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,2ND YEAR
2018-2022 BATCH

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.

Table of Content

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(III)

Sl.No.	Paper Code	Paper Name	Credit
1.	EC301	Electronic Devices	3
2.	EC302	Digital System Design	3
3.	EC303	Signals & Systems	3
4.	EC304	Network Theory	3
5.	ES-CS301	Data Structure & Algorithm (ES)	3
6.	BS-M301	Probability & Statistics (BS)	3
7.	EC391	Electronic Devices Lab	3
8.	EC392	Digital System Design Lab	3
9.	EC-CS391	Data Structure Lab	3
10.	MC381	Environmental Science	0

EvenSemester(IV)

Sl.No.	Paper Code	Paper Name	Credit
1.	EC401	Analog Communication	3
2.	EC402	Analog Electronic Circuits	4
3.	EC403	Microprocessor & Microcontrollers	3
4.	ES-CS401	Design and Analysis of Algorithm(ES)	4
5.	BS-M401	Numerical Methods(BS)	4
6.	BS-B401	Biology for Engineers	6
7.	EC491	Analog Communication Lab	2
8.	EC492	Analog Electronic Circuits Lab	2
9.	EC493	Microprocessor & Microcontrollers Lab	2
10.	BS-M(CS)491	Numerical Methods Lab	
11.	HS-HU481	Soft Skill Development Lab	

Odd Semester(III) Articulation Matrix

Paper Code	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3
EC301	3.00	3.00	2.33	1.50	1.00	--	--	1.00	--	--	--	1.00	2.33	1.00	1.00
EC302	3	2.16	2	1	-	1	1	-	-	-	-	2.5	2.83	1	2.5
EC303	3	2.8	2	2.5	2.3	2	-	-	-	-	1	3	3	2	3
EC304	2.5	2.6	1.75	1	-	1	1	-	-	-	-	1	3	1.33	1
ES-CS301	2.34	2.67	2	2	2	-	-	1	-	-	-	1.34	3	1	1.33
BS-M301	2.83	2.66	2.33	1.83	-	-	-	1.00	-	2	1.667	1.00	2	1.4	1.00
EC391	3.00	3.00	3.00	1.40	2.00	-	-	1.00	3.00	1.00	-	1.00	3.00	1.00	1.00
EC392	2.83	2.33	3	-	2	0.83	-	-	2	0.66	-	2.83	2.83	1.5	2.0
EC-CS391	3	2.67	2.833	1	-	-	-	-	-	-	-	2.5	3	1	1
MC381	-	1	1	-	-	1	1	-	-	-	-	-	1	1	-

EvenSemester(IV) Articulation Matrix

Paper Code	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
EC401	3.0	2.5	1.5	1.5	1.0	1.0	1.0	-	-	-	-	2.0	2.50	1.00	2.00
EC402	3	2.83	2.83	1	-	2.33	2.6	-	-	-	-	2.67	3.00	2.50	1.50
EC403	2.83	2.6	2	1.667	1	-	-	-	-	-	1	1.25	2.5	1.17	1
ES-CS401	3	3	2.83	2.83	2.83	2.83	2	-	-	-	-	3	3	2	1
BS-M401	3	3	1	2.67	1	1	-	-	-	-	1	2	3	1	1
BS-B401	2.83	-	1.16	1	-	-	2	1	-	-	-	-	2	1	-
EC491	3	2	1	3	1.5	1.5	1.33	1	1	2	-	2	2.33	1.50	2.00
EC492	3	2.66	2	2.83	-	2.33	2.33	-	3	-	-	3	3.00	2.83	1.83
EC493	2.84	2.5	2.5	1.8	1	-	-	-	-	-	1.2	1.5	2	1.17	1
BS-M(CS)491	3	2.83	1.167	2.5	3	1	-	-	2	-	1	2	3.00	1	1
HS-HU481	-	-	-	-	-	2	-	2	1	3	-	2	-	1	1

University Syllabus:

Unit	Content	Hrs/Unit
MODULE 1	Module 1 Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	6
MODULE 2	Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation -corresponding algorithms and complexity analysis. ADT queue. Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	8
MODULE 3	Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of binary tree, B tree, B+ tree: definitions, algorithms and analysis.	8
MODULE 4	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	8

RESOURCES:

1. Data Structure with C by Sheymour Lipschutz.

2.Data Structures using C by Reema Thareja .

Course Title: Electronic Devices	**Code: EC301**
Type Of Course: Theory	**Course Designation: Compulsory**
Semester: 3rd	**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 Electronics
Course Objective (COb's) of Electronic Devices:

EC301:COb1: Be able to differentiate materials based on band diagram for specified device design
EC301:COb2: Be able to calculate carrier statistics and transport properties under electric field
EC301:COb3: Be able to analyze two-terminal junction devices
EC301:COb4: Be capable to investigate electrical properties of BJT with equivalent circuit modeling
EC301:COb5: Be able to evaluate electrical properties of MOS and MOSFET
EC301:COb6: Be accomplished to synthesize the fabrication process for specific device

Course Outcome (CO's) of Electronic Devices:

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC301:CO1	**Calculate** position of Fermi Level and Density of States for a given semiconductor to estimate the carrier distribution	**K3:** Applying
EC301:CO2	**Compute** carrier transport properties under external conditions for determination of conductivity of a given semiconductor device	**K3:** Applying
EC301:CO3	**Investigate** electrical properties of two-terminal junction devices based on specific design parameters and external biasing conditions for characterization	**K4:** Analyzing
EC301:CO4	**Determine** optical propertiesof two-terminal semiconductor junction devices for analyzing optical transmitter and receivers	**K4:** Analyzing
EC301:CO5	**Evaluate** electrical performance of multi-junction three-terminal devices for synthesizing VLSI circuits	**K4:** Analyzing
EC301:CO6	For a given fabrication procedure, **synthesize** the process outcome for device engineering	**K5:** Evaluating

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	**3**	**3**	**2**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**2**	**--**	**--**
CO 2	**3**	**3**	**3**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**2**	**--**	**--**
CO 3	**3**	**3**	**3**	**2**	**1**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**3**	**--**	**--**

CO 4	**3**	**3**	**2**	**1**	**1**	**--**	**--**	**--**	**--**	**--**	**--**	**1**	**2**	**--**	**--**
CO 5	**3**	**3**	**2**	**2**	**1**	**--**	**--**	**1**	**--**	**--**	**--**	**1**	**3**	**1**	**1**
CO 6	**3**	**3**	**2**	**1**	**1**	**--**	**--**	**1**	**--**	**--**	**--**	**1**	**2**	**1**	**1**
Avg:	**3.00**	**3.00**	**2.33**	**1.50**	**1.00**	**--**	**--**	**1.00**	**--**	**--**	**--**	**1.00**	**2.33**	**1.00**	**1.00**

University Syllabus:

Module	Content	Hrs/Unit
Module 1: Energy bands & Current Carriers in Semiconductors	Bonding Forces in Solids, Energy Bands theory in crystals (Qualitative Analysis), Metals, Semiconductors, & Insulators, Fermi-Level, Intrinsic and Extrinsic Semiconductors, Concept of Holes, Carrier Concentration. and Mobility, diffusion and drift of carriers, continuity equation, Injected minority carrier charge, Recombination and generation of charge carriers. Generation and recombination of carriers; Poisson and continuity equation	06
Module 2: p-n junction and Bipolar Junction Transistor	Physical Description of p-n junction, Basic device technologies for fabrication of a p-n junction, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode ` BJT: Basic Construction, I-V characteristics, Ebers-Moll Model	10
Module 3: MOSFET	MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor	06
Module 4: Opto–Electronics & Integrated Circuit	Optical absorption in semiconductors, photovoltaic effects, solar cells (p-n junction), Photoconductors, Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor, LED, Semiconductor Laser (p-n junction) IC: fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.	10

GATE syllabus mapping:

GATE syllabus content	Mapping unit of university syllabus
Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers	Module 1
Poisson and continuity equations; P-N junction, Zener diode	Module 2
BJT	Module 2
MOS capacitor, MOSFET	Module 3
LED, photo diode and solar cell	Module 3
Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process	Module 4

RESOURCES:

1. Physics of Semiconductor Devices – S. M. Sze – Wiley
2. Semiconductor Devices – D. A. Neamen – TMH
3. https://nptel.ac.in/courses/115102103/3
4. Solid State Electronic Devices – Streetman – PHI
5. Solid State Electronic Devices – Bhattacharyya & Sharma – Oxford
6. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-772-compound-semiconductor-devices-spring-2003/ lecture-notes/lecture3.pdf
7. Optoelectronic Devices - P. Bhattacharyya – PHI
8. https://www.youtube.com/watch?v=Gwyi2brc0QQ

Course Title: Digital System Design	**Code: EC 302**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 3rd	**Contact Hours: 3L/week**
Continuous Assessment: 25 marks	**Final Exam:70Marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisite: Basic Electronics Engineering, Solid State Devices

