RCC INSTITUTE OF INFORMATION TECHNOLOGY
APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO MAKAUT, W.B.
AN ISO 9001 - 2008 & ISO 14001 - 2004 CERTIFIED INSTITUTE
A UNIT OF RCC INSTITUTE OF TECHNOLOGY AN AUTONOMOUS SOCIETY OF DEPARTMENT OF HIGHER EDUCATION, GOVT. OF WEST BENGAL

COURSE BOOKLET
B.TECH,3RD YEAR
2017-2021BATCH

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
RCC INSTITUTE OF INFORMATION TECHNOLOGY
CANAL SOUTH ROAD, BELIAGHATA
KOLKATA - 700 015, WEST BENGAL, INDIA

This revised version of Course booklet is being published in accordance with Outcome Based Education (OBE) policy approved by Program Assessment Committee (PAC), Departmental Advisory Board(DAB), Department of Electronics and Communication Engineering (ECE)

Department of Electronics and Communication Engineering

All faculty members associated with Department of Electronics and Communication Engineering, RCCIIT, concerned faculty members of Basic Science and Humanities and the honorable members of DAB, Electronics and Communication Engineering of RCCIIT are acknowledged for their timely support and relevant inputs towards the preparation of this booklet.

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About Department:

Department of Electronics and Communication Engineering is successfully running since 2006 with a intake of 60 seats. In 2010 intake increased to 120; from 2012 the department also started 2 years full time PG program in Tele Communication to make a significant contribution in the field of higher studies.

The Department used to organize seminars, development programs, and workshops for faculties, staffs and students in support of incessant development. A pool of competent faculty member of the Department constantly motivates the students to get placed by means of job, research and higher studies; and the outcomes reflect in the achievement.

The pass out students of the ECE Department now associated with pioneer Institutions like North Dakota State University (USA), University of Regina (Canada), College of Medicine Swansea University (UK), University of Illinois, Chicago (USA), University of Buffalo (USA), Texas Tech University, different IITs (Kharagpur, Kanpur, Roorkee, Guwahati), IIM (Kozhikode), IIEST, ISM, Jadavpur University etc. Moreover the students of this Department are also allied with prestigious organizations like BSNL, ECIL, WBSEB, AAI, INTERRA SYSTEM, TCS, CTS, INFOSYS, IBM, ACCENTURE, TECH MAHINDRA, ERICSSON L&T etc. The Department is also involved actively in the frontier research, corroborated by a significant number of research papers in various national and international journals and conferences.

Vision of the Department

Graduates of this department will be part of global academia/industry through sincere professional commitments, research and innovations by ethically considering environmental impacts and societal benefits in the multidisciplinary culture for sustainable development of civilization throughout their career.

Mission of the Department

Mission No.	Mission Statements
M1	Be able to develop sustainable solutions of problems related to electronics and communication engineering as individual or part of a team maintaining professional ethics and environmental aspects.
M2	Be competent to perceive higher studies through research, innovation and managerial skills for integrated life-long learning..
M3	Create leadership qualities through learning beyond classroom, effective communication, inter-personal skill, technological development and innovation for benefit of society

Program Outcome (POs) of the Department

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, research literature, and analyse 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 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 andwrite effective reports and design documentation, make effective presentations, and giveand 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 Educational Objectives (PEOs) of the Department

PEO No.	Program Educational Objectives Statements
PEO1	Be competent to solve electronics and communication engineering related problems by applying fundamental principles of natural sciences, domain knowledge using modern tools, techniques and inter-personal skills for early employment in industry/academia.
PEO2	Be part of diverse multinational sectors by continuously interpreting global professional development through innovative research and self-study in subject domain and allied fields as a part of life-long learning.
PEO3	Be qualified to construct professional work using acquired domain knowledge as individual or team-member in global environment pertaining to electronics fulfilling ethical, societal and environmental issues.

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome(PSOs) Statements
PSO1	Investigate the design/development of intra and interdisciplinary complex problems/systems through acquired technical knowledge in the field of electronics and communication engineering using state-of-the-art hardware and software tools.
PSO2	Estimate every multidisciplinary project in the light of professional ethics for societal welfare prior to implementation and keeping the environment safe through teamwork or individual means.
PSO3	Invent novel technical solutions applicable for academia/industry relevant to electronics and communication engineering through complex engineering activities maintaining specified constraints with possible life-long impact.

Correlation between PEOs and Mission of the Department of Electronics & Communication Engineering, RCCIIT

PEO No.	PEO statements	M1	M2	M3
PEO1	Be competent to solve electronics and communication engineering related problems by applying fundamental principles of natural sciences, domain knowledge using modern tools, techniques and inter-personal skills for early employment in industry/academia.	3	2	2
PEO2	Be part of diverse multinational sectors by continuously interpreting global professional development through innovative research and self-study in subject domain and allied fields as a part of life-long learning.	1	3	3
PEO3	Be qualified to construct professional work using acquired domain knowledge as individual or team-member in global environment pertaining to electronics fulfilling ethical, societal and environmental issues.	2	2	3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Odd Semester(V)

Sl.No.	Paper Code	Paper Name	Credit
1.	HU501	Economics for Engineers	3
2.	EC501	Analog Communication	4
3.	EC502	Microprocessor& Microcontrollers	4
4.	EC503	Control System	3
5.	F.E. EC504A EC504B	 Computer Architecture Data Structure & C	4
6.	EC591	Analog Communication Lab	2
7.	EC592	Microprocessor& Microcontrollers Lab	2
8.	EC593	Control System Lab	2
9.	F.E. EC594A EC594B	 Computer Architecture Lab Data Structure & C Lab	2

EvenSemester(VI)

Sl.No.	Paper Code	Paper Name	Credit
1.	HU601	Principles of Management	2
2.	EC601	Digital Communication	3
3.	EC602	Digital Signal Processing	3
4.	EC603	Telecommunication System	3
5.	EC604	A. Antenna Theory & Propagation B. Information Theory & Coding	3
6.	EC605	A. Object Oriented Programming(IT) B. Programming Language(CSE) C. Electronic Measurement & Instrumentation(EI)	3
7.	EC691	Digital Communication Lab	2
8.	EC692	Digital Signal Processing Lab	2
9.	EC695	A. Object Oriented Programming(IT)Lab B. Programming Language(CSE)Lab C. Electronic Measurement & Instrumentation(EI)Lab	2
10.	EC681	Seminar	2

Odd Semester(V) Articulation Matrix

Paper Code	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
HU501	2.98	2.98	2.98	0	2.98	0	0.84	0	0.84	0	0	0	0.99	0.99	0
EC501	2.98	2.32	2.48	0	0	1.19	1.19	0	0	0	0	1.81	2.64	1.38	1.65
EC502	2.8	2.56	1.97	1.64	0.99	0	0	0	0	0	0.99	1.23	2.46	1.15	0.99
EC503	2.95	2.95	2.95	2.62	2.62	0.98	1.47	0	0	0	0	1.47	2.94	0.98	0.98
EC504B	2.87	2.24	1.76	1.76	0.96	0	0	0	1.27	0	0	0	1.91	0	1.27
EC591	2.98	1.99	0.99	2.98	1.49	1.49	1.32	0.99	0.99	1.98	0	1.98	2.31	1.49	1.98
EC592	2.97	1.98	2.97	1.98	1.98	0	0	0	2.97	1.98	0	0.99	2.97	2.48	1.68
EC593	2.49	2.65	2.82	2.15	2.98	0.99	0.99	1.98	1.98	0.99	1.32	1.98	2.84	1.49	1.49
EC594B	2.45	2.18	1.23	1.77	0	0	1.23	0.82	0	0.82	1.36	0	2.45	1.19	1.76

EvenSemester(VI) Articulation Matrix

Paper Code	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
EC601	2.82	2.66	2.16	2.16	2.32	1.00	0.00	0.00	0.00	0.00	0.00	2.16	2.99	1	1.33
EC602	2.98	2.82	2.49	1.99	2.49	1.99	0	0	0	0	0	2.98	2.98	0.99	1.99
EC603	2.99	2.66	2.82	0	0	2.15	1.99	0	0	0	0	2.66	2.99	1.33	2.32
EC604A	2.97	2.64	2.31	1.98	1.98	0.99	0.99	0	0	0	0	2.47	2.64	0.99	2.47
EC604B	2.99	2.83	2.66	0	0	0.99	0	0	0	0	0	2.99	1.99	0.99	0.99
EC605A	2.5	2.5	1.25	2.08	0	0	0	1.94	1.66	1.66	1.66	1.66	1.8	0.97	2.08
HU601	2.53	0	0.84	0	0.84	2.53	2.53	0	0.84	0.84	2.53	0	0.84	0.84	0.98
EC681	2.59	1.6	0	0	2	1.74	1.66	1.66	1.99	1.99	1.99	1.19	1.19	1.59	0.99
EC691	3	3	1.67	2.17	2.33	0.99	0.99	0	1.99	0.99	0	1.99	2.99	1.99	0.99
EC692	2.99	2.66	1.6	2.99	1	0.99	0.99	0	1.99	2.99	1.99	2.49	2.26	1.46	2.52
EC695A	2.98	2.98	1.49	2.49	0	0	0	2.32	1.98	1.98	1.99	0	2.48	1.82	1.99

