronics**	**(3-0-0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on Fundamentals of the Engine, Electronic Engine control system, construction and operation of sensors and actuators, role of electronics in vehicle motion control, instrumentation and advanced features for safety and comfort in vehicles.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	**Mapping to POs(1-12)/ PSOs (13,14)**		
	Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**

CO-1	**Explain** the construction and the operation of various parts of the Automobile and Engine.	1		10
CO-2	**Analyse** and **examine** the Engine control system with respect to various performance terms	-	1	-
CO-3	**Analyse** and **apply** various Sensors and Actuators in the Engine control applications.	3	7	2
CO-4	**Analyse** and **design** various subsystems of Vehicle Motion Control and Instrumentation	-	2	
CO-5	**Analyse** and **design** Occupant Protection System, Advanced Features and Communication using CAN protocol.	6	4	12

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.5	1.5	3.0	2.0	-	3.0	2.0	-	-	1.0	-	1.0	-	-

Pre-requisites: Basics of Mechanical Engineering, Analog and Digital Electronic Circuits, Control systems and microcontrollers.

Contents:

Unit-I

Automotive Fundamentals: Automobile Physical Configuration, SI Engine and its Components, 4 Stroke Cycle Operation, Intake System, Ignition System, Diesel Engine Operation, Electric Vehicles Configuration, Transmission, Driveshaft, Differential, Suspension, Brakes, Steering System **08 Hrs**

Unit-II

The Basics of Electronic Engine Control: Motivation for Electronic Engine Control, Concept of an Electronic Engine Control System, Definition of General Terms and Engine Performance Terms, Engine Mapping, Catalytic Converters, Electronic Fuel-Control System, Electronic Ignition. **08 Hrs**

Unit-III

Sensors and Actuators: Mass Air Flow-rate Sensor, Indirect Measurement of MAF, Manifold Absolute Pressure Sensor, Magnetic Reluctance Position Sensor, Hall Effect Position Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor, Temperature Sensors, Exhaust Gas Oxygen Sensor, Fuel Injection Actuator, Exhaust Gas Recirculation Actuator, Ignition System Actuator
08 Hrs

Unit-IV

Vehicle-Motion Control: Cruise Control System, Antilock Braking System, Electronic Suspension Control System, Electronic Steering Control. **Automotive Instrumentation:** Signal Conversion, Multiplexing, Sampling, Fuel Quantity Measurement, Coolant Temperature Measurement, Oil Pressure Measurement, Vehicle Speed Measurement **08 Hrs**

Unit-V

Occupant Protection System, Collision Avoidance Radar Warning System, Low Tyre Pressure Warning System, Sensor and Control Signal Multiplexing, Radio Navigation, Automatic Driving Control, Controller Area Network Protocol **07 Hrs**

Reference Books:

1) William B. Ribbens, “Understanding Automotive Electronics”, 6/e, Elsevier,2003.
2) A. K. Babu, “ Automotive Electrical and Electronics”, 2/e, Khanna publishing,2016
3) Tom Denton, “Automobile Electrical and Electronic Systems”, 5/e, Institute off Motor Industry, 2017
4) Najamuz Zaman, “Automotive Electronics Design Fundamental’’ first edition, Springer 2015.

22UECO642	Cryptography	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):
The course focuses on study of encryption/ decryption algorithms of different symmetric and asymmetric cryptographic techniques, Hash functions, Message authentication codes & Digital signature algorithms.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able	**Mapping to POs (1-12)/ PSOs (13,14)**

to:		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Identify** security services, security threats and mechanisms and **Analyze** different classical encryption and decryption techniques.	2	1,4	-
CO-2	**Analyze** DES algorithm and different modes of operation.	2	1	4
CO-3	**Evaluate** advanced encryption standard (AES).	2	-	4
CO-4	**Apply** the concepts of private and public key encryption techniques to various algorithms.	-	4,14	2
CO-5	**Demonstrate** and **Illustrate** Elliptic curve arithmetic, Hash functions, digital signature algorithms	1	4,14	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.3	2.5	-	1.6	-	-	-	-	-	-	-	-	-	2

Pre-requisites: Communication networks and finite fields.

Contents:

Unit-I

Introduction and Classical Encryption Techniques: Computer Security Concepts, Attacks, Services and mechanisms, Model for Network Security, Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machines, Steganography. **07 Hrs**

Unit-II

Block Cipher and Encryption Standards: S-DES, Block Cipher Principles, DES, Strength of DES, Block cipher modes of operation. **08 Hrs**

Unit-III

Advanced Encryptions Standard: Evaluation criteria for AES, AES Structure, AES round functions. AES Key expansion, an AES Example.