Course Outcomes (CO's) of Digital System Design

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC 302.CO1	Choose the code conversion techniques relate number system and binary codes.	K1 : Remembering
EC302 .CO2	Apply different methods of reduction of logical expressions to construct different combinational circuits.	K3 : Applying
EC302.CO3	Combine appropriate logic devices (MUX/DEMUX, gates, PLD) to design different combinational circuits	K6: Creating
EC 302.CO4	Adapt proper flip-flops to construct sequential circuits	K6: Creating
EC 302.CO5	Analyze different types of D/A and A/D conversion techniques and Logic families to compare their performance.	K4: Analysing
EC 302.CO6	**Explain** basic VLSI design modeling styles for demonstrating combinational and sequential circuits.	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	2	-	-	-	1	1	-	-	-	-	2	3	1	2
CO2	3	2	-	-	-	1	1	-	-	-	-	2	3	1	2
CO3	3	3	2	1	-	1	1	-	-	-	-	3	3	1	3
CO4	3	3	2	1	-	1	1	-	-	-	--	3	3	1	3
CO5	3	1	-	-	-	1	1	-	-	-	-	2	2	1	2
CO6	3	2	-	-	-	1	1	-	-	-	-	3	3	1	3
AVG	3	2.16	2	1		1	1					2.5	2.83	1	2.5

University Syllabus:

Unit	Content	Hrs/Unit
1: Module 1	1. Review of Number System, 2 .Signed and Unsigned Number. 3. Logic Simplification and Combinational Logic Design: 4.Review of Boolean Algebra and De Morgan's Theorem,	10

	5. SOP & POS forms, Canonical forms, 6. Karnaugh's map, 7.Binary codes, Code Conversion. 8.MSI devices like Comparators, Multiplexers, Encoder, Decoder, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Fast adders, Barrel shifter and ALU.	
2: Module 2	Sequential Logic Design: 1. Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered F.F. 2.Ripple and Synchronous counters, 3. Shift registers, 4. Finite state machines, Design of synchronous FSM. 5. Designing synchronous circuits like Synchronous Counter, Pulse train generator, Pseudo Random Binary Sequence generator,	6
3: : Module 3	Logic Families and Semiconductor Memories: 1. TTL, ECL, CMOS families 2. Semiconductor Memories, 3. Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices. 4. Different types of A/D and D/A conversion techniques. Sample and Hold Circuit	8
4: : Module 4	VLSI Design flow style: 1 .Design entry Schematic, FSM & HDL, different modeling in VHDL, 2. Data types and objects, 3.Dataflow, 4.Behavioral and Structural Modeling, 5. Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.	8

RESOURCES:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Schilling &Belove, Digital Integrated Electronics, Tata McGraw Hill,
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.
6. R. Anand, "Digital Electronics", Khanna Publishing House, New Delhi, 2017.
7. A. Anand Kumar, " Fundamentals of Digital Circuits", PHI, New Delhi
8. S. Salivahanan, S. Arivazhagan , "Digital Circuits and Design", Oxford University Press

Course Title: Signals & Systems	**Code: EC303**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 3th	**Contact Hours: 3L/week**
Continuous Assessment: 25 marks	**Final exam: 70 marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Basic mathematics – vector, linear algebra, calculus

Course Outcomes (CO's) of Signals & Systems

On completion of the course students will be able to

CO#	CO Statements	Bloom's Revised Knowledge Level
EC303.CO1	**Apply** the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to model signals and systems.	**K3:Apply**
EC303.CO2	**Analyse** the Fourier techniques to examine the spectral characteristics of continuous-time periodic and aperiodic signals.	**K4:Analyse**
EC303.CO3	**Classify** systems based on their properties and demonstrate convolution to infer the response of LTI system.	**K2:Classify**
EC303.CO4	**Examine** impulse response and Fourier analysis to inspect system properties.	**K4:Examine**
EC303.CO5	**Apply** the Laplace transform and Z- transform to construct continuous-time and discrete-time systems.	**K3:Apply**
EC303.CO6	**Develop** the idea of sampling to solve real life signal processing applications.	**K6:Develop**

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	3	-	3
CO2	3	3	-	2	3	-	-	-	-	-	-	3	3	-	3
CO3	3	3	1	-	2	-	-	-	-	-	1	3	3	-	3
CO4	3	3	-	-	3	-	-	-	-	-	-	3	3	-	3
CO5	3	3	-	-	3	-	-	-	-	-	-	3	3	-	3
CO6	3	2	3	3	2	2	-	-	-	-	-	3	3	2	3
AVG	3	2.8	2	2.5	2.3	2	0	0	0	0	1	3	3	2	3

University Syllabus:

Unit	Content	Hrs/Unit
1:Module-I	Signals and systems as seen in everyday life, and in various branches of engineering and science. Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.	6
2:Module-II	Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift invariant systems. System representation through differential equations.	6
3:Module-III	Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases.	8
4:Module-IV	Evolution of Transforms: Fourier Transform, Laplace Transform , Z-transform (single sided and Double sided) The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, , solution to differential equations and system behavior using Laplace Transformation The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.	8
5:Module-V	The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.	4

RESOURCES:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia).
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.
11. R. Anand, Signals and Systems, Khanna Publishing House, 2018.

Course Title: Network Theory	**Paper Code: EC 304**
Type of Course: Theory	**Course Designation: Theory**
Semester: 3rd	**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: Basic electrical

Course Outcomes (CO's) of Network Theory

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC304.CO1	***Apply*** different network reduction techniques like circuital laws and network theorems for simplifying practical circuits.	L3: Apply
EC304.CO2	***Classify*** the complex periodic waveforms by using Fourier series and obtain steady state response of any given network for periodic input.	L4:Analyze
EC304.CO3	***Apply*** the Laplace transform to obtain the transient response analysis of RC,RL and RLC network and transfer function of any network.	L3: Apply
EC304.CO4	***Show*** the pole-zero locations and the sinusoidal response for any electrical network.	L2: Understand
EC304.CO5	***Design*** filters circuits to obtain desired frequency response for any given electrical network.	L6: Design
EC304.CO6	***Analyze*** different two port network parameters and inspect their behaviour for interconnection of such networks.	L4: Analyze

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	3	1	1
CO2	3	3	1	-	-	-	-	-	-	-	-	1	3	2	1
CO3	3	3	2	-	-	-	-	-	-	-	-	1	3	1	1
CO4	2	-	-	-	-	-	-	-	-	-	-	1	3	1	1
CO5	2	2	2	1	-	1	1	-	-	-	-	1	3	2	1
CO6	2	3	2	-	-	1	-	-	-	-	-	1	3	1	1
AVG	2.5	2.6	1.75	1		1	1					1	3	1.33	1

University Syllabus:

Unit	Content	Hrs/Unit
Module 1	Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits.	8
Module 2	Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.	6
Module 3	Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.	6
Module 4	Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole -zero locations, Convolution Theorem and Two port networks and interconnections, Behavior of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.	12

RESOURCES:

1. Ashfaq Husain, Networks & Systems, Khanna Publishing House, New Delhi, 2018.
2.Alexander Sadiku, Fundamentals of electric circuits.

Course Title: Data Structure & Algorithm	**Paper Code: ES-CS 301**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 3rd	**Contact Hours: 3L/week**
Continuous Assessment: 25 marks(CA1,CA2,CA3 & CA4) Attendance : 5 marks	**Final Exam: 70 Marks**
Writer : (Course Coordinator)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Basic knowledge of C programming

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
ES-CS 301.CO1	*Classify* the variations of different data structures and Algorithms.	L2: Understand
ES-CS 301.CO2	*Define* the time and space complexities of any Algorithm and obtain the same for different searching techniques.	L1:Remember
ES-CS 301.CO3	*Select* ADTs such as Stack and Queue to perform expression conversion problem.	L3: Apply
ES-CS 301.CO4	*Explain* the algorithms for different sorting methods along with their complexity analysis.	L2: Understand
ES-CS 301.CO5	*Make use of* link list for implementing operations like insertion, deletion, traversing and searching etc.	L3: Apply
ES-CS 301.CO6	*Demonstrate* the non-linear data structures such as Graph, tree and their applications.	L2: Understand

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2					1				2	**3**	**1**	**2**
CO2	3	3		2				1				2	**3**	**1**	**2**
CO3	2	2		2	3			1				1	**3**	**1**	**1**
CO4	2			2	1			1				1	**3**	**1**	**1**
CO5	2			2	3			1				1	**3**	**1**	**1**
CO6	2			2	1			1				1	**3**	**1**	**1**
AVG	2.34	2.67	2	2	2			1				1.34	**3**	**1**	**1.33**

Course Title: Engineering Mathematics	**Code:BS-M 301**
Type Of Course: Theory	**Course Designation: Compulsory**
Semester: 3rd	**Contact Hours:4L/week**
Continuous Assessment: 25 Marks **Attendance : 5 Marks**	**Final Exam: 70 Marks**
Writer: Course Coordinator	**Approved by HoD**

Pre-requisites:knowledge from BSM 102

Course Objective (COb's) of Mathematics II B

BSM 301**:COb1:** Be able to apply the concept and techniques of basic probability theory to detertmine probability of occurring of an event in real life problem.

BSM 301:COb2: Be able to understand the applications of Binomial, Poisson , Uniform, Exponential, Normal distribution function**.**

BSM 301:COb3: Be able to find mean, variance, standard deviation, median and mode for different distribution function as well as for different type of sample.