Course Title: Economics for Engineers	Code: HU501
Type of Course: Theory	Course Designation: Compulsory
Semester: 5th	Contact Hours: 3L/week
Continuous Assessment: 25 marks	Final Exam:70Marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Course Outcomes (CO's) of Analog Communication

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
HU501.CO1	Recall the concepts of Accounting and Recognize different systems used in industrial applications.	K1 :Remembering
HU 501.CO2	Discuss on the design of appropriate accounting tool required for real life problems.	K6: Discuss
HU 501.CO3	Apply and demonstrate the use of Economical concepts.	K3: Applying
HU 501.CO4	Analyze and Simulate a sequential accounting tool for a system or process appropriate for required accuracy.	K4: Analysing
HU 501.CO5	Design a sequential economic policy that can work according to the required specifications.	K5: Evaluating
HU 501.CO6	Justify a specific accounting technique for an specific purpose.	K5: Evaluating

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0
CO2	0	3	0	0	0	0	1	0	0	0	0	0	1	1	0
CO3	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0
CO4	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0
CO5	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
CO6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AVG	3	3	3	0	3	0	1	0	1	0	0	0	1.00	1.00	0.00

University Syllabus

Unit	Content
Module-I	1. Economic Decisions Making – Overview, Problems, Role, Decision making process. 2. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life -Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement &Learning Curve, Benefits.
Module-II	3. Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal & Effective Interest. 4. Cash Flow & Rate Of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio

	Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.
Module-III	5. Inflation And Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. 6. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. 7. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.
Module-IV	8. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight -Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances. 9. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. 10. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.

Resources:

1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, TedEschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,DavidB.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R.PaneerSeelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub

Course Title: Analog Communication	Code: EC501
Type of Course: Theory	Course Designation: Compulsory
Semester: 5th	Contact Hours: 4L/week
Continuous Assessment: 25 marks	Final Exam:70Marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisites: Engineering Mathematics, Signal and System

Course Outcomes (CO's) of Analog Communication

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC501.CO1	**Understand** the fundamental components of analog communication system along with need for modulation to calculate antenna size for different carrier frequency	K2 : Understanding
EC501.CO2	**Evaluate** parameters in time and frequency domain for different types of modulation scheme to compare the methods.	K5: Evaluating
EC501.CO3	**Analyze** the different types of modulation and demodulation methods to design communication system	K4: Analysing
EC501.CO4	**Design** a super-heterodyne receiver by choosing the appropriate components and frequency	K6: Creating
EC501.CO5	**Apply** different multiplexing techniques for developing communication system	K3: Applying
EC501.CO6	**Evaluate** the Noise temperature&SNR for different systems to compare the performance of the different modulation methods.	K5: Evaluating

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	1	3	-	1
CO2	3	3	3	-	-	1	1	-	-	-	-	2	3	1	2
CO3	3	1	-	-	-	1	1	-	-	-	-	1	2	1	1
CO4	3	3	3	-	-	1	1	-	-	-	-	2	3	1	1
CO5	3	1	1	-	-	1	1	-	-	-	-	2	2	2	2
CO6	3	3	3	-	-	2	2	-	-	-	-	3	3	2	3
AVG	3	2.33	1.66	-	-	1	1	-	-	-	-	1.83	**3.00**	**2.83**	**2.67**

University Syllabus:

Unit	Content	Hrs/Unit

1: Module 1	**Introduction to Analog Communication:** Elements of communication system - Transmitters, Transmission channels & receivers , Concept of modulation and its needs . **Continuous Wave Linear Modulation:** a) Amplitude modulation(AM-DSB/TC): Time domain representation of AM signal (expression derived using a single tone message), modulation index , frequency domain (spectral) representations, illustration of thecarrier and side band components; transmission bandwidth for AM; Phasor diagram of an AM signal; Calculation of Transmitted power & sideband power & Efficiency ; concept of under, over and critical modulation of AM-DSB-TC. b) Other Amplitude Modulations: Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. Single side band modulation (SSB) both TC & SC and only the basic concept of VSB, Spectra and band-width.	9
2: Module 2	**Generation & Detection of Amplitude Modulation**: a) Generation of AM: Concept of i) Gated and ii) Square law modulators, Balanced Modulator. b) Generation of SSB: Filter method, Phase shift method and the Third method **Demodulation for Linear Modulation:** Demodulation of AM signals: Detection of AM by envelope detector , Synchronous detection for AM-SC, Effects of Frequency &Phase mismatch, Corrections. **Principle of Super heterodyne receivers:** Super heterodyning principle, intermediate frequency, Local oscillator frequency, image frequency.	9
3: : Module 3	**Angle Modulation:** a) Frequency Modulation (FM) and Phase Modulation (PM): Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Bessel's functions and Fourier series. ; Phasor diagram; b) **Generation of FM & PM:** Narrow and Wide-band angle modulation, Basic block diagram representation of generation of FM & PM, Concept of VCO & Reactance modulator c) **Demodulation of FM and PM:** Concept of frequency discriminators , Phase Locked Loop	8
4: Module4	4 **Multiplexing:** a) Frequency Division Multiplexing, Time Division Multiplexing, (FDM) b) Stereo – AM and FM: Basic concepts with block diagrams c) **Random Signals and Noise in Communication System:** i) Noise in Communication systems – Internal & External noise, Noise Temperature, Signal-to-Noise ratio, White noise, thermal noise, Figure of Merit	10

GATE syllabus mapping:

GATE syllabus content	**Mapping unit of university syllabus**
Random processes: autocorrelation and power spectral density, properties of white noise,filtering of random signals through LTI systems**;**	Not available in University syllabus
Analog communications: amplitudemodulation and demodulation, spectra of AM	Module1
Angle modulation and demodulation, spectra of FM, circuits for analog communications**;**	Module 3
Superheterodyne receivers	Module 2
Circuits for analog communications	Module 2 & Module3

RESOURCES:

1. Information Theory, Coding and Cryptography – R. Bose (McGraw Hill)
2. An Introduction to Error control codes – S. Gravano (Oxford)
3. Information and Coding – N. Abramson (McGraw Hill)
4. Introduction to Information Theory – M. Mansurpur (McGraw Hill)
5. Error Control Coding – S. Lin and D.J. Costello Jr. (Prentice Hall)
6. https://nptel.ac.in/courses/117101053/
7. https://nptel.ac.in/courses/108/102/108102117/

Course Title: Microprocessor & Microcontroller	**Code: EC502**
Type of Course: Theory	**Course Designation: Core**
Semester: 5th	**Contact Hours: 3L + 1T**
Continuous Assessment: 30 marks	**Semester Exam: 70 marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Digital Electronics

Course Outcomes (CO's) of Microprocessor & Microcontroller

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC502.CO1	*Understand* internal architecture and different operating modes of a typical microprocessor (Intel 8085 and 8086).	L2: Understand
EC502.CO2	*Apply* the acquired skills of assembly language programming for developing problem solving algorithms.	L3: Apply
EC502.CO3	*Design* proper electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.	L6: Create
EC502.CO4	*Describe* the fundamental concepts and architecture of microcontrollers.	L2: Understand
EC502.CO5	*Explain* the functional behavior and control word format of different support IC chips.	L2: Understand
EC502.CO6	*Compare* recognized standards and design methodologies to select appropriate Microprocessor (8085 & 8086) and Microcontroller (8051, PIC) to meet specified performance requirements.	L4: Evaluating

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	2	**2**	**1**	**1**
CO2	3	3	2	1	1	-	-	-	-	-	1	-	**3**	**2**	**1**
CO3	2	3	3	2	-	-	-	-	-	-	-	1	**3**	**1**	**1**
CO4	3	2	-	-	-	-	-	-	-	-	-	-	**3**	**1**	**1**
CO5	3	-	1	-	-	-	-	-	-	-	-	1	**1**	**1**	**1**
CO6	3	3	3	2	1	-	-		-		1	1	**3**	**1**	**1**
AVG	2.833333333	2.6	2	1.6667	1	0	0	0	0	0	1	1.25	**2.50**	**1.17**	**1.00**

University Syllabus:

Unit	Content	Hrs/Unit
1	Introduction to Microcomputer based system. History Evolution of Microprocessor and	**1**

	microcontrollers and their advantages and disadvantages.	
	Architecture of 8085 Microprocessor. Address / Data Bus multiplexing and demultiplexing. Status and Control signal generation. Instruction set of 8085 Microprocessor. Classification of instructions, addressing modes, timing diagram of the instructions. **Assembly language programming:** Addition, Multiplication, Block Transfer, Ascending order, Descending order, Finding largest & smallest number, Look-up table etc. Interrupts of 8085 processor: classification of interrupts, Programming using interrupts (programming using INTR is not required)	**8**
	Serial and parallel data transfer – Basic concept of serial I/O, DMA, Asynchronous and synchronous serial transmission using SID and SOD pins of 8085 Microprocessor.	**2**
2	**8051 architecture**: 8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts. **Assembly language Programming using 8051** Moving data: External data moves, code memory read only data moves, PUSH and POP opcodes, data exchanges. Logical operations: Byte-level, bit-level, rotate and swap operations. Arithmetic operations: Flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic. Jump and call instructions: Jump and call program range, jumps, calls and subroutines, interrupts and returns.	**7**
3	**The 8086 microprocessor: Architecture**, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts. **Assembly language programming**: Addition, Multiplication, Block Transfer, Ascending order, Descending order, Finding largest & smallest number etc.	**7**
4	**Support IC chips: 8255, 8253 and 8251:** Block Diagram, Pin Details, Modes of operation, control word(s) format. Interfacing of support IC chips with 8085, 8086 and 8051.	**6**
	Memory interfacing with 8085, 8086 & 8051. ADC / DAC interfacing with 8085, 8086 & 8051.	**4**
	Brief introduction to **PIC microcontroller (16F877**): Architecture, PIN details, memory layout etc.	**1**

RESOURCES:

TEXT BOOKS:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar (Penram International) (strongly recommended)
2. The 8051 microcontroller - K. Ayala (Thomson) 15. Microprocessors & interfacing – D. V. Hall (Tata McGraw-hill)
3. Ray &Bhurchandi, Advanced Microprocessors & Peripherals, TMH
4. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)
5. An Introduction to Microprocessor and Applications –Krishna Kant (Macmillan)

References:

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan (Oxford university press).
2. 8086 Microprocessor –K Ayala (Cengage learning)
3. Microprocessors – The 8086/8088, 80186/80386/80486 and the Pentium family – N. B. Bahadure (PHI).
4. The 8051 microcontrollers – Uma Rao and Andhe Pallavi (PEARSON).

Course Title: Control System	**Code: EC503**
Type of Course: Theory	**Course Designation: Core**
Semester: 5th	**Contact Hours: 3L + 1T**
Continuous Assessment: 25+5 marks	**Semester Exam: 70 marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Course Outcome: After the successful completion of the course the students will be able to

CO#	CO Statement	Bloom's Revised knowledge Level
CO1	**Develop** mathematical models of physical systems.	**K6: Create**
CO2	**Evaluate** the response of closed and open loop feedback systems.	**K5: Evaluate**
CO3	**Analyze** the stability of the feedback systems.	**K4: Analyze**
CO4	**Examine** stability of feedback systems in frequency domain	**K4: Analyze**
CO5	**Design** various kinds of compensator.	**K6: Create**
CO6	**Implement** state space models to evaluate a system	**K3: Apply**

CO-PO-PSOMapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	–	–	–	–	–	–	1	3	1	1
CO2	3	3	3	2	2	–	1	–	–	–	–	1	3	1	1
CO3	3	3	3	3	3	1	1	–	–	–	–	1	3	1	1
CO4	3	3	3	3	3	1	2	–	–	–	–	2	3	1	1
CO5	3	3	3	3	3	1	2	–	–	–	–	2	3	1	1
CO6	3	3	3	3	3	1		–	–	–	–	2	3	1	1
AVG	3	3	3	2.67	2.67	1	1.5	0	0	0	0	1.5	3.00	1.00	1.00

University Syllabus

Unit	Content	Hr
Module 1	INTRODUCTION:Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback.Mathematical models – Differential equations, Impulse Response and transfer functions - Translational and Rotational mechanicalsystems	4
Module 2	TRANSFER FUNCTION REPRESENTATION Transfer Function of linear systems, Block diagram representation of systems	5

	considering electrical systems as examples -Block diagram algebra – Representation by Signal flow graph - Reduction using mason's gain formula.	
Module 3	TIME RESPONSE ANALYSIS Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants.	5
Module 4	STABILITY ANALYSIS IN S-DOMAIN The concept of stability – Routh's stability criterion – limitations of Routh's stability. Root Locus Technique: The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.	5
Module 5	FREQUENCY RESPONSE ANALYSIS Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin- Stability Analysis from Bode Plots.	6
Module 6	STABILITY ANALYSIS IN FREQUENCY DOMAIN Polar Plots, Nyquist Plots Stability Analysis.	4
Module 7	CLASSICAL CONTROL DESIGN TECHNIQUES Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain, PID Controllers.	5
Module 8	STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability	6

Resources

TEXT BOOKS:

1. Automatic Control Systems 8th edition– by B. C. Kuo 2003– John Wiley and son's.,
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition.

REFERENCE BOOKS:

1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.
2. Control Systems Engg. by NISE 3rd Edition – John Wiley

Course Title: Data Structure & C	**Code: EC504B**
Type Of Course: Theory	**Course Designation: Elective**
Semester: 5th	**Contact Hours: 4L/week**
Continuous Assessment: 25 Marks **Attendance : 5 Marks**	**Final Exam: 70 Marks**
Writer Course Coordinator	**Approved by HoD (Convenor of DAB)**

Pre-requisites: CS 201 Basic Computation & Principles of Computer Programming;
M 101 & M 201 Mathematics (Basics of Set Theory).

COURSE OBJECTIVE:

- To impart a thorough understanding of linear data structures such as array, linked list, stack, queue and their applications.
- To impart a thorough understanding of non-linear data structures such as tree, graph and their applications.
- To impart familiarity with various sorting, searching and hashing techniques and their performance comparison.
- To impart a basic understanding of dynamic memory allocation.
- To impart an understanding of comparing various algorithms in terms of time and space.

COURSE OUTCOMES (COs)

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC504B.CO1	**Demonstrate** the concept of different categories of data structures.	Understanding (Level II)
EC504B.CO2	**Identify** different parameters to analyze the performance of an algorithm.	Analyzing (Level IV)
EC504B.CO3	**Explain** the significance of dynamic memory allocationtechniques.	Applying (Level III)
EC504B.CO4	**Design** algorithms to perform operations withlinear and nonlinear data structures.	Applying (Level III)
EC504B.CO5	**Illustrate** various technique for searching, sorting and hashing.	Understanding (Level II)
EC504B.CO6	**Choose** appropriate data structures to solve realworld problems efficiently.	Applying (Level III)

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	-	1	-	-	-	2	-	1
CO2	3	3	1	1	-	-	-	-	1	-	-	-	2	-	1
CO3	3	2	2	2	-	-	-	-	1	-	-	-	2	-	1
CO4	3	3	3	3	1	-	-	-	2	-	-	-	2	-	2
CO5	3	2	1	1	-	-	-	-	1	-	-	-	2	-	1
CO6	3	3	3	3	1	-	-	-	2	-	-	-	2	-	2
AVG.	3.00	2.33	1.83	1.83	1.00	0	0	0	1.33	0	0	0	2.00	-	1.33

University Syllabus :

Unit	Content	Hrs/Unit

1	**Linear Data Structure (8L):** **Introduction (2L):** Why we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations. **Array (2L):** Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials. **Linked List (4L):** Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.	8
2	**Linear Data Structure (7L):** **Stack and Queue (5L):** Stack and its implementations (using array, using linked list), applications. Queue, circular queue, dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications. **Recursion (2L):** Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.	7
3	**Non-Linear Data Structure (15L):** **Trees (9L):** Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only). **Graphs (6L):** Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, backedge, cross-edge, forward-edge), applications. Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).	15
4	**Searching, Sorting (10L):** **Sorting Algorithms (5L):** Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort. **Searching (2L):** Sequential search, binary search, interpolation search. **Hashing (3L):** Hashing functions, collision resolution techniques.	10

GATE syllabus (If applicable for GATE):

GATE syllabus content	Mapping unit of university syllabus
Arrays, linked lists, asymptotic worst case time and space complexity	Unit 1
Recursion, stacks, queues	Unit 2
Trees, binary search trees, binary heaps, graphs, graph search, minimum spanning trees	Unit 3
Searching, sorting, hashing	Unit 4

RESOURCES:

1. "Data Structures And Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. "Data Structures" by S. Lipschutz.
5. "Data Structures Using C" by Reema Thareja.
6. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.
7. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Course Title: Analog Communication Lab	Code: EC591
Type of Course: Lab	Course Designation: Practical
Semester: 5th	Contact Hours: 3P/week
Continuous Assessment: 40 Marks	Final Exam: 60 Marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisites: Signals and Systems