08 Hrs

Unit-IV

Public Key Cryptography and Key Management: Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman key exchange. ElGamal cryptosystem. **08 Hrs**

Unit-V

Elliptic Curve Arithmetic and Hash functions : Elliptic curve arithmetic, Elliptic curve cryptography, Applications of Cryptographic Hash Functions, Secure Hash Algorithm (SHA), Digital Signatures, Digital Signature Standard. **08 Hrs**

Reference Books:

1) William Stallings, “Cryptography and Network Security,” 5/e, Pearson Education (Asia) Pte. Ltd. / Prentice Hall of India, 2011.
2) Behrouz A. Forouzan, “Cryptography and Network Security”, TMH, 3rd Edition, 2015.
3) Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.
4) Bernard Menezes, “Network Security and Cryptography”, Cengage Learning India Pvt. Ltd, Second Impression 2011.

CIE and SEE Evaluation (from 2024-25 batch)

Courses with LTP 3-0-0 and 4-0-0 or 2-2-0/3-2-0

Continuous Internal Evaluation (CIE):

- Two Internal Assessment and one Improvement test each of 20 marks and one hour duration.
- Two higher scores from three tests are taken representing 40 marks.
- Question Paper pattern for Internal Assessment: 3 questions of 10 marks each with maximum of two sub-divisions. Q.3 is compulsory and one question to be answered from Q.1 and Q.2.
- Course Teacher Assessment (CTA): Minimum two components such as
- quiz, seminar, written assignment, any technical activity related to course each of 5marks. Total CTA marks-10.
- CIE = 40 (from tests) + 10 (from CTA) = 50 marks.

Semester End Examination (SEE):

- SEE is conducted for100 marks with 3 hours duration. It is reduced to 50 marks.
- Question Paper pattern for SEE: Five units with built in choice. Each question with maximum of three sub-divisions.
- Two questions are to be set from each unit with built in choice, for example Q.1 or Q.2 in unit -I, Q.3 or Q.4 in unit-II and so on.
- A total of 5 full questions to be answered choosing one full question from each unit. All five units are to be answered compulsorily.
- Each question is of 20 marks.
- The Question paper is to be set for duration of 3 hours both for 3 and 4 credits courses.
- The Question paper is to be set for 100 marks for 3 and 4 credits courses.

ASC(IC)/PCC with LTP 2-0-2, 3-0-2 and 2-2-2

Continuous Internal Evaluation (CIE):

Theory CIE component:

- Two Internal Assessment and one Improvement test each of 20 marks and
- one hour duration.
- Two higher scores from three tests are taken representing 40 marks.

- Question Paper pattern for Internal Assessment: 3 questions of 10 marks each with maximum of two sub-divisions. Q.3 is compulsory and one question to be answered from Q.1 and Q.2.
- Course Teacher Assessment (CTA): Totally based on conduction of experiments as set by the course teacher.

Laboratory component assessment:

- 5 marks: for conduction, regularity, involvement, journal writing, etc. Minimum 75% of attendance is compulsory. If the performance is not satisfactory in laboratory the student shall be detained and required to reregister for the course as a whole whenever offered next.
- 5 marks: Lab Test. A Lab test as per the class time table has to be
- conducted at the end for 50 marks and scale down to 5 marks.
- CIE for integrated course = 40 (from IA tests) + 10 (from CTA i.e. lab component) = 50 marks.
- There will not be any remuneration for Final Lab Test since it is CTA of
- integrated course.
- Copy of the Marks list to be sent to the concerned course instructor immediately after the completion of test for that batch. Original Marks list to be maintained in the department.
- CIE= 40(from tests) + 10 (from CTA i.e. lab component) = 50 marks.

Semester End Examination (SEE):

- SEE is conducted for100 marks with 3 hours duration. It is reduced to 50 marks.
- Question Paper pattern for SEE: Five units with built in choice. Each
- question with maximum of three sub divisions.
- Two questions are to be set from each unit with built in choice, for example
- Q.1 or Q.2 in unit -I, Q.3 or Q.4 in unit-II and so on.
- A total of 5 full questions to be answered choosing one full question from each unit. All five units are to be answered compulsorily.
- Each question is of 20 marks.
- The Question paper is to be set for duration of 3 hours both for 3 and 4 credits courses.
- The Question paper is to be set for 100 marks for 3 and 4 credits courses.

AEC/HSMS/UHV Courses with LTP 1-0-0:

Continuous Internal Evaluation (CIE):

- Two Internal Assessment and one Improvement test each of 20 marks and
- one hour duration.
- Two higher scores from three tests are taken representing 40 marks.
- Question Paper pattern for Internal Assessment: MCQ 20 questions.
- Course Teacher Assessment (CTA): Minimum two components such as quiz, seminar, written assignment, any technical activity related to course etc. each of 5marks. Total CTA marks-10.
- CIE = 40(from tests) +10(from CTA) =50 marks.

Semester End Examination (SEE):

- SEE is conducted for 50 marks of 1 hour duration. There will be 50 MCQs.
- Question Paper pattern for SEE: The question paper will contain 12 MCQ questions drawn from each Unit.
- Students have to answer maximum of 10 questions from each unit.
- All five units are to be answered compulsorily.