BSM 301:COb4: Be able to understand the application of sampling distribution and Simple idea of Bivariate distribution ; Correlation and Regression ; and Simple problems .

BSM 301**:COb5:** Be able to understand the application of margfinal distribution.

BSM 301:COb6: Be able understand the ensembles and difference between statistics and mathematics.

Course Outcome (CO's) of Mathematics II B

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
BSM 301:CO1	Learn basic probability theory to deal with problems with engineering science.	**K3:** Applying
BSM 301: CO2	Learn about Random variables (discrete and continuous) ; Probability mass function ; Probability density function and distribution function. Distributions : Binomial, Poisson , Uniform, Exponential, Normal, t & 2χ and their application.	**K3:** Applying
BSM 301:CO3	Learn about Expectation & Variance (t & 2χ excluded); Moment generating function ; Reproductive Property of binomial; Poisson and Normal Distribution (Proof not required). Transformation of random variables (one variable); Chebychev inequality (statement) and problems. Binomial approximation to Poisson distribution and Binomial approximation to Normal distribution (statement only); Central Limit Theorem (statement) Law of large numbers (Weak law); and theirSimple applications.	**K4:** Analyzing
BSM 301:CO4	Learn about Population: Sample ; Statistic; Estimation of parameters (Consistent and 18L Unbiased) ; Sampling distribution of sample mean and sample variance (proof not required). Point estimate ; Maximum likelihood estimate of statistical parameters (Binomial, Poisson and Norma distribution). Interval estimation .	**K4:** Analyzing

BSM 301:CO5	Learn about Simple & composite hypothesis ; Critical region; Level of Significance ; Type 4L I and Type II Errors ; Best Critical Region ; Neyman–Parson Theorem (Proof not required); Application to Normal Population ; Likelihood Ratio Test (Proof not required) ; Comparison of Binomial Populations ; Normal Populations ; Testing of Equality of Means ; 2χ-test of Goodness of Fit (application only). Simple idea of Bivariate distribution ; Correlation and Regression ; and Simple problems .	**K3: Applying**
BSM 301:CO6	Classify and leaern the difference between real analysis and complex analysis.	**K4: Analyzing.**s

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	3	3	--	--	--	--	--	--	--	--	3	2	--
CO2	3	3	3	3	--	--	--	--	--	--	--	--	2	1	--
CO3	3	3	2	2	-	--	--	--	--	--	--	--	2	1	--
CO4	3	2	2	1	-	--	--	--	--	2	1	1	2	2	1
CO5	2	2	2	1	-	--	--	--	--	2	2	1	` 1	-	1
CO6	3	3	2	1	-	--	--	1	--	2	2	1	2	1	1
AVG	2.83	2.66	2.33	1.83	-	--	--	1.00	--	2	1. 6	1.00	2	1.4	1.00

University Syllabus:

Module	Content	Hrs/Unit
1.Probability	Random Experiment; Sample space; Random events; Probability of events . 10L Axiomatic definition of probability; Frequency definition of probability; Finite sample spaces and equiprobable measure as special cases ; Probability of non- disjoint events (Theorems). Counting techniques Applied to probability problems; Conditional probability; General Multiplication theorem ; Independent events; Bayes' theorem and related problems Random variables (discrete and continuous) ; Probability mass function ; Probability density function and distribution function. Distributions : Binomial, Poisson , Uniform, Exponential, Normal, t & 2χ . Expectation & Variance (t & 2χ excluded); Moment generating function ; Reproductive Property of binomial; Poisson and Normal Distribution (Proof not required). Transformation of random variables (one variable); Chebychev inequality (statement) and problems. Binomial approximation to Poisson distribution and Binomial approximation to Normal distribution (statement only); Central Limit Theorem (statement) Law of large numbers (Weak law); Simple applications.	26
2.Statistics :	Population: Sample ; Statistic; Estimation of parameters (Consistent and 18L Unbiased) ; Sampling distribution of sample mean and sample variance (proof not required). Point estimate ; Maximum likelihood estimate of statistical parameters (Binomial, Poisson and Norma distribution). Interval estimation .	18
3.Testing of Hypothesis :	Simple & composite hypothesis ; Critical region; Level of Significance ; Type 4L I and Type II Errors ; Best Critical Region ; Neyman–Parson Theorem (Proof not required); Application to Normal Population ; Likelihood Ratio Test (Proof not required) ; Comparison of Binomial Populations ; Normal Populations ; Testing of Equality of	9

	Means ; 2χ-test of Goodness of Fit (application only). Simple idea of Bivariate distribution ; Correlation and Regression ; and Simple problems .	

GATE syllabus mapping:

GATE syllabus content	**Mapping unit of university syllabus**
Bivrate distribution and bayes theorem	Module 2
Basic probability	Module 1
Continuous probability distribution	Module 2,3
Basic statistics	Module 4

RESOURCE

1. Reena Garg, Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishers. 2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

3. Michael Greenberg, Advanced Engineering Mathematics, Pearson.

4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.

5. Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning

6 . Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi.

7. E. L. Ince, Ordinary Differential Equations, Dover Publications.

8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, Mc-GrawHill.

Course Title: Data Structure & Algorithm Lab.	**Code: ES-CS391**
Type of Course: Lab	**Course Designation: Compulsory**
Semester: 3rd	**Contact Hours: 2P/week**
Continuous Assessment: 40 marks(PCA1 & PCA2)	**Final Exam: 60 Marks**
Writer: Course Coordinator	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Knowledge of C programming

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
ES-CS391.CO1	Define abstract data types using arrays and linked list.	KL1:Remembering
ES-CS391.CO2	Apply the different linear data structures like stack and queue to various computing problems.	KL3: Apply
ES-CS391.CO3	Explain different types of trees and apply them to problem solutions.	KL 5 :Evaluating
ES-CS391.CO4	Discuss graph Structure and understand various operations on graphs and theirapplicability.	KL6 : Creating
ES-CS391.CO5	Analyze the various sorting and searching algorithms.	KL4:Analyse
ES-CS391.CO6	Understand the hashing technique and hash functions.	KL2:Understand

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

	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	-	-	-	-	-	-	-	-	3	2	1	1
CO2	3	2	2	-	-	-	-	-	-	-	-	3	3	1	-
CO3	3	3	3	1	-	-	-	-	-	-	-	3	3	1	1
CO4	3	3	3	1	-	-	-	-	-	-	-	3	2	1	-
CO5	3	2	2	-	-	-	-	-	-	-	-	2	2	1	-
CO6	3	3	3	1	-	-	-	-	-	-	-	2	2	1	1
AVG	3	2.67	2.833	1	0	0	0	0	0	0	0	2.5	3	1	1

University Syllabus:

Unit	Content	Hrs/Unit
Module : Array	Exp 1: Implementation of array operations, Merging Problem Exp 2: Stacks :adding, deleting elements Circular Queue: Adding & deleting elements Exp 3: Queues adding, deleting elements Exp 4 Circular Queue: Adding & deleting elements Exp 5: Evaluation of expressions operations on Multiple stacks & queues Exp 6: Sparse Matrices : Multiplication, addition.	2 2 2 2 2 2
Module : Linked List	Exp 7: Implementation of linked lists: inserting, deleting, and inverting a linked list. Exp 8: Implementation of stacks & queues using linked lists. Exp 9: Polynomial addition, Polynomial multiplication	2 2 2
Module : Tree	Exp 10: Recursive and Nonrecursive traversal of Trees Exp 11: Threaded binary tree traversal, AVL tree implementation	2 2
Module : Sorting & searching	Exp 12: Application of sorting algorithms Exp 13: Application of searching algorithms Exp 14:Hash tables implementation: searching, inserting and deleting.	2 2 2

RESOURCES:

1. 1. Data Structure with C by SheymourLipschutz.

2.Data Structures using C by Reema Thareja .

Course Title: Electronics Devices Lab	Code: EC391
Type Of Course: Laboratory	Course Designation: Compulsory
Semester: 3rd	Contact Hours: 2P/week
Continuous Assessment: 40 Marks	Final Exam: 60 Marks
Writer: (Course Coordinator)	Approved by HoD (Convenor of DAB)

Pre-requisites: Fundamental knowledge on Physics and Electronics
Course Objective (COb's) of Electronics Devices Lab:

EC301:COb1: Be able to identify active and passive components for circuit design
EC301:COb2: Be able to characterize electrical properties of two-terminal active devices
EC301:COb3: Be able to calculate electrical properties of three-terminal active devices necessary for amplifier design
EC301:COb4: Be capable to analyze electro-optic properties of optoelectronic devices
EC301:COb5: Be able to design voltage regulator circuit using two-terminal active devices
EC301:COb6: Be capable to compute small-signal parameters of three-terminal junction devices

Course Outcome (CO's) of Electronics Devices Lab:

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC391:CO1	**Identify** passive and active components for analog circuit design	**K3:** Understanding
EC391:CO2	**Characterize** two-terminal active devices for required specification for estimating electrical performance	**K3:** Applying
EC391:CO3	**Compute** electrical characteristics of three-terminal active devices with required circuitry specifications and pre-defined input conditions for amplifier design	**K4:** Analyzing
EC391:CO4	**Analyze** efficiency of optoelectronic receiver under specific external input	**K4:** Analyzing
EC391:CO5	**Estimate** performance of voltage regulator using two-terminal active devices for RPS design	**K5:** Evaluating
EC391:CO6	**Evaluate** small-signal parameters for three-terminal junction devices for differential amplifier design	**K5:** Evaluating