Course Outcomes (CO's) of Analog Communication Lab

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC591.CO1	**Examine** various analog modulation schemes in time and frequency domains.	K4: Analysing
EC591.CO2	**Measure** the transmission power of amplitude and frequency modulated signal.	K5: Evaluating
EC591.CO3	**Measure** distortion of the demodulated output of an AM signal.	K5: Evaluating
EC591.CO4	**Evaluate** different parameter related to PLL.	K5: Evaluating
EC591.CO5	**Analyse** FM demodulation.	K4: Analysing
EC591.CO6	**Examine** different parameters of radio receiver and SNR of a RF amplifier.	K4: Analysing

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	1	2	2	1	1	2	-	2	2	2	2
CO2	3	2	1	3	3	2	2	1	1	2	-	2	3	2	2
CO3	3	2	1	3	2	2	1	1	1	2	-	2	3	2	2
CO4	3	2	1	3	1	1	1	1	1	2	-	2	2	1	2
CO5	3	2	1	3	1	1	1	1	1	2	-	2	2	1	2
CO6	3	2	1	3	1	1	1	1	1	2	-	2	2	1	2
AVG	3	2	1	3	1.5	1.5	1.333	1	1	2	0	2	2.33	1.50	2.00

University Syllabus:

Unit	Content	Hrs/Unit
1	Measurement of modulation index of an AM signal.	3
2	Measurement of output power with varying modulation index an AM signal(for both DSB-&SSB)	3
3	Measurement of distortion of the demodulated output with varying modulation index of an	3

	AMsignal (for both DSB-SC & SSB).	
4	Measurement of power of different frequency components of a frequency modulated signal &the measurement of the bandwidth.	3
5	Design and set up a PLL using VCO & to measure the lock frequency.	3
6	Design and set up a FM demodulator using PLL.	3
7	Measurement of SNR of a RF amplifier.	3
8	Measurement of selectivity, sensitivity, fidelity of a superheterodyne receiver.	3

RESOURCES:

1.Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc-Graw Hill
2.B.P.Lathi -Communication Systems- BS Publications
3. Carlson—Communication System,4/e , Mc-Graw Hill
4. Proakis&Salehi Fundamentals of Communication Systems- Pearson
5. https://swayam.gov.in/nd1_noc20_ee16/preview

Course Title: Microprocessors & Microcontrollers Lab	Code: EC592
Type of Course: Lab	Course Designation: Practical
Semester: 5th	Contact Hours: 3P/week
Continuous Assessment: 40 marks	Semester Exam: 60 marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisites: Digital Electronics

Course Outcomes (CO's) of Microprocessors & Microcontrollers Lab

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC592.CO1	Understand the fundamentals of assembly language programming of 8085 microprocessor & 8051 microcontroller.	L2: Understand
EC592.CO2	Apply the programming knowledge for data transfer, arithmetic and logical operations in 8085 & 8051.	L3: Application
EC592.CO3	Develop the programs for different applications and execute them using 8085 trainer kit/simulator on PC.	L6: Create
EC592.CO4	Develop the programs for subroutine calls and IN/OUT instructions using 8255 PPI.	L6: Create
EC592.CO5	Develop the programs for different applications and run them using 8051 trainer kit/simulator on PC.	L6: Create
EC592.CO6	Apply the programming knowledge for understanding of communication with other trainer kit or any external circuit using 8085 microprocessor / 8051 microcontroller.	L3: Application

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	-	-	-	3	2	-	1	2	3	2
CO2	3	2	3	2	-	-	-	-	3	2	-	1	2	3	2
CO3	3	2	3	2	-	-	-	-	3	2	-	1	2	2	2
CO4	3	2	3	2	-	-	-	-	3	2	-	1	2	3	2
CO5	3	2	3	2	-	-	-	-	3	2	-	1	2	2	2
CO6	3	2	3	2	2	-	-	-	3	2	-	1	2	2	3
AVG	3	2	3	2	2	0	0	0	3	2	0	1	2	2.5	2.167

University Syllabus:

Sl. No	Name of the Experiments	No. of hours
a)	Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical). Assignments based on above.	**3**
b)	a) Familiarization with 8085 & 8051simulator on PC. Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the simulator. Assignments based on above	**3**
c)	**Programming using kit and simulator for:** i) Table look up ii) Copying a block of memory iii) Shifting a block of memory iv) Packing and unpacking of BCD numbers v) Addition of BCD numbers vi) Binary to ASCII conversion vii) String Matching, Multiplication using shift and add method and Booth's Algorithm	**6**
d)	Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly.	**3**
e)	Study of timing diagram of an instruction on oscilloscope.	**3**
f)	Interfacing of 8255**:** Keyboard and Multi-digit Display with multiplexing using 8255	**6**
g)	Study of 8051 Micro controller kit and writing programs as mentioned in S/L3. Write programs to interface of Keyboard, DAC and ADC using the kit.	**3**
h)	Serial communication between two trainer kits	**3**

Total 30 hours (10 classes each of 3 periods)

RESOURCES:

TEXT BOOKS:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar (Penram International) (strongly recommended)
2. The 8051 microcontroller - K. Ayala (Thomson)
3. Microprocessors & interfacing – D. V. Hall (Tata McGraw-hill)
4. Ray &Bhurchandi, Advanced Microprocessors & Peripherals, TMH
5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)
6. An Introduction to Microprocessor and Applications –Krishna Kant (Macmillan)

References:

Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan(Oxford university press).
8086 Microprocessor –K Ayala (Cengage learning)
Microprocessors – The 8086/8088, 80186/80386/80486 and the Pentium family – N. B. Bahadure (PHI).
The 8051 microcontrollers – Uma Rao and Andhe Pallavi (PEARSON).

Course Title: Control System Lab	**Code: EC593**
Type of Course: Lab	**Course Designation: Core**
Semester: 5th	**Contact Hours: 3P**
Continuous Assessment: 40 marks	**Semester Exam: 60 marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Course Outcome (CO): After the successful completion of the course the students will be able to:

CO#	CO Statement	Bloom's Revised knowledge Level
EC593.CO1	**Discuss** the need of software tools (MATLAB, PSPICE) to illustrate modeling and simulation of anysystem.	**K2:Understand**
EC593.CO2	**Determine** the equivalent transfer function for the following block diagram	**K3:Apply**
EC593.CO3	**Evaluate** the response of 1st and 2nd order system	**K5: Evaluate**
EC593.CO4	**Analyze** the stability of the feedback systems in S-domain	**K4: Analyze**
EC593.CO5	**Examine** the Stability stability of the feedback in frequency domain	**K4: Analyze**
EC593.CO6	**Design** various kinds of compensator	**K6: Create**

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	3	–	–	2	2	–	–	3	2	1	1
CO2	2	3	3	1	3	–	–	2	2	–	–	2	3	1	1
CO3	3	3	3	2	3	–	–	2	2	–	–	1	3	1	1
CO4	3	3	3	3	3	1	1	2	2	1	1	2	3	2	2
CO5	3	3	3	3	3	1	1	2	2	1	1	2	3	2	2
CO6	3	3	3	3	3	1	1	2	2	1	2	2	3	2	2
AVG	2.50	2.67	2.83	2.17	3.00	1.00	1.00	2.00	2.00	1.00	1.33	2.00	2.83	1.50	1.50

University Syllabus

Exp no.	Content	Hr
1.	Familiarization with MATLAB Control System tool Box, MATLAB- SIMULINK tool box &pSPICE.	3
2.	Determination of step response for 1st order & 2nd order system with amity feedback on CRO & calculation of control system specifications for variations of system design.	3
3.	Simulation of step response & impulse response for Type-I & Type-II system with unity feedback using MATLAB &pSPICE.	3
4.	Determination of root locus, Bode-plot, Nyquist Plot, using MATLAB control system toolbox for a given 2nd order transfer function & determination of different control system specifications.	3
5.	Determination of PI, PD, and PID controller action on 1st order simulated process.	3
6.	Determination of approximate transfer function experimentally using Bode Plot.	3
7.	Evaluation of steady-state error, setting time, percentage peak overshoots, gain margin, phase margin with addition of lead compensator in forward path transfer functions using MATLAB &pSPICE.	3
8.	Study of position control system using servomotor.	3
9.	Design and hardware implementation of a temperature controller using microprocessor/micro-controller.	3

Resources

TEXT BOOKS:

1. Automatic Control Systems 8th edition– by B. C. Kuo 2003– John Wiley and son's.,
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International
(P) Limited, Publishers, 2nd edition.

REFERENCE BOOKS:

1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.
2. Control Systems Engg. by NISE 3rd Edition – John Wiley

Course Title: Data Structure and Algorithm Lab	Code: EC-594B
Type Of Course: Practical	Course Designation: Compulsory
Semester: 5th	Contact Hours: 3p/week
Continuous Assessment: 40 Marks	Final Exam: 60 Marks
Writer Course Coordinator	Approved by HoD (Convenor of DAB)

Pre-requisites: Introduction to C.