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	-	2	-	-	1	3	1	-	-	3	1	-
CO 2	3	3	3	1	2	-	-	1	3	1	-	-	3	1	-
CO 3	3	3	3	2	2	-	-	1	3	1	-	-	3	1	-
CO 4	3	3	3	1	2	-	-	1	3	1	-	1	3	1	1

CO 5	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**1**	**3**	**1**	**-**	**1**	**3**	**1**	**1**
CO 6	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**1**	**3**	**1**	**-**	**1**	**3**	**1**	**1**
Avg	**3.00**	**3.00**	**3.00**	**1.40**	**2.00**	**--**	**--**	**1.00**	**3.00**	**1.00**	**--**	**1.00**	**3.00**	**1.00**	**1.00**

University Syllabus:

Experiments	Content	Hrs/Unit
1	Identifying and study of different components like resistor, capacitors, diodes, LED, Transistors, FET(JFET & MOSFET) etc	02
2	Study of different instruments used in the laboratories like, power supply, Oscilloscope, Multimeter etc	02
3	CHARACTERISTICS OF PN JUNCTION DIODE a) To Plot the Volt Ampere Characteristics of PN Junction Diode under Forward and Reverse Bias Conditions. b) To find the Cut-in voltage, Static Resistance, Dynamic Resistance for Forward Bias & Reverse Bias	02
4	CHARACTERISTICS OF ZENER DIODE & LOAD REGULATION a) To Obtain the Forward Bias and Reverse Bias characteristics of a Zener diode. b) Find out the Zener Break down Voltage from the Characteristics. c) To Obtain the Load Regulation Characteristics	02
5	COMMON BASE BIPOLAR TRANSISTOR CHARACTERISTICS a) To plot the Input and Output characteristics of a transistor connected in Common Base b) Configuration and to find the h – parameters from the characteristics	02
6	COMMON EMITTER BIPOLAR TRANSISTOR CHARACTERISTICS a) To plot the Input and Output characteristics of a transistor connected in Common Emitter b) Configuration and to find the h – parameters from the characteristics	02
7	Design self-bias BJT circuit	02
8	JFET drain & transfer characteristics (common source) a) Drain characteristics b) Transfer Characteristics. c) To find rd, gm, and μ from the characteristics	02
9	Study Characteristics of Photo transistor	02
10	Study Characteristics of LED & LDR	02

References:

1. Semiconductor Devices – D. A. Neamen – TMH
2. Solid State Electronic Devices – Streetman – PHI
3. Optoelectronic Devices - P. Bhattacharyya – PHI

Course Title: Digital System Design Lab.	Code: EC 392
Type of Course: Laboratory	Course Designation: Practical
Semester: 3rd	Contact Hours: 2P/week
Continuous Assessment: 40 marks	Semester Exam:60 marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisite: Basic Electronics Engineering Lab.

Course Outcomes (CO's) of Digital System Design Lab.

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC 392.CO1	Classify different logic gate ICs inspecting their truth table	K4 - Analyzing
EC392 .CO2	Solve Boolean functions in SOP and POS form to build logic circuits using logic gates	K3-Applying
EC392.CO3	Combine logic gates to design combinational circuits like MUX/DE-MUX/DECODER	K6 - Creating
EC 392.CO4	Demonstrate the state table of different Flip-flops to understand their functioning	K2 - Understanding
EC 392.CO5	Choose suitable flip-Flops to design Synchronous and Asynchronous Counters.	K6-Creating
EC 392.CO6	Apply logic circuit simulator/ software to develop combinational and sequential circuit.	K3 - Applying

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

	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	-	-	-	-	2	-	-	2	2	2	2
CO2	3	3	3	-	-	1	-	-	2	1	-	3	3	1	2
CO3	3	2	3	-	-	1	-	-	2	1	-	3	3	1	2
CO4	3	2	-	-	-	-	-	-	2		-	3	3	1	2
CO5	3	3	3	-	-	2	-	-	2	1	-	3	3	2	2
CO6	3	3	-	-	2	1	-	-	2	1	-	3	3	2	2
AVG	2.83	2.33	3	0	2	0.83	0	0	2	0.66	0	2.83	2.83	1.5	2.0

University Syllabus

Sl. No.	Name of Experiment	Hrs/Unit
1	Introduction to Digital Electronics Lab- Nomenclature of Digital Ics, Specifications, Study of the Data Sheet, Concept of Vcc and Ground, Verification of the Truth Tables of Logic Gates using TTL ICs.	**Total 30 Hrs**
2	Implementation of the Given Boolean Function using Logic Gates in Both Sop and Pos Forms.	
3	Verification of State Tables of Rs, J-k, T and D Flip-Flops using NAND & NOR Gates	
4	Implementation and Verification of Decoder/De-Multiplexer and Encoder using Logic Gates.	
5	Implementation of 4x1 Multiplexer using Logic Gates.	
6	Implementation of 4-Bit Parallel Adder Using 7483 IC.	
7	Design , and Verify the 4- Bit Synchronous Counter	
8	Design, and Verify the 4-Bit Asynchronous Counter.	
9	Simulation of MOS Inverter with different loads using PSPICE software.	
10	Simulation of CMOS Inverter for different parameters Kn, Kp as a design variable in suitable circuit simulator software.	
11	Design of a 4-bit Multiplexer using VHDL\Verilog	
12	Design of a decade counter using VHDL\Verilog.	
13	Design of a 3-input NAND gate and its simulation using suitable logic simulator	

RESOURCES:

1. Douglas L Perry, “VHDL: Programming by Example”, McGraw-Hill, 2002.
2. Charles H. Roth, Lizy Kurian John, “Digital systems design using VHDL”, Thomson, 2008.

Course Title: Environmental Science	**Code: MC381**
Type of Course: Theory	**Course Designation: Elective**
Semester: 3rd	**Contact Hours:**
Continuous Assessment: 60 Marks	**Final Assessment: 40 Marks**
Writer: Course Coordinator	**Approved by HoD (convenor of DAB)**

PRE-REQUISITES: Some basic knowledge of environmental protection and other extracurricular activities.

Course Objective:

MC381cob1.We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us.
MC381cob2. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times.

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Knowledge Level
MC381.CO1	Create awareness how small efforts can help to save environment.	Create	K6
MC381.CO2	Collaborate to sensitize students about the environmental issues	Collaborate	K6
MC381.CO3	Develop some proposals for waste disposal, environmental solutions	Develop	K6
MC381.CO4	Plan the principles of 3Rs, saving electricity	Plan	K5
MC381.CO5	Collaborate in in mass education program	Collaborate	K6
MC381.CO6	Understand about the different flora	Understand	K2

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1		1	1			1	1						1	1	
CO2		1	1			1	1						1	1	
CO3		1	1			1	1						1	1	
CO4		1	1			1	1						1	1	
CO5		1	1			1	1						1	1	
CO6		1	1			1	1						1	1	
AVG.	0	1	1	0	0	1	1	0	0	0	0	0	1	1	0

University Syllabus :

Idea of an activity-based course on environment protection is to sensitize the students on the

above issues through following two type of activities.

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation of

less waste, avoiding electricity waste

ii) Slogan making event

iii) Poster making event

iv) Cycle rally

v) Lectures from experts

(b) Actual Activities:

i) Plantation

ii) Gifting a tree to see its full growth

iii) Cleanliness drive

iv) Drive for segregation of waste

v) To live some big environmentalist for a week or so to understand his work

vi) To work in kitchen garden for mess

vii) To know about the different varieties of plants

viii) Shutting down the fans and ACs of the campus for an hour or so

Unit	Content
1	a) Creating awareness on how small efforts can help to save environment b) Participating in mass education programmes c) Proposal for cycling d) using biodegradable products e) Environmental awareness posters/slogan writing/assignment to reflect the critical thinking
2	a) Creating awareness on environmental issues b) renewable non-renewable energy, c) sustainable development goals d) air water soil pollution e) pollution and linkage to health f) posters/slogan writing/assignment to reflect the critical thinking
3	Proper methods of domestic waste disposal. Water management Developing solutions Cleanliness drive Environmental awareness posters/slogan writing/assignment to reflect the critical thinking

4	Plan the principles of 3Rs, saving electricity Resource conservation Preservation of nature- Marches, poster campaigns Alternative energy consciousness. saving electricity Water recycling water crisis posters/slogan writing to reflect the critical thinking
5	mass awareness Resource conservation – Awareness to be developed on water, energy, soil. Preservation of nature- Marches, poster campaigns Alternative energy consciousness. posters/slogan writing/assignments to reflect the critical thinking
6	Understanding diversity of plants Plantation and beautification- Plantation of trees, their preservation and upkeep, posters/slogan writing/assignment to reflect the critical thinking

Assessment:

1. Attendance: 15

2. Assignment: 15

3. Posters : 15

4. Participation in events: 15

5. Assesment by Teacher: 40

Suggested Text/Reference Books M.P. Poonia& S.C. Sharma, Environmental Studies, Khanna Publishing House, New Delhi, 2019