COURSE OBJECTIVE:

- Compare performance of different algorithms.
- Compute the time complexity of algorithm.
- Develop the searching and sorting problems
- Solve simple problems applying concepts of Data Structure
- Practice the use of linear and nonlinear data structure for different problems
- Develop user friendly tiny utility application

COURSE OUTCOMES (COs)

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC-594B.CO1	**Apply**concept of different data structure.	Understanding (Level II)
EC-594B.CO2	**Identify**the data structure and its application	Creating (Level VI)
EC-594B.CO3	**Develop** algorithms for sorting, searching, insertion and matching	Developing (Level III)
EC-594B.CO4	**Explain**data structure in different application.	Evaluating (Level V)
EC-594B.CO5	**Analyse**the running time of an algorithm.	Analysing (Level VI)
EC-594B.CO6	**Apply**the concept of data structure in different problem.	Understanding (Level II)

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	-	-	-	-	1	3	3	3
CO2	3	3	3	2	3	-	-	2	-	-	-	2	3	1	2
CO3	3	2	2	1	2	-	-	1	1	-	-	2	3	2	2
CO4	3	2	2	2	3	-	-	2	-	-	1	2	3	3	3
CO5	3	3	3	2	3	-	-	1	1	-	1	2	3	2	2
CO6	3	3	3	1	1	-	-	-	1	-	-	1	3	3	2
AVG.	3.00	2.67	2.67	1.50	2.17	0	0	1.50	1.00	0	1.00	1.67	3.00	2.33	2.33

University Syllabus :

Week	Content	Hrs/Unit
1	Assignment on Array , Structure, Pointers.	4
2	Stack Implementation, Operation and Application (Infix to Postfix Conversion and Postfix evaluation).	4
3	Implementation of Linear, Circular and Priority Queue.	4
4	Linked list (Linear, Circular and Doubly linked list).	4
5	Linked list implementation of Stack and Queue.	4
6	Binary search Tree construction, insertion of node, deletion of node and traversal.	
7	Graph representation and traversal.	4
8	Spanning tree detection either through Prims or by Kruskal.	4
9	Hashing, Collision Resolution and Heap Sort.	4

Stacks and Queues: adding, deleting elements

Circular Queue: Adding & deleting elements Merging Problem : Evaluation of expressions operations on Multiple stacks & queues : Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues using linked lists:

Polynomial addition, Polynomial multiplication Sparse Matrices : Multiplication, addition. Recursive and Nonrecursive traversal of Trees Threaded binary tree traversal.AVL tree implementation Application of Trees.

Application of sorting and searching algorithms, Hash tables implementation: searching, inserting and deleting, searching & sorting techniques. (Detailed instructions for Laboratory Manual to follow for further guidance. The details will be uploaded in the website from time to time)

RESOURCES:

1. Data Structure using C by Balaguruswamy.

Course Title: Digital Communications	**Code: EC601**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 6th	**Contact Hours: 3L/week**
Continuous Assessment: 25 Marks **Attendance : 5 Marks**	**Final Exam: 70 Marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Fundamental knowledge on communications

Course Objective (COb's) of Digital Communications:

EC601:COb1: Be able to understand the fundamentals of digital signaling, information theory and coding, digital transmission and reception.

EC601:COb2: Be able to gather the basic knowledge for designing, analyzing, comparing, and managing digital communication systems ranging from data networks

EC601:COb3: Be able to analyze the data to use less channel bandwidth without sacrificing information by using source coding techniques

EC601:COb4: Be capable to manage communication system resources

EC601:COb5: Be able to using modern encryption/decryption methods

Course Outcomes (CO's) of Digital Communications

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC601.CO1	**Explain** the concept ofprobability theory and random processes to correlate the cumulative distribution function, probability density function.	K2: Understanding
EC601.CO2	**Analyze** signal vector representations to study receiver principles.	K4: Analyzing
EC601.CO3	**Identify** different types of sampling processes in digital communication systems.	K3: Applying
EC601.CO4	**Interpret** different carrier modulation techniques considering noise aspects.	K5: Evaluating
EC601.CO5	**Apply**different types of digital modulation techniques for appropriate communication.	K3: Applying
EC601.CO6	**Determine** various parameters related to digital baseband transmission techniques	K5: Evaluating

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	-	-	-	-	-	-	2	3	-	1
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	-	1
CO3	3	2	1	1	2	-	-	-	-	-	-	2	3	-	1
CO4	3	3	2	3	3	1	-	-	-	-	-	3	3	1	2
CO5	3	3	3	1	-	1	-	-	-	-	-	2	3	1	1
CO6	2	2	3	3	2	-	-	-	-	-	-	2	3	-	2

AVG	**2.83**	**2.67**	**2.17**	**2.17**	**2.33**	**1.00**	**0**	**0**	**0**	**0**	**0**	**2.17**	**3.00**	**1.00**	**1.33**

University Syllabus:

Module	Content	Hrs/ Unit
Module 1: Probability Theory and Random Processes	Probability Theory and Random Processes: Conditional probability, communication example, joint probability, statistical independence, random variable-continuous and discrete, cumulative distribution function, probability density function – Gaussian, Rayleigh and Rician, mean, variance, random process, stationary and ergodic processes, correlation coefficient, covariance, auto correlation function and its properties, random binary wave, power spectral density. [6L]	6
Module 2: Signal Vector Representation	Signal Vector Representation: Analogy between signal and vector, distinguishibility of signal, orthogonality and orthonormality, basis function, orthogonal signal space, message point , signal constellation, geometric interpretation of signals, likelihood functions, Schwartz inequality, Gram-Schmidt orthogonalization procedure, response of the noisy signal at the receiver, maximum likelihood decision rule, decision boundary, optimum correlation receiver; probability of error , error function, complementary error function, Type-I and Type-II errors. [6L]	6
Module 3: Digital Data Transmission	Digital Data Transmission: Concept of sampling, Pulse Amplitude Modulation (PAM), interlacing and multiplexing of samples, Pulse Code Modulation (PCM), quantization, uniform and non-uniform quantization, quantization noise, binary encoding, A-Law and μ -law companding, differential PCM, delta modulation and adaptive delta modulation. Digital transmission components, source, multiplexer, line coder, regenerative repeater, concept of line coding – polar/unipolar/bipolar NRZ and RZ, Manchester, differential encoding and their PSDs, pulse shaping, Inter Symbol Interference (ISI), Eye pattern, Nyquist criterion for zero ISI, equalizer, zero forcing equalizer, timing extraction. [10L]	10
Module 4: Digital Modulation Techniques	Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, basic digital carrier modulation techniques: ASK, FSK and PSK, Coherent Binary Phase Shift Keying (BPSK), geometrical representation of BPSK signal; error probability of BPSK, generation and detection of BPSK Signal, power spectrum of BPSK. Concept of M-ary Communication, M-ary phase shift keying, the average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), error probability of QPSK signal, generation and detection of QPSK signals, power spectra of QPSK signals, Offset Quadrature Phase shift Queuing (OQPSK), Coherent Frequency Shift Keying (FSK), Binary FSK, error probability of BFSK signals, generation and detection of Coherent Binary FSK signals, power spectra of BFSK signal, Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying: GMSK, basic concept of OFDM, constellation diagram, Some performance issues for different digital modulation techniques - Error Vector Magnitude (EVM), Eye Pattern and Relative Constellation Error (RCE), Conceptual idea for Vector Signal Analyzer (VSA) 14L	14

RESOURCES:

1. Digital Communications, S. Haykin, Wiley India.
2. Principles of Communication Systems, H. Taub and D.L.Schilling, TMH Publishing Co.
3. Wireless Communication and Networks : 3G and Beyond, I. SahaMisra, TMH Education.

4. Digital Communications, REFERENCE BOOKS: d) Applications, B. Sklar and P.K.Ray, Pearson. e) J.G.Proakis, TMH Publishing Co.