Course Title: Analog Communication	**Code: EC 401**
Type of Course: Theory	**Course Designation: Core**
Semester: 4th	**Contact Hours: 3P/week**
Continuous Assessment: 25 Marks **Attendance: 5 Marks**	**Final Exam: 70 Marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Signals & System

Course Outcomes (CO's) of Radar Engineering

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC401.CO1	Explain the fundamentals of Analog communication and necessity of modulation.	K2:Understanding
EC401.CO2	Explain time and frequency domain representation of amplitude modulated waveforms along with it's generation and detection techniques.	K5: Evaluating
EC401.CO3	Design a super-heterodyne receiver by choosing the appropriate components and frequency.	K6: Creating
EC401.CO4	Evaluate time and frequency domain representation of angle modulated waveform along with it's generation and detection techniques.	K5: Evaluating
EC401.CO5	Apply various Multiplexing techniques for efficient utilization of communication systems.	K3: Applying
EC401.CO6	Apply the knowledge of random variables and statistical analysis to evaluate the effect of Noise & other parameters for different systems in order to compare the performance of the different modulation methods.	K3: Applying

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
CO2	3	3	2	2	1	1	1	-	-	-	-	2	3	1	2
CO3	3	3	2	2	1	1	1	-	-	-	-	2	3	1	2
CO4	3	3	2	2	1	1	1	-	-	-	-	2	3	1	2
CO5	3	2	1	1	-	1	1	-	-	-	-	2	2	1	2
CO6	3	2	1	1	-	1	1	-	-	-	-	2	2		2
Avg	3.0	2.5	1.5	1.5	1.0	1.0	1.0	0	0	0	0	2.0	2.50	1.00	2.00

University Syllabus:

Unit	Content	Hrs/Unit
1: Continuous Wave Linear Modulation:	1. Elements of communication system - Transmitters, Transmission channels &receivers, Concept of modulation, its needs. Continuous Wave Linear Modulation: 2. Amplitude modulation (AM-DSB/TC): Time domain representation of AMsignal (expression derived using a single tone message), modulationindex, 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. 3. 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 andband-width.	8
2: Generation & Detection of Amplitude Modulation	1. Generation of AM: Concept of i) Gated and ii) Square law modulators, BalancedModulator. 2. Generation of SSB: Filter method, Phase shift method 3. Demodulation of AM signals: Detection of AM by envelope detector,Synchronous detection for AM-SC, Effects of Frequency & Phase mismatch,Corrections. 4. Principle of Super heterodyne receivers: Super heterodyningprinciple, intermediate frequency, Local oscillator frequency, image frequency.	8
3: Angle Modulation	1. Frequency Modulation (FM) and Phase Modulation (PM): Time andFrequency domain representations, Spectralrepresentation of FM and PM for a single tone message, Bessel's functions andFourier series.; Phasor diagram; 2. Generation of FM & PM: Narrow and Wide-band angle modulation, Basicblock diagram representation of generation of FM & PM, Concept of VCO &Reactance modulator 3. Demodulation of FM and PM: Concept of frequency discriminators, Phase LockedLoop	8
4: Multiplexing&Noise in Communication systems	1. Frequency Division Multiplexing, Time Division Multiplexing, (FDM) 2. Stereo - AM and FM: Basic concepts with block diagrams 3. Random Signals and Noise in Communication SystemNoise Temperature, Signal-to-Noise ratio, Whitenoise, thermal noise, Figure of Merit. 4. Noise performance in Analog Communication systems: SNRcalculation for DSB/TC, DSB-SC, SSB-TC, SSB-SC & FM 5. Conditional probability, communication example, joint probability, statisticalindependence, random variable-continuous and discrete, cumulative distributionfunction, probability density function – Gaussian, Rayleigh and Rician.	8

GATE syllabus:

GATE syllabus content	Mapping unit of university syllabus
Amplitude modulation and demodulation	**Unit- 1**
Angle modulation and demodulation	**Unit-3**
Spectra of AM and FM	**Unit- 1 & Unit-3**
Super heterodyne receivers	**Unit-2**
Circuits for analogue communications	**Unit 2, Unit 3**
Basics of TDMA, FDMA and CDMA	**Unit-4**

RESOURCES:

1. Dr. S Sharma: Communication Systems. Katson Books
2. B P Lathi: Modern Digital & Analog Communication System. Oxford University Press
3. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc-Graw Hill
4. Singh &Sapre—Communication Systems: 2/e, TMH
5. Proakis& Salehi Fundamentals of Communication Systems- Pearson
6. e-book : P Ramakrishna Rao: Analog Communication: TMH Publication
7: NPTEL: Analog Communication Course by Prof: Goutam Das

Course Title: Analog Electronic Circuits	**Code: EC 402**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 4th	**Contact Hours: 3L/week**
Continuous Assessment: 25 marks **5 Marks attendance**	**Final Exam- 70 Marks**
Writer: (Course Coordinators)	**Approved by HOD (Convenor of DAB)**

Pre-requisites: Electronic Devices.

Course Outcomes (CO's) of Analog Electronic Circuits

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC 402.CO1	**Understand** working principle of diode circuits for signal shaping applications.	**K2:Understanding**
EC402.CO2	**Apply** concept of biasing, low frequency and high frequency model of transistor to obtain the voltage and current gain, input-output impedance and stability of signals.	**K3:Applying**
EC402.CO3	**Analyze** the effect of feedback in transistor amplifier circuit and oscillator circuits to obtain the frequency response characteristics, signal gain, bandwidth of signals and conditions for sustained oscillation etc.	**K4: Analyzing**
EC402.CO4	**Understand** different power amplifier to obtain their working principle and conversion efficiency.	**K2: Understanding**
EC402.CO5	**Design** ideal operational amplifier and filter circuits for signal processing applications, and analog application.	**K6: Creating**
EC402.CO6	**Explain** different electronic circuit using multi-vibrator for various applications.	**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**	**3**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**1**
CO2	**3**	**3**	**3**		**-**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**1**
CO3	**3**	**3**	**3**	**1**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**2**
CO4	**3**	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**1**
CO5	**3**	**3**	**3**	**1**	**-**	**3**	**3**		**-**	**-**	**-**	**2**	**3**	**3**	**2**
CO6	**3**	**3**	**3**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**2**
Avg	**3**	**2.83**	**2.83**	**1**	**0**	**2.33**	**2.6**	**0**	**0**	**0**	**0**	**2.67**	**3.00**	**2.50**	**1.50**

University Syllabus:

Module	Content	Hrs/Unit

1: Discrete Analog Circuits	Diode Circuits: Rectifiers, Clipper, Clamper Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.	**10**
2. Transistor frequency responses and feedback topology	High frequency transistor models, frequency response of single stage and multistage amplifiers, cascade amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.	**6**
3.Oscillators	Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load.	**6**
4. Differential and operational amplifier	Differential amplifier: Basic structure and principle of operation, calculation of differential gain, Common mode gain, CMRR and ICMR. OP-AMP: Basic structure and characteristics, inverting and non-inverting amplifiers. OP-AMP applications: Integrator and differentiator, summing amplifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.	**10**

GATE syllabus mapping

Gate Syllabus content	Mapping Unit of University Syllabus
Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability	Module 1
Mid-frequency small-signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational;	Module 2
Oscillators: criterion for oscillation	Module 3
Simple op-amp circuits; Active filters,single-transistor and op-amp configurations; Function generators, wave-shaping circuits.	Module 4

RESOURCES:

1. Electronic Devices and Circuit Theory, R. L. Boylestad, L. Nashelsky, Pearson, 11th Ed., 2015.
2. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press,1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11 Publishing,Edition IV
5. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, JohnWiley, 3rd Edition
6. A.K. Maini, Analog Electronics, Khanna Publishing House, New Delhi, AICTRecommended-2018.

Course Title: Microprocessor & Microcontroller	Code: EC403
Type of Course: Theory	Course Designation: Core
Semester: 4th	Contact Hours: 3L/week
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
EC403.CO1	***Generalize*** the architectural view and operating modes of microprocessor for explaining Intel 8085 and 8086.	L3: Apply
EC403.CO2	***Apply*** the acquired skills of assembly language programming for developing problem solving algorithms.	L3: Apply
EC403.CO3	***Design*** proper electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.	L6: Create
EC403.CO4	***Correlate*** the working methodologies of microprocessor and microcontroller to gain comprehensive knowledge about architecture and addressing modes of Intel 8051.	L4: Analyze
EC403.CO5	***Explain*** the use of cache memory and virtual memory in the context of advanced architectural designing.	L2: Understand
EC403.CO6	***Compare*** recognized standards and design methodologies to select appropriate Microprocessor (8085 & 8086) and Microcontroller (8051, ARM) to meet specified performance requirements.	L5: Evaluate

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.	2.83	2.6	2	1.667	1	-	-	-	-	-	1	1.25	2.5	1.17	1

University Syllabus:

Module No.	Content	Hrs/Module
I	Microprocessors 8085 and 8086- Pin description, memory, data structure/ access. Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access (DMA), instruction sets of microprocessors (with examples of 8085 and 8086	**10L**
II	Interfacing with peripherals- timer, serial I / O, parallel I / O, A/D and D/A converters; Arithmetic coprocessors, System level interfacing design.	**8L**
III	Concepts of virtual memory, Cache memory; Advanced coprocessor architectures- 286, 486, Pentium; Microcontrollers 8051 systems- pin and port description.	**8L**
IV	Introduction to RISC processors; ARM microcontrollers interface design.	**6L**

RESOURCES:

Text Books:

T1.Microprocessor architecture, programming and application with 8085 – **R.S. Gaonkar** (Penram International Publishing, 1996) (strongly recommended)

T2. Microprocessors and microcontrollers **- N. Senthil Kumar, M. Saravanan and S.Jeevananthan** (Oxford university press).