Course Title: Digital Signal Processing	**Code: EC602**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 6th	**Contact Hours: 3L/week**
Continuous Assessment: 25 marks	**Final exam: 70 marks**
Writer:(Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Signals & systems

Course Outcomes (CO's) of Digital Signal Processing

On completion of the course students will be able to

CO#	CO Statements	Bloom's Revised Knowledge Level
EC602.CO1	**Build** knowledge on the time domain representation and classification of discrete time signals and systems to classify different real time DSP Signals and Systems and their attributes.	**K3:Build**
EC602.CO2	**Build** knowledge on different Frequency Domain transformation attributes to analyze the discrete time signals and systems.	**K3:Build**
EC602.CO3	**List** different application areas of frequency domain transforms like z transform and DFT to define DSP applicability in real needs.	**K1:List**
EC602.CO4	**Design** the methods of IIR and FIR filters and their Realization for the use of LTI filters.	**K6:Design**
EC602.CO5	**Determine** the standard structural forms to Realize the use of LTI filters for filtering different real world signals	**K5:Determine**
EC602.CO6	**Explain** the architectures of digital signal processors as well as FPGA to illustrate their usage in system implementation.	**K2:Explain**

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	2	-	-	-	-	-	-	-	3	3	-	2
CO2	3	3	-	2	-	-	-	-	-	-	-	3	3	-	2
CO3	3	3	-	2	-	-	-	-	-	-	-	3	3	-	2
CO4	3	3	2	2	2	2	-	-	-	-	-	3	3	1	2
CO5	3	3	-	1	-	-	-	-	-	-	-	3	3	-	2
CO6	3	2	3	3	3	-	-	-	-	-	-	3	3	-	2

AVG	3	2.83	2.50	2.00	2.50	2.00	0	0	0	0	0	3.00	3.00	1.00	2.00

University Syllabus:

Unit	Content	Hrs/Unit
1:**Discrete-time signals**	Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences – periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences.	3
2:LTI systems	Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.	6
3:**Z-Transform**	Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples and exercises, characteristic families of signals along with ROCs, convolution, correlation and multiplication using Z-transform, initial value theorem, Perseval's relation, inverse Z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.	6
4:**Discrete Fourier Transform:**	Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises.	5
5:**Fast Fourier Transform**	Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.	4
6:**Filter Design**	Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transforms, design of linear phase FIR filters, no. of taps, rectangular, Hamming and Blackman windows.	5
7:**Digital Signal Processor**	Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor, writing of small programs in Assembly Language.	4
8:**FPGA**	Architecture, different sub-systems, design flow for DSP system design, mapping of DSP algorithms onto FPGA.	3

RESOURCES:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis&D.G.Manolakis, Pearson Ed.
2. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.
3. Digital Signal Processing Signals, Systems and Filters, A. Antoniou, TMH Publishing Co.
4. VLSI Digital Signal Processing Systems Design and Implementation, Wiley International Publication.
5. Digital Signal Processing with Field Programmable Gate Arrays, U.Meyer-Baese, Springer.

Course Title: Telecommunication System	Code: EC603
Type of Course: Theory	Course Designation: Theory paper
Semester: 6th	Contact Hours: 3P/week
Continuous Assessment: 100 marks	
Writer: Course Coordinator	Approved by HoD (Convenor of DAB)

Pre-requisites: Analog Electronics, Digital Electronics

Course Outcomes (CO's) of Telecommunication System

On completion of the course students will be able to

Couse Outcomes (COs)

CO#	CO Statements	Bloom's Revised Knowledge Level
EC603.CO1:	**Understand** the fundamentals of telecommunication systems from ancient local loop systems to modern telecommunication system and its various components to explore the history of telecommunication.	KL2:Understand
EC603.CO2:	**Identify** the differenttypes of switching systems such as electromechanical switching, crossbar switching system, digital switching to establish connections between nodes within a network.	KL3: Identify
EC603.CO3:	**Distinguish** between types of transmission media, signaling techniques, types of standard carrier channels for the modern communication purpose.	KL4:Analyse
EC603.CO4:	**Explain** the different types of dialing system (i.e. pulse dialing, tone dialing) ,concept of cordless telephones, Digital PABX, IP telephony, MODEM used to explore older and modern telephony system	KL2:Understand
EC603.CO5:	**Define** the stored program control and different types of software architecture to increase the efficiency of switching.	KL1: Define
EC603.CO6:	**Apply** the knowledge of traffic engineering techniques to obtain blocking probability, traffic load, GOS for upgrading the network efficiency and performance.	KL3: Apply

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	1	-	-	-	-	-	3	3	1	3
CO2	3	3	3	-	-	2	-	-	-	-	-	3	3	1	2
CO3	3	3	3	-	-	3	2	-	-	-	-	3	3	2	3
CO4	3	3	3	-	-	3	-	-	-	-	-	3	3	2	2
CO5	3	2	2	-	-	2	-	-	-	-	-	2	3	1	2

CO6	3	3	3	-	-	2	-	-	-	-	-	2	3	1	2
AVG	3	2.67	2.833	0	0	2.33	2	0	0	0	0	2.5	3	1.33	2.33

University Syllabus:

Unit	Content	Hrs/Unit
1: Evaluation of Telecommunication System	1. Evolution of Telecommunication; Components and Examples of Telecommunication systems 2. Pulse dialling & Tone dialling 3. Telephone Instruments -rotary dial and push button types.	3
2: Details about media and Transmission line	1. Concept of guided and unguided media. 2. Copper, Co-axial, and Fiber optic. 3. Concept of Transmission Bridge 4. Hybrid circuit for 2-wire to 4-wire conversion 5. Concept of PCM Carriers 6. American and European standards of carrier channels	6
3: Switching System	1. BORSCHT Functions 2. Switching hierarchy & routing 3. Signalling techniques-in channel & common channel signalling 4. Concept of SS7 signalling system	4
4Analog and digital swithching	1. Electro-mechanical switching- Strowger& Crossbar switching.. 2. Circuit Switching & Packet Switching. 3. Different types of Digital Switching systems - Time division Time switch 4. Time multiplexed Space switch, Time multiplexed Time switch 5. Hybrid switching, TS, ST, STS, TST systems 6. Architecture of 5ESS system	6
5. Different types of software architecture	1. Different Software architecture 2. Different Application software 3. Concept of Electronic Exchange 4. Introduction to cordless telephones and Digital PABX	4
6. Traffic engineering system	1. Introduction to traffic engineering. 2. Blocking network, blocking probability 3. Grade of service, traffic load calculation 4. Erlang-B and congestion formulas-case studies	4
7. Different types of broad band system	1. Concept of RS 232C, DTE and DCE 2. Facsimile Transmission 3. Broad band transmission ,DSL and ADSL 4. Concept of ISDN and B-ISDN	4
8. Modern telecommunication system	1. Voice over IP and its application 2. Session initiation protocol 3. H.323 signalling 4. IP multimedia service	4

RESOURCES:

1. T. Viswanathan, " Telecommunications Switching Systems & Networks", PHI
2.J.C.Bellamy "Digital Telephony"- Wiley-India.
3. R L Freeman "Telecommunication System Engineering"- Wiley-India
4. P.Gnanasivam, "Telecommunication Switching and Network"- New age publisher
5 .NPTEL , Telecommunication and switching system network, prof. Y.N. Singh
6. Forouzan, " Data communications and networking", The McGraw-Hill Companies

Course Title: Antenna Theory & Propagation	**Code: EC604A**
Type Of Course: Theory	**Course Designation: Optional**
Semester: 6th	**Contact Hours: 3L/week**
Continuous Assessment: 25 Marks **Attendance : 5 Marks**	**Final Exam: 70 Marks**
Writer: (Course Coordinator)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Fundamental knowledge on Physics and Electromagnetic Theory

Course Outcome (CO's) of Antenna Theory & Propagation:

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC604A:CO1	**Interpret** relations between various antenna parameters for estimating antenna characteristics	**K2: Understanding**
EC604A:CO2	**Apply** knowledge of electromagnetic potentials for calculating radiation pattern of short radiating structures	**K3: Applying**
EC604A:CO3	**Analyze** the fields radiated from antenna for interpret the radiation pattern	**K4: Analyzing**
EC604A:CO4	**Evaluate** radiated field from various antenna arrays for computing gain and directivity	**K5: Evaluating**
EC604A:CO5	**Evaluate** design principles for different radiation structures for demonstrating characteristic features of wireless transmission	**K5: Evaluating**
EC604A:CO6	**Estimate** noise characteristics of propagating radio waves for evaluating signal strength in free-space communication	**K5: Evaluating**

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	-	2	2	-	2
CO2	3	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO4	3	3	3	3	2	1	-	-		-	-	3	3	1	3
CO5	3	2	1	1	-	-	1	-	-	-	-	1	2	1	1
CO6	3	3	3	3	-	-	1	-	-	-	-	3	3	1	3
AVG	**3**	**2.67**	**2.333**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**2.5**	**2.666**	**1**	**2.5**

University Syllabus:

Module	Content	Hrs/Unit
Module 1: Review of Maxwell's Equation and Antenna Characteristics	Radiationof e.m waves and introducing Antenna[**1L**] Vector Potential and Retarded Vector Potential, Radiation fields of a Hertzian dipole(electric)[**2L**] Duality Principle, Radiation fields due to short magnetic dipole [**2L**] Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain; Impedance, VSWR, Polarization; Effective height and Receive Aperture; Noise Temperature of Antenna[**2L**]	07
Module 2: Rectifier and detector diodes	Radiation fields and Characteristics of λ/2 dipole[**1L**] Discussion on λ/4 monopole antenna[**1L**] Current distribution and Radiation patterns of center-fed dipoles of length λ, 3λ/2 and 2 λ. Horizontal and Vertical antennas over a plane ground[**2L**] Antenna Arrays: electric Field due to 2 element arrays, 3 element Arrays[**2L**] Pattern Multiplication; Uniform Linear Array[**2L**] End fire and Broad side; Phased array[**1L**]	09
Module 3: Characteristics and properties of Antenna	Travelling Wave Antenna, Helical Antenna[**2L**] Folded Dipole, Yagi-Uda Array [**2L**] Loop Antenna, Electrically Short Antennas, Broad Band Antenna (Log periodic Antenna) [**2L**] Microstrip Patch Antenna[**1L**] Radiation from an aperture: Sectoral and Pyramidal Horn Antennas, Design of Optimum Horn Antenna[**2L**] Parabolic and Corner Reflectors and feed systems[**1L**] [Major stress on Characteristics features, applications (including frequency at which used), advantages and disadvantages, major design principles and equations (without long and detailed derivations]	10
Module 4: Methods of Propagation	Ground Wave Propagation, Components of ground wave, Field strength dependence on physical factors[**1L**] Sky wave Propagation; Ionospheric Layers; Virtual Height, Critical Frequency, MUF, Skip distance, Sporadic Reflections[**3L**] Space wave propagation: Tropospheric Scatter, Ducting Super refraction, Sub refraction[**2L**] Friss Transmission Formula, SNR of a Radio Link[**2L**] Physical (Medium) effects on Radio wave Propagation: Absorption, Refraction and Radio Horizon [**1L**] Diffraction, Multipath Propagation and fading, Noise, Doppler effect[**1L**]	10

RESOURCES:

1. Antenna (for all application), John D. Kraus and Ronald J. Marhcfka; Tata- MacGraw Hill, 3rd Edition
2. Antenna & Wave Propagation, K.D Prasad; Satya Prakashan, New Delhi, 3rd Edition
3. Antenna Theory: Analysis & Design, Constantine A. Balanis; Willey, 3rd Edition
4. Elements of Electromagnetics; Mathew N.O. Sadiku, Oxford University Press, 5th Edition (2010)
5. Electromagnetic Waves & Radiating Systems, EC Jordan & K.G. Balmain; Pearson Education, 2nd Edition (2009)
6. Microstrip Antenna Design Handbook- Ramesh Garg; Artech House (2001)

Course Title: Information Theory and Coding	**Code: EC604B**
Type of Course: Theory	**Course Designation: Elective**
Semester: 6th	**Contact Hours: 3L/week**
Continuous Assessment: 25 marks	**Final Exam:70Marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Engineering Mathematics, Basics of communication system

Course Outcomes (CO's) of Information Theory and Coding

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
PE-EC604B.CO1	**Understand** the basic concept of information theory such as information, entropy, mutual information, channel capacity for comparing various channels.	K2 : Understanding
PE-EC604B.CO2	**Analyze** various source coding techniques to compare their efficiency.	K4: Analyzing
PE-EC604B.CO3	**Construct** linear block codes to identify the error.	K3: Applying
PE-EC604B.CO4	**Design** encoding circuits to create cyclic code.	K6: Creating
PE-EC604B.CO5	**Construc**t BCH codes to solve error in coded message.	K6: Creating
PE-EC604B.CO6	**Evaluate** the distance in the Convolution code to determine error.	K5: Evaluating

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	3	2	-	1
CO2	3	3	2	-	-	-	-	-	-	-	-	3	2	-	1
CO3	3	3	3	-		1	-	-	-	-	-	3	2	1	1
CO4	3	3	3	-	-	1	-	-	-	-	-	3	2	1	1
CO5	3	3	3	-	-	1	-	-	-	-	-	3	2	1	1
CO6	3	3	3	-	-	-	-	-	-	-	-	3	2	-	1
AVG	3	2.83	2.66	-	-	1	-	-	-	-	-	3	2	1	1

University Syllabus:

Unit	Content	Hrs/Unit
1: Module 1	**Source Coding** Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes.	7
2: Module 2	**Channel Capacity And Coding** Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.	7
3: : Module 3	**Linear And Block Codes For Error Correction** Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes	8
4:Module 4	**Cyclic Codes** Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes.	7
5: Module 5	**BCH Codes** Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.	8
6: Module 6	**Convolutional Codes** Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrixrepresentation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples ofconvolutional codes, Turbo codes, Turbo decoding.	8

RESOURCES:

Information Theory, Coding and Cryptography – R. Bose (McGraw Hill)**Convolutional Codes [8L**

8.
9. An Introduction to Error control codes – S. Gravano (Oxford)
10. Information and Coding – N. Abramson (McGraw Hill)
11. Introduction to Information Theory – M. Mansurpur (McGraw Hill)
12. Error Control Coding – S. Lin and D.J. Costello Jr. (Prentice Hall)
13. https://nptel.ac.in/courses/117101053/
14. https://nptel.ac.in/courses/108/102/108102117/

Course Title: Object Oriented Programming	Code: EC 605A
Type Of Course: Theory	Course Designation: Elective
Semester: 5th	Contact Hours: 3L/week
Course Coordinator	

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Knowledge Level
EC 605A.CO1	Describe the use of objects and classes and apply knowledge to develop programs.	Understand	K2
EC 605A.CO2	Identify reusability property use of abstract classes & methods, interfaces.	Understand	K2
EC 605A.CO3	Construct the ability of creation and handling of packages	Apply	K3
EC 605A.CO4	Explain different types of Exception handling and learn the use of throws and catches	Evaluate	K5
EC 605A.CO5	Create threads to run tasks using the Thread class, control threads using the methods and execute tasks in a thread pool and Multithreading.	Apply	K3
EC 605A.CO6	Design applications with applets and event-driven graphical user interface.	Design	K6

Mapping of COs with POs and PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	-	-	-	2	-	-	2	2	2	1	3
CO2	3	3	1	3	-	-	-	1	-	-	2	2	2	2	3
CO3	3	3	2	3	-	-	-	3	-	-	2	2	1	1	3
CO4	3	3	2	3	-	-	-	3	-	-	2	2	3	1	2
CO5	3	3	0	1	-	-	-	2	2	2	2	2	3	1	2
CO6	3	3	0	3	-	-	-	3	2	2	2	2	2	1	2
AVG.	3	3	2	3	0	0	0	2.3	2	2	2	2.00	2.17	1.17	2.5

University Syllabus

Unit No	Content	Hr
Module 1	Object oriented design [10 L] Concepts of object oriented programming language, Major and minor elements, Object, Class, relationships among objects, aggregation, links, relationships among classes-association, aggregation, using, instantiation, meta -class, grouping constructs.	
Module 2	Object oriented concepts :Difference between OOP and other conventional programming – advantages and disadvantages. Class, object, message passing, inheritance, encapsulation, polymorphism	4
Module 3	Basic concepts of object oriented programming using Java: Implementation of Object oriented concepts using Java.	22

	Language features to be covered:	
Module 4	Basic concepts of java programming : advantages of java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested & inner classes, basic string handling conceptsString (discuss charAt() , compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray() , toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods) &StringBuffer classes (discuss append(), capacity(), charAt(), delete(), deleteCharAt(), ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods), concept of mutable and immutable string, command line arguments, basics of I/O operations – keyboard input using BufferedReader& Scanner classes.	6
Module 5	Reusability properties – Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages.	6
Module 6	Exception handling & Multithreading] – Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter -thread communication, deadlocks for threads, suspending & resuming threads.	6
Module 7	Applet Programming (using swing) – Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets, concept of delegation event model and listener, I/O in applets, use of repaint(), getDocumentBa se(), getCodeBase() methods, layout manager (basic concept), creation of buttons (JButton class only) & text fields.	4

Textbooks/References:

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING
5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
6. Ivor Horton's Beginning Java 2 SDK – Wrox
7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Title: Digital Communication Laboratory	**Code: EC691**
Type of Course: Lab	**Course Designation: Practical**
Semester: 6th	**Contact Hours: 6P/week**
Continuous Assessment: (40 + 60) marks	
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Signals and Systems, Analog Communication

Course Outcomes (CO's) of Digital Communication Laboratory

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC691.CO1	**Experiment with** different source encoding techniques.	K3: Applying
EC691.CO2	**Identify** various line encoding techniques.	K3: Applying
EC691.CO3	**Experiment with** different carrier modulation techniques.	K3: Applying
EC691.CO4	**Analyze** probability of symbol error for binary carrier modulation techniques by simulation study.	K4: Analyzing
EC691.CO5	**Examine** the properties of 7-length and 15-length PN sequences using shift register.	K4: Analyzing
EC691.CO6	**Construct** a digital data transmission system via optical fiber link.	K6: Creating