T3. Computer Organization and Design The hardware and software interface.**DA Patterson and J H Hennessy**,(Morgan Kaufman Publishers).

T4 . **Kenneth J. Ayala**, The 8051 Microcontroller, Penram International Publishing, 1996.

Reference Books:

R1. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.

R2.Keneth Ayala, keneth. J. Ayala- The 8086 Microprocessor: Programming and interfacing the PC- West Pub.

Course Title: Design and Analysis of Algorithms	Code: ESCS401
Type of Course: Theory	Course Designation: Engineering Science
Semester: 4th	Contact Hours: 3L/week
Continuous Assessment: 30 Marks End Semester Exam: 70 marks	
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisites: Programming for Problem Solving (ES-CS201), Data Structure & Algorithms (ES-CS301)

Course Outcomes (CO's) of Design and Analysis of Algorithms

On completion of the course students will be able to

CO#	CO Statement	Bloom's Revised knowledge Level
CO1	**Analyze** time complexity of algorithms based on asymptotic analysis.	K4: Analyze
CO2	**Synthesize** divide-and-conquer algorithms to solve recurrence relation based problems	K6: Create
CO3	**Design** algorithms based on Greedy paradigm to reduce complexity of exhaustive search based approach	K6: Create
CO4	**Develop** Dynamic Programming algorithms to solve complex real world problems	K6: Create
CO5	**Compose** algorithms based on Brute force paradigm to solve computationally expensive problems	K6: Create
CO6	**Understand** the concept of Computability of algorithm and computability classes to analyze Approximation algorithms, Randomized algorithms	K2: Understand

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	3	2	2	2	2	-	-	-	-	3	3	1	1
CO2	3	3	3	3	3	3	2	-	-	-	-	3	3	2	1
CO3	3	3	2	3	3	3	2	-	-	-		3	3	2	1
CO4	3	3	3	3	3	3	2	-	-	-	-	3	3	2	1
CO5	3	3	3	3	3	3	2	-	-	-	-	3	3	2	1
CO6	3	3	3	3	3	3	2	-	-	-	-	3	3	2	1
AVG	3.00	3.00	2.83	2.83	2.83	2.83	2.00	0	0	0	0	3.00	3.00	2.00	1.00

University Syllabus:

Unit	Content	Hrs/Unit
1**:** Introduction:	Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds - best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.	8
2. Fundamental Algorithmic Strategies:	Brute-Force, Greedy,Dynamic Programming, Branchand-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics -characteristics and their application domains.	8
3. Graph and Tree Algorithms:	Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.	6
4: Tractable and Intractable Problems:	Computability of Algorithms, Computability classes - P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques	6
5. Advanced Topics	Approximation algorithms, Randomized algorithms, Class of problems beyond NP - P SPACE	4

RESOURCES:

Suggested books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms - E. Horowitz et al.
3. Design & Analysis of Algorithms – Gajendra Sharma, Khanna Publishing House.
4. Design and Analysis of Algorithm, AnanyLevitin,, Pearson

Suggested reference books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms—A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

Online :

1.Nptel : Design And Analysis Of Algorithms, MadhavanMukund, Chennai Mathematical Institute
2. .Nptel: Introduction To Algorithms Andanalysis, Prof.SouravMukhopadhyay, IIT Kharagpur
3. Nptel: Design And Analysis Of Algorithms, IIT Bombay

Course Title: Numerical Methods	**Code: BS-M401**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 4th	**Contact Hours: 2L/week**
Continuous Assessment: 25 marks	**Final exam: 70 marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Class XII Mathematics

Course Outcomes (CO's) of Numerical Methods

On completion of the course students will be able to

CO#	**CO Statements**	**Bloom's Revised Knowledge Level**
BS-M401.CO1:	**Understand**the different types of errors and real number representation to select the suitable numerical technique.	KL2: Understand
BS-M401.CO2:	**Apply** different interpolation techniques and numerical integration techniques to solve practical problems numerically.	KL3: Apply
BS-M401.CO3:	**Choose** suitable numerical technique for obtaining the numerical solutions of System of linear equations.	KL5: Evaluate
BS-M401.CO4:	**Analyze** different numerical techniques to find solutions of algebraic equations.	KL4: Analyze
BS-M401.CO5:	**Solve** ordinary differential equations using different numerical techniques.	KL3: Apply
BS-M401.CO6:	**Estimate** the various errors and approximations to justify the selection of numerical technique.	KL5: Evaluate

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	1	1	-	-	-	-	1	2	3	1	1
CO2	3	3	1	3	1	1	-	-	-	-	1	2	3	1	1
CO3	3	3	1	3	1	1	-	-	-	-	1	2	3	1	1
CO4	3	3	1	3	1	1	-	-	-	-	1	2	3	1	1
CO5	3	3	1	3	1	1	-	-	-	-	1	2	3	1	1
CO6	3	3	1	2	1	1	-	-	-	-	1	2	3	1	1
AVG	3	3	1	2.67	1	1	0	0	0	0	1	2	3	1	1

University Syllabus:

Unit	Content	Hrs/Unit
1	Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.	10
2	Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method.	8
3	Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method.	4

RESOURCES:

1. C.Xavier: C Language and Numerical Methods.
2. R.S. Salaria, Computer Oriented Numerical Methods, Khanna Publishing House.
3. Dutta & Jana: Introductory Numerical Analysis.
4. J.B.Scarborough: Numerical Mathematical Analysis.
5. Jain, Iyengar ,& Jain: Numerical Methods (Problems and Solution).

Course Title: Analog Communication Lab	Code: EC491
Type of Course: Lab	Course Designation: Practical
Semester: 4th	Contact Hours: 2P/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
EC491.CO1	**Examine** various analog modulation schemes in time and frequency domains.	K4: Analysing
EC491.CO2	**Measure** the transmission power of amplitude and frequency modulated signal.	K5: Evaluating
EC491.CO3	**Measure** distortion of the demodulated output of an AM signal.	K5: Evaluating
EC491.CO4	**Evaluate** different parameter related to PLL.	K5: Evaluating
EC491.CO5	**Analyse** FM demodulation.	K4: Analysing
EC491.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	1.33	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.	2
2	Measurement of output power with varying modulation index an AM signal(for	2

	both DSB- &SSB)	
3	Measurement of distortion of the demodulated output with varying modulation index of an AMsignal (for both DSB-SC & SSB).	2
4	Measurement of power of different frequency components of a frequency modulated signal &the measurement of the bandwidth.	2
5	Design and set up a PLL using VCO & to measure the lock frequency.	2
6	Design and set up a FM demodulator using PLL.	2
7	Measurement of SNR of a RF amplifier.	2
8	Measurement of selectivity, sensitivity, fidelity of a superheterodyne receiver.	2

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
6. https://www.etti.unibw.de/labalive/index/analogmodulation/

Course Title: NUMERICAL METHODS LAB	Code: BS-M491
Type of Course:Practical	Course Designation: Compulsory
Semester: 4th	Contact Hours: 2P/week
Continuous Assessment: 40 marks	Final Exam:60Marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Prerequisite Courses:

- Basic Engineering Mathematics knowledge
- Basic Coding knowledge

Course Outcomes (CO's) of Numerical Methods Lab

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
BS-M491.CO1	**Understand** the utilization of MATLAB/C/Python in solving different problems using suitable numerical methods.	KL2: Understanding
BS-M491.CO2	**Apply** fundamentals of interpolation techniques to solve practical problems numerically through software tools.	KL3: Applying
BS-M491.CO3	**Compare** different numerical integration techniques using software tools to solve practical problems.	KL4: Analyzing
BS-M491.CO4	**Choose** suitable numerical technique to find the numerical solutions of System of linear equations through software tools.	KL5: Evaluating
BS-M491.CO5	**Analyze** different numerical techniques to find solutions of algebraic equations through software tools.	KL4: Analyzing
BS-M491.CO6	**Solve** ordinary differential equations using different numerical techniques through software tools.	KL3: Applying

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	1	3	1	-	-	2	-	1	2	3	1	1
CO2	3	3	1	3	3	1	-	-	2	-	1	2	3	1	1
CO3	3	3	1	3	3	1	-	-	2	-	1	2	3	1	1
CO4	3	3	1	3	3	1	-	-	2	-	1	2	3	1	1
CO5	3	3	1	3	3	1	-	-	2	-	1	2	3	1	1
CO6	3	3	1	2	3	1	-	-	2	-	1	2	3	1	1
AVG	3	2.8333333	1.167	2.5	3	1	0	0	2	0	1	2	3.00	1	1

University Syllabus:

Unit	Content	Hrs/Unit
Assignment I	Assignments on 1. Newton forward /backward, 2. Lagrange's interpolation.	4
Assignment II	Assignments on numerical integration using 1. Trapezoidal rule, 2. Simpson's 1/3 rule, 3. Weddle's rule.	6
Assignment III	Assignments on numerical solution of a system of linear equations using 1. Gauss elimination 2. Gauss-Seidel iterations.	4
Assignment IV	Assignments on numerical solution of Algebraic Equation by 1. Regular-Falsimethod 2. Newton Raphson'smethod	4
Assignment V	Assignments on ordinary differential equation: 1. Euler's Method 2. Runga-Kutta method.	4
Assignment VI	Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.	2

RESOURCES:

Text Books:

T1. R.S. Salaria, Computer Oriented Numerical Methods, Khanna Publishing House.
T2. Jain, Iyengar ,& Jain: Numerical Methods (Problems and Solution).