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	2	1	1	-	2	1	-	2	3	2	1
CO2	3	3	1	2	2	1	1	-	2	1	-	2	3	2	1
CO3	3	3	1	2	2	1	1	-	2	1	-	2	3	2	1
CO4	3	3	2	2	3	1	1	-	2	1	-	2	3	2	1
CO5	3	3	2	2	2	1	1	-	2	1	-	2	3	2	1
CO6	3	3	3	3	3	1	1	-	2	1	-	2	3	2	1
AVG	3.00	3.00	1.67	2.17	2.33	1.00	1.00	-	2.00	1.00	-	2.00	3.00	2.00	1.00

University Syllabus:

Unit	Content	Hrs/Unit
Exp-1	Study of PAM and demodulation	3
Exp-2	Study of PCM and demodulation	3
Exp-3	Study of delta modulator and demodulator	3
Exp-4	Study of adaptive delta modulator and demodulator	3
Exp-5	Study of line coders: polar/unipolar/bipolar NRZ ,RZ and Manchester	3
Exp-6	Study of BPSK modulator and demodulator	3
Exp-7	Study of BFSK modulator and demodulator	3
Exp-8	Study of ASK modulator and demodulator	3
Exp-9	Study of QPSK modulator and demodulator	3
Exp-10	Simulation study of probability of symbol error for BPSK modulation	3
Exp-11	Simulation study of probability of symbol error for BFSK modulation	3
Exp-12	Design, implementation and study of all the properties of 7-length and 15-length PN sequences using shift register	3
Exp-13	Construction of a digital data transmission system via optical fiber link.	3

RESOURCES:

Text Books:

T1. Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.
T2. Principle of Communication System - Taub& Schilling, TMH

Reference Books:

R1. Communication Systems: Analog and Digital – Sanjay Sharma, S.K.Kataria& Sons
R2. Communication Systems: Analog and Digital – Singh and Sapre, TMH

E-Resource (Website link/E-book/Journal/MOOC etc.):

E1. https://nptel.ac.in/courses/108/102/108102096/

Course Title: Digital Signal Processing	**Code: EC692**
Type of Course: Lab	**Course Designation: Compulsory**
Semester: 6th	**Contact Hours: 3P/week**
Continuous Assessment: 40 marks	**Final exam: 60 marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Basic Matlab/Python programmming, Signals & Systems

Course Outcomes (CO's) of Digital Signal Processing

On completion of the course students will be able to

CO#	**CO Statements**	**Bloom's Revised Knowledge Level**
EC692.CO1	**Experimentwith** signal sampling and various signal arithmetic operations to understand DSP operations on signals in simulation.	**K3: Experiment with**
EC692.CO2	**Develop** the linear convolution algorithm to analyze the LTI system output for real-time long data sequences.	**K6: Develop**
EC692.CO3	**Evaluate** the DFT and Z transform to inspect the frequency components of discrete time signals and systems.	**K5: Evaluate**
EC692.CO4	**Construct** different kinds of digital filters in simulation.	**K6: Construct**
EC692.CO5	**Develop** a system based on digital signal processor to sample analog continuous time signals and perform arithmetic operations in real-time.	**K6: Creating**
EC692.CO6	**Design** digital filters using digital signal processing kit to perform signal filtering in real-time.	**K6: Creating**

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	-	1	-	1	-	2	-	-	2	2	1.5	2
CO2	3	3	1	-	1	-	1	-	2	-	-	2	2	1.5	2
CO3	3	3	2	-	1	-	1	-	2	-	-	2	2.25	1.5	2
CO4	3	3	2	3	1	-	1	-	2	-	-	3	2.4	1.5	3
CO5	3	1	-	3	-	1	-	-	2	3	2	3	2.33	1.5	2.66
CO6	3	3	2	3	1	1	-	-	2	3	-	3	2.4	1.5	3
AVG	3	2.67	1.60	3.00	1.00	1.00	1.00	0	2	3	2	2.50	2.23	1.5	2.44

University Syllabus:

Unit	Content	Hrs/Unit
1	Sampled sinusoidal signal, various sequences and different arithmetic operations.	3
2	Convolution of two sequences using graphical methods and using commands- verification of the properties of convolution.	3
3	Z-transform of various sequences – verification of the properties of Z-transform.	3
4	Twiddle factors – verification of the properties.	3
5	DFTs / IDFTs using matrix multiplication and also using commands.	3
6	Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.	3
7	Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.	3
8	Butterworth filter design with different set of parameters.	3
9	FIR filter design using rectangular, Hamming and Blackman windows.	3
10	Writing & execution of small programs related to arithmetic operations and convolution using Assembly Language of TMS320C 5416/6713 Processor, study of MAC instruction.	3
11	Writing of small programs in VHDL and downloading onto Xilinx FPGA.	3
12	Mapping of some DSP algorithms onto FPGA.	3

RESOURCES:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis&D.G.Manolakis, Pearson Ed.
2. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.
3. Digital Signal Processing Signals, Systems and Filters, A. Antoniou, TMH Publishing Co.
4. VLSI Digital Signal Processing Systems Design and Implementation, Wiley International Publication.
5. Digital Signal Processing with Field Programmable Gate Arrays, U.Meyer-Baese, Springer.

Course Title: Object Oriented Programming Lab	Code: EC 695A
Type of Course: Practical	Course Designation: Elective
Semester: 6th	Contact Hours: 3P/week
Course Coordinator	

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Knowledge Level
EC 695A.CO1	Define an object oriented programming language, and associated class libraries and learn how to develop object oriented programs.	Remember	K1
EC 695A.CO2	Understand the concepts of class, constructor, data encapsulation, inheritance, overriding and polymorphism to describe large scale software.	Understand	K2
EC 695A.CO3	Develop and debug programs using object oriented principles with wrapper class, arrays.	Apply	K3
EC 695A.CO4	Apply the concept of interfaces- multiple inheritance, extending interfaces.	Apply	K3
EC 695A.CO5	Analyze and use an integrated environment development by creating and accessing packages and multithreaded programming	Analyze	K4
EC 695A.CO6	Develop programs with Graphical User Interfaces capabilities and solve related problems.	Create	K6

Mapping of COs with Pos and PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	-	-	-	2	-	-	2	-	2	1	2
CO2	3	3	1	3	-	-	-	1	-	-	2	-	2	3	2
CO3	3	3	2	3	-	-	-	3	-	-	2	-	3	2	2
CO4	3	3	2	3	-	-	-	3	-	-	2	-	3	2	2
CO5	3	3	-	1	-	-	-	2	2	2	2	-	2	1	2
CO6	3	3	-	3	-	-	-	3	2	2	2	-	3	2	2
AVG.	3	3	1.5	2.5	-	-	-	2.333	2	2	2	-	2.50	1.83	2

University syllabus

Experiments
1. Assignments on class, constructor, overloading, inheritance, overriding 2. Assignments on wrapper class, arrays 3. Assignments on developing interfaces- multiple inheritance, extending interfaces 4. Assignments on creating and accessing packages 5. Assignments on multithreaded programming 6. Assignments on applet programming

Course Title: Seminar	**Code: EC681**
Type of Course: Sessional	**Course Designation: Compulsory**
Semester: 6th	**Contact Hours: N/A**
Assessment: 100 marks	
Writer: (Course Coordinator)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Knowledge on basic and applied sciences, professional course, professional electives and free elective subjects along with ethical and environmental policy.

COURSE OUTCOMES (CO's)

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC681: CO1	**Exhibit** comprehensive module-level knowledge on given engineering topic within specified time-frame	**K2: Understanding**
EC681: CO2	**Interpret** in-depth relevance of the subject of discussion with present technological standards	**K2: Understanding**
EC681: CO3	**Construct** well-organized outcome with up-to-date information in accordance with techno-socio requirement	**K3: Applying**
EC681: CO4	**Compare** the importance of technological development with previous solutions having keen focus on chronological Societal demand	**K4: Analyzing**
EC681: CO5	**Analyze** intra-disciplinary/multidisciplinary pertinence of the overall impact through teamwork or individual means	**K4: Analyzing**
EC681: CO6	**Infer** possible ethical, economic and environmental impact of the topic for the benefit of civilization	**K2: Understanding**

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	-	-	-	1	3	-	-	2	1	1
CO2	3	2	-	-	-	-	-	-	-	1	-	1	1	-	1
CO3	3	2	-	-	-	2	1	-	-	2	-	1	1	1	1
CO4	2	1	-	-	-	3	1	1	-	-	-	1	1	2	1
CO5	2	2	-	-	-	1	-	1	3	2	-	1	1	2	1
CO6	-	-	-	-	-	1	3	3	-	-	2	2	-	2	1
AVG	**2.6**	**1.6**	**-**	**-**	**2**	**1.75**	**1.67**	**1.67**	**2**	**2**	**2**	**1.2**	**2**	**2.25**	**1.4**