Reference Books:

R1. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.

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

E1. https://www.mathworks.com

Course Title: Analog Electronic Circuits Lab	Code: EC492
Type of Course: Lab	Course Designation: Sessional
Semester: 4th	Contact Hours: 2P/week
Continuous Assessment: 100 marks	
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisites: Electronic Devices.

Course Outcomes (CO's) of Analog Electronic Circuits Lab

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC492.CO1	Justify the performance of diode based circuits for signal shaping, power supply applications.	**K5:Evaluating**
EC492.CO2	Analyzethe characteristics of BJT amplifiers for investigating the gain and efficiency of the amplifier.	**K4:Analyzing**
EC492.CO3	Estimate the efficiency of complementary symmetry class B push pull power amplifiers for high power applications.	**K5: Evaluating**
EC492.CO4	Design oscillator circuits using BJT to generate specific frequency of a signal for audio, radio frequency etc. applications.	**K6:Creating**
EC492.CO5	Analyzethe electrical characteristics of MOSFETs with required circuitry specifications for designing amplifier circuits.	**K4:Analyzing**
EC492.CO6	Construct common Source JFET/MOSFET amplifiers circuits for estimating the efficiency of the amplifier.	**K6:Creating**

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	**3**	**3**	**2**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**3**	**2**
CO 2	**3**	**3**	**3**	**3**	**-**	**2**	**2**	**-**	**3**	**-**	**-**	**3**	**3**	**3**	**2**
CO 3	**3**	**3**	**2**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**3**	**2**
CO 4	**3**	**2**	**2**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**3**	**2**
CO 5	**3**	**3**	**1**	**2**	**-**	**1**	**1**	**-**	**3**	**-**	**-**	**3**	**3**	**2**	**1**
CO 6	**3**	**2**	**2**	**3**	**-**	**2**	**2**	**-**	**3**	**-**	**-**	**3**	**3**	**3**	**2**
Avg	**3**	**2.66**	**2**	**2.83**	**-**	**2.33**	**2.33**	**-**	**3**	**-**	**-**	**3**	**3.00**	**2.83**	**1.83**

University Syllabus:

Unit	Content	Hrs/Unit
1: Discrete Analog Circuits	**Ex-1**Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).	2
	Ex-2. Design and set up the following rectifiers with and without filters and to determine ripple factor and rectifier efficiency: (a). Full Wave Rectifier (b). Bridge Rectifier	2
	Ex-3. Design and set up the BJT common emitter amplifier using voltage divider bias with and without feedback and determine the gain- bandwidth product from its frequency response.	2
	Ex-4. Set-up and study the working of complementary symmetry class B push pull power amplifier and calculate the efficiency	2
	Ex-5. Realize BJT Darlington Emitter follower with and without bootstrapping and determine the gain, input and output impedances	2
	Ex-6. Conduct an experiment on Series Voltage Regulator using Zener diode and power transistor to determine line and load regulation characteristics.	2
	Ex-7. Design and set-up the following tuned oscillator circuits using BJT, and determine the frequency of oscillation. R-C Phase shift Oscillator/Wien Bridge Oscillator	2
	Ex-8. Plot the transfer and drain characteristics of n-channel MOSFET and calculate its parameters, namely: drain resistance mutual conductance and amplification factor.	2
	Ex-9. Design, setup and plot the frequency response of Common Source JFET/MOSFET amplifier and obtain the bandwidth.	2

RESOURCES:

1. "Electronic Devices and Circuit Theory" by R. L. Boylestad, L. Nashelsky, Pearson, 11th Ed., 2015
2. "Digital Circuits" -Vol-I & II by D.Ray Chaudhuri, Platinum Publishers, 2nd Ed., 2013

Course Title: Microprocessor and Microcontroller Lab	Code: EC493
Type of Course: Lab	Course Designation: Practical
Semester: 4th	Contact Hours: 2P/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 Microprocessor and Microcontroller Lab
On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC493.CO1	Understand the fundamentals of assembly language programming of 8085 microprocessor & 8051 microcontroller.	L2: Understand
EC493.CO2	Apply the programming knowledge for data transfer, arithmetic and logical operations in 8085 & 8051.	L3: Application
EC493.CO3	Develop the programs for different applications and execute them using 8085 trainer kit/simulator on PC.	L6: Create
EC493.CO4	Develop the programs for subroutine calls and IN/OUT instructions using 8255 PPI.	L6: Create
EC493.CO5	Develop the programs for different applications and run them using 8051 trainer kit/simulator on PC.	L6: Create
EC493.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):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	-	-	-	-	-	-	-	1	-	1	1	1
CO 2	3	3	3	2	1	-	-	-	-	-	1	1	3	2	1
CO 3	3	3	3	2	1	-	-	-	-	-	2	2	3	1	1
CO 4	3	2	1	1	1	-	-	-	-	-	-	-	1	1	1
CO 5	3	1	3	1	1	-	-	-	-	-	1	1	1	1	1
CO 6	3	3	3	3	1	-	-	-	-	-	1	2	3	1	1
Avg.	2.84	2.5	2.5	1.8	1	-	-	-	-	-	1.2	1.5	2	1.17	1

University Syllabus:

Unit	Content	Hrs/Unit
1	Familiarization with 8085 & 8051simulator on PC.	Total 30 Hrs
2	Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the KIT. Assignments based on above	
3	**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	
4	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.	
5	Study of timing diagram of an instruction on oscilloscope.	
6	Interfacing of 8255: Keyboard and Multi-digit Display with multiplexing using 8255	
7	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.	
8	Serial communication between two trainer kits	

RESOURCES:

Text/Reference Books:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.
5. Keneth Ayala, keneth. J. Ayala- The 8086 Microprocessor: Programming and interfacing the PC- West Pub.

Course Title Soft Skills Development Lab	**Code: HS-HU 481**
Type Of Course: Practical	**Course Designation: Compulsory**
Semester: 4th	**Contact Hours: 3L/week**
Continuous Assessment: 40 Marks	**Final Exam: 60 Marks**
Writer: Course Coordinator	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Fundamental knowledge in **English Language** in **Intermediate** Level

Course Objective (COb's) of English Language Laboratory:

HS-HU 481 COb1	**Enabling the students recognize Soft Skill Pattern Formal / inInformal Situation**
HS-HU 481 COb2	**Enabling the students develop effective Communication**
HS-HU 481 COb3	**Enabling the students recognize Communication Cues in Informal Situation**
HS-HU 481 COb4	**Enabling the students recognize Communication Cues in Formal Situation**
HS-HU 481 COb5	**Enabling the students improve their Critical Reading Skill**
HS-HU 481 C Ob6	**Enabling the students improve their Technical Writing Skill**

Course Outcome (CO's) of English Language Laboratory:

On successful completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
HS-HU 481 CO1	**Comprehend Spoken and Written varieties of English Language**	**K2:** Understanding
HS-HU 481 CO2	**Apply Rules of English Grammar Skill for Speaking correctly in Formal & Informal Setting**	**K3:**Applying
HS-HU 481 CO3	**Apply Rules of English Grammar Skill for Business Presentation**	**K3:**Applying
HS-HU 481 CO4	**Analize Rules of English Grammar Skill for effective Inter-personal Communication**	**K4:**Analyzing
HS-HU 481 CO5	**Apply English Soft for Responding Verbally & Nonverbally in Business Situation**	**K3:**Applying
HS-HU 481 CO6	**Demonstrate Soft Skill for Business Spoken and Written Communication**	**K-6**: Creating

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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	**2**	-	**2**	1	3	-	**2**	0	1	1
CO2	-	-				**2**	-	**2**	**1**	**3**	-	**2**	**0**	**1**	**1**
CO3	-	-				**2**		**2**	**1**	**3**	-	**2**	**0**	**1**	**1**
CO4	-	-				**2**		**2**	**1**	**3**	-	**2**	**0**	**1**	**1**
CO5	-	-				**2**		**2**	**1**	**3**	-	**2**	**0**	**1**	**1**
CO6	-	-				**2**		**2**	**1**	**3**	-	**2**	**0**	**1**	**1**
Avg	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**1**	**3**	**0**	**2**	**0**	**1**	**1**

University Syllabus:

Module	Contents	Hrs /Unit
Module 1:	SoftSkills&InterpersonalCommunication An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft SkillDevelopment. Interpersonalrelations;communicationmodels,processandbarriers;teamcommunication;developinginterpersonalrelationshipsthrougheffectivecommunication;listeningskills;essentialformalwritingskills;corporate communicationstyles–assertion,persuasion,negotiation	08
Module 2:	SWOT&CreativeThinking DiscoveringtheSelf;Setting Goals;Beliefs,Values,Attitude,Virtue. DevelopingPositiveThinkingandAttitude;DrivingoutNegativity;MeaningandTheoriesofMotivation;EnhancingMotivationLevels.	06
Module 3:	CorporateCommunication PublicSpeaking:Skills, Methods,StrategiesandEssentialtipsforeffective publicspeaking. GroupDiscussion:Importance,Planning,Elements,Skillsassessed;Effectivelydisagreeing,Initiating,SummarizingandAttainingtheObjective. Interview&PresentationSkills:InterviewerandInterviewee–in-depthperspectives.Before,DuringandAftertheInterview. TipsforSuccess:Types,Content,AudienceAnalysis,EssentialTips–Before,DuringandAfter,OvercomingNervousness.	10
Module 4:	Non-VerbalCommunication&PersonalityDevelopment ImportanceandElements;B	06

	odyLanguage.Concept, Essentials,Tipsc Meaning,Nature,Features,Stages,Models;LearningSkills;AdaptabilitySkills.	
Module 5	***BusinessEtiquette &TeamWork*** ConceptofTeams;Buildingeffectiveteams;ConceptofLeadership andhoningLeadershipskills.Meaning, Nature,Features,Stages, Models;LearningSkills;AdaptabilitySkills.	04

IELTS Syllabus Mapping:

IELTS syllabus content	Mapping unit of university syllabus
English Vocabulary: Application	Module1
English **Reading Skill**	Module 2
English **Writing Skill**	Module 2 & 4
English **Effective Communication**	Available 1. 5, 4 & 3
English Grammar in Use	Module 3

RESOURCES:

Text Books

i. **Board of Editors. Contemporary Communicative English fur Technical Communication. Pearson Education. New Delhi**

ii. **D Sudharani. English Language Laboratory. Pearson Education. New Delhi**

Reference Books

- ManagingSoftSkills for PersonalityDevelopment– edited byB.N.Ghosh,McGrawHill India,2012.
- EffectiveCommunicationand SoftSkills,NitinBhatnagar,PearsonEducationIndia, 2011
- EnglishandSoftSkills–S.P.Dhanavel, Orient BlackswanIndia,2010.

EffectiveBusinessCommunication, KulbhushanKumar,KhannaPublishingHouse, 2021

Course Title: Biology for Engineers	Code: BS B-401
Type Of Course: Theory	Course Designation: Compulsory
Semester: 4TH SEMESTER	Contact Hours: 3L/week
Continuous Assessment: 25 Marks Attendance : 5 Marks	Final Exam: 70 Marks
Writer: **Course Coordinator**	Approved by HoD

PRE-REQUISITES:
Higher secondary Biology knowledge

COURSE OBJECTIVE:

1. Introduction to Basics of Biology which includes cell, the unit of life, Different types of cells and classification of living organisms.
2. Understanding what are biomolecules present in a cell, their structure function and their role in a living organism. Application of certain bio molecules in Industry.
3. Brief introduction to human physiology, which is essential for bioengineering field.
4. Understanding the hereditary units, that is genes and genetic materials (DNA and RNA) present in living organisms and how they replicate and pass and preserve vital information in living organisms.
5. How biology can be applied in our daily life using different technology, for production of medicines to transgenic plants and animals to designing new biotechnological products

Course Outcome (CO's) of Biology

On completion of the course students will be able to

CO Number	CO statement	Bloom's Revised Taxonomy
CO1	**Describe** how biological observations of 18th Century that lead to major discoveries & fundamental importance of observations in any scientific inquiry by taking examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor	**K2**
CO2	**Understand** that classification per se is not what biology is all about but to highlight the underlying criteria, such as morphological, biochemical and ecological aspects	**K2**
CO3	**Apply** the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring	**K3**
CO4	**Understand** that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine & how DNA as a genetic material in the molecular basis of information transfers.	**K2**
CO5	**Classify** enzymes and different mechanisms of enzyme action, biological processes at the	**K4**

	reductionistic level.	
CO6	**Identify** microorganisms and microscopes	**K3**

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

Correlation levels 1, 2 or 3 as defined below :

1 : Slight(Low) 2 : Moderate(Medium) 3 : Substantial(High) If there is no correlation, put " '- "

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3		1	1									2		
CO 2	3		2	1			3	1					2	1	
CO 3	2		1				2						2	1	
CO 4	3		1	1			1						2	1	
CO 5	3		1	1									2		
CO 6	3		1										2		
AVERAGE	2.83	0	1.16	1	0	0	2	1	0	0	0	0	2	1	0

University Syllabus:

Unit	Content	Hrs/Unit
1	To convey that Biology is as important a scientificdiscipline as Mathematics, Physics and ChemistryBring out the fundamental differences betweenscienceandengineeringbydrawingacomparison between eye and camera, Bird flyingandaircraft.Mention the most excitingaspect of biology as an independent scientificdiscipline. Whywe need to studybiology? Discusshowbiologicalobservationsof18th Centurythat lead to majordiscoveries.Examples from Brownian motion and the origin ofthermodynamicsbyreferring to theoriginal observation of Robert Brown and JuliusMayor. These examples will highlight thefundamentalimportanceofobservationsinanyscientific inquiry.	2

2	The underlying criterion, such as morphological,biochemicalor ecological behighlighted.Hierarchy of life forms at phenomenological level.Acommon threadweaves this hierarchyClassification.Discussclassificationbasedon (a)cellularity-Unicellularormulticellular(b)ultrastructure-prokaryotesoreucaryotes.(c) excretion energy and Carbon utilisation -Autotrophs,heterotrophs,lithotropes(d)Ammoniaexcretion–aminotelic, uricoteliec,ureotelic (e)Habitata- acquatic or terrestrial (e) Moleculartaxonomy- three major kingdoms of life. Agivenorganismcancomeunderdifferentcategory based on classification. Model organismsfor the study of biology come from differentgroups.E.coli, S.cerevisiae,D.Melanogaster,C.elegance,A.Thaliana,M.musculus	3
3	To convey that "Genetics is to biology whatNewton's laws are to Physical Sciences" Mendel'slaws, Concept of segregation and independentassortment.Concept ofallele.Genemapping,Geneinteraction,Epistasis.MeiosisandMitosis betaught asa part ofgenetics.Emphasis to be give not to the mechanics of celldivision nor the phases but how geneticmaterialpasses from parentto offspring.Concepts of recessiveness and dominance.Concept of mapping of phenotype to genes.Discuss about the single gene disorders inhumans.Discusstheconceptofcomplementationusinghumangenetics.	4
4.	Biomolecules: To convey that all forms of life havethesame building blocks and yetthemanifestations are as diverse as one can imagineMolecules of life. In this context discussmonomericunits andpolymeric structures.Discuss about sugars, starch and cellulose. Aminoacidsand proteins.Nucleotides andDNA/RNA.Two carbonunitsandlipids.	4
5	Enzymes**:** To convey that without catalysis lifewouldnot have existed on earthEnzymology:Howto monitorenzyme catalysedreactions.How doesan enzymecatalysereactions? Enzyme classification. Mechanism ofenzymeaction. Discuss atleast twoexamples. Enzyme kinetics and kineticparameters. Why should we know theseparameterstounderstandbiology?RNAcatalysis.	4
6	Information Transfer:The molecular basis ofcoding and decoding genetic information isuniversalMolecular basis of information transfer. DNA as ageneticmaterial.Hierarchy of DNA structure-from single stranded to double helix tonucleosomes.Conceptofgenetic code.Universalityanddegeneracyofgenetic code.Define gene in terms of complementation andrecombination.	4
7	structure. Primary secondary, tertiary andquaternarystructure.Proteins asenzymes,transporters,receptorsandstructuralelements.	5
8	Metabolism**:** The fundamental principlesofenergy transactions are the same in physical andbiologicalworld.Thermodynamicsas appliedto biologicalsystems.Exothermic and endothermic versusendergonic and exergoinc reactions. Concept ofKeqandits relation tostandardfree energy. Spontaneity. ATP as an energy currency. Thisshould include the breakdown of glucose toCO_2 + H_2O (Glycolysis and Krebs cycle) andsynthesis of glucose from CO_2 and H_2O(Photosynthesis).Energyyieldingandenergyconsuming reactions. Concept of Macromolecular analysis**:** How to analysebiological processes at the reductionist levelProteins-structure andfunction.Hierarch inprotein Energycharge	4
9	Microbiology Concept of single celled organisms.Concept of species and strains. Identification andclassificationofmicroorganisms. Microscopy.Ecological aspects ofsingle celledorganisms. Sterilization and media compositions.Growth kinetics.	3

RESOURCES:

T1. Biology for Engineers, Dr.Sandhimita Mondal, Dr. Arnab Ganguli

R1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.;Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd