RCC INSTITUTE OF INFORMATION TECHNOLOGY
APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO MAKAUT, W.B.
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A UNIT OF RCC INSTITUTE OF TECHNOLOGY AN AUTONOMOUS SOCIETY OF DEPARTMENT OF HIGHER EDUCATION, GOVT. OF WEST BENGAL

COURSE BOOKLET
B.TECH,4TH YEAR
2017-2021BATCH

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

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

Department of Electronics and Communication Engineering

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

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About Department:

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

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

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

Vision of the Department

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

Mission of the Department

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

Program Outcome (POs) of the Department

Engineering Graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend andwrite effective reports and design documentation, make effective presentations, and giveand receive clear instructions.

11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs) of the Department

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

Program Specific Outcomes (PSOs)

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

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

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

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

Odd Semester(VII)

Sl.No.	Paper Code	Paper Name	Credit
1.	EC701	Wireless Communication & N/W	3
2.	EC702	Microelectronics & VLSI Designs	3
3.	EC703	A.RF & Microwave Engineering B.Optical Communication & N/W C.Computer Networks D.FPGA & Reconfigurable Computing	3
4.	EC704	A.RadarEngg B.Embedded Systems C.Biomedical Instrumentation	3
5.	F.E. EC705	A.Artificial Intelligence(CSE) B.Robotics(CSE) C.Database Management System D.Power Electronics	3
6.	HU781	Group Discussion	2
7.	EC792	VLSI Design Lab	2
8.	EC793	A.RF & Microwave Engineering Lab B.Optical Communication & N/W Lab C.Computer Networks Lab D.FPGA & Reconfigurable ComputingLab	2
9.	F.E. EC795	A.Artificial Intelligence(CSE) B.Robotics(CSE) C.Database Management System D.Power Electronics	2
10.	EC781	Industrial Training	2
11.	EC782	Project Part I	2

EvenSemester(VIII)

Sl.No.	Paper Code	Paper Name	Credit
1.	HU801A	Organizational Behaviour	2
2.	EC801	A.Smart Antenna B.Digital Image Processing C.Satellite Communication and Remote Sensing	3
3.	EC802	A.Neural Network &Application(CSE) B.Material Science & Engineering(Mat.Sc) C.Renewable Energy(EE) D.Audio& Speech Processing(CSE)	3
4.	EC881	Design Lab/Industrial Problem Related Practical Training	4
5.	EC893	Grand Viva	3
6.	EC882	Project Part II	6

Odd Semester(VII) 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
EC701	2.67	2.5	2.5	2.2	2.75	0	2.5	0	0	0	0	2.17	3	1	1.67
EC702	2.83	2.6	2	2.6	1.83	1	1	0	0	0	0	2	2.67	1.3	2.5
EC703A	3	3	2.4	1	2	0	2	1	0	0	0	2	1.83	1	1
EC705C	1.6	2.2	2.2	1.6	1.6	3	1	2	0	0	1.5	1	1.67	1.2	2
EC704A	3	2.83	2.33	1.5	1.33	1.3	1.7	0	0	0	0	2	2.67	1.5	2
EC704B	3	2	2.33	0	2	2	0	0	0	0	0	1.5	2.33	2	1.5
EC781	2	2.67	1.5	1.75	1.67	2.3	3	1.5	2	1.67	1.8	2	3	2.5	3
EC782	3	3	2	1	2.5	2	2	2.5	2.75	3	3	2.6	3	2.8	2.67
EC792	3	2.66	2.16	2.33	2.5	0	1.2	0	1.16	0	0	3	3	2.66	2.17
EC793A	3	2.67	3	2.2	2.17	1	1	1	2	1	0	1.25	2.83	1.67	1
EC795C	3	2	3	0	3	0	0	0	2.25	0	3	3	1.83	1.2	1.83
HU781	2.25	1.83	2.5	2.6	2.6	2.5	2	2.33	3	3	2	3	2.25	3	2.66

EvenSemester(VIII) 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
EC801B	3	2.83	2.33	2.67	2.67	2.5	2	0	0	0	0	3	2.83	2	1
EC801C	3	2.83	2.5		2.5	2	2.2	0	0	0	0	3	3	2.66	3
EC802B	3	1.6	1.66	0	0	2.33	2.5	0	0	0	0	3	2.83	2.33	1
HU801A	3	0	1	0	1	3	3	0	1	1	3	0	1	1	1.17
EC881	3	3	3	1	0	1	0	2	3	1	0	1	2	2	1
EC882	3	3	2.5	3	2.5	0	0	3	3	3	3	2.83	2.8	3	2.83
EC 893	2	2.75	2.4	3	2.5	2	2	2	2	2	0	3	2.66	2	3

Course Title: Wireless Communication and Networks	Code: EC701
Type of Course: Theory	Course Designation: Compulsory
Semester: 7th	Contact Hours: 3L/week
Continuous Assessment: 25 Marks Attendance : 5 Marks	Final Exam: 70 Marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisites: Fundamental knowledge on communications

Course Objective (COb's) of Wireless communication and networks:

EC701:COb1: An understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.

EC701:COb2: An ability to compare recent technologies used for wireless communication.

EC701:COb3: An ability to explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks.

EC701:COb4: An ability to explain multiple access techniques for Wireless Communication

EC701:COb5: An ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless network

Course Outcomes (CO's) of Wireless communication and networks

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC701.CO1	**Understand** the concept of wireless communication system to demonstrate cellular structure, frequency reuse, cell splitting, capacity enhancement techniques for cellularnetworks, channel assignment schemes.	K2: Understanding
EC701.CO2	**Discuss**about characteristics of wireless channel and propagation path loss models to estimate different types of fading effects.	K6: Creating
EC701.CO3	**Analyze**the different types of mobile wireless communication systems to examine modern evolution strategies of wireless network.	K4: Analyzing
EC701.CO4	**Define** the conceptof multiple access technologies in cellular communication to exhibit the efficiency.	K1: Remembering
EC701.CO5	**Understand** different architecture and access mechanisms for CDMA, WLAN, wireless broad band networks to explain different applications in wireless communication.	K2: Understanding
EC701.CO6	**Analyze** different types of mobile internet protocol to examine tunneling and routing process for accessing external PDN.	K4: Analyzing

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	2	2	-	1	-	-	-	-	-	-	-	2	3	-	2
CO2	2	2	-	-	-	-	-	-	-	-	-	1	3	-	1
CO3	3	3	3	3	3	-	3	-	-	-	-	3	3	1	2
CO4	3	-	-	2	2	-	2	-	-	-	-	2	3	-	1
CO5	3	-	2	2	3	-	2	-	-	-	-	2	3	1	2
CO6	3	3	-	3	3	-	3	-	-	-	-	3	3	-	2
AVG	2.67	2.50	2.50	2.20	2.75	0	2.50	0	0	0	0	2.17	3.00	1.00	1.67

University Syllabus:

Module	Content	Hrs/Unit
Module 1: Cellular Structure	Cellular Mobile Wireless Networks: Systems and Design Fundamentals: Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes – Fixed channel, Dynamic channel and Hybrid channel, mobility management location management and handoff management, handoff process, different types of handoff. [6L] Characteristics of wireless channel and propagation path loss models: Different Multi-path propagation mechanisms, Multi-path effects on mobile communication, Fading, different types of fading, small and large scale fading, slow and fast fading, narrowband and wideband fading, Inter symbol interference, fast fading model, Doppler effect due to velocity of mobiles, Rayleigh envelop, free space propagation model, two ray ground reflection model, log distance path loss model, log normal shadowing model, macro and micro cell propagation models, types of base stations and mobile station antennas. [6L]	12
Module 2:Modern Mobile Wireless Communication Systems	Modern Mobile Wireless Communication Systems Evolution strategies – First Generation (1G) to Fourth Generation (4G), Personal Area Networks :PAN, Low Tier Wireless System: Cordless Telephone, Second Generation (CT2), Digital European Cordless Telecommunications (DECT), Public wide-area Wireless Networks: 1 G to 3G cellular networks. [2L] Multiple Access Technologies in cellular communication, Time division multiple access (TDMA), narrowband and wideband TDMA, synchronous and asynchronous TDMA, Frequency division multiple access (FDMA), Code Division Multiple Access (CDMA), Direct-sequence CDMA, spread spectrum technique, spectral efficiency of different wireless access technologies: Spectral Efficiency in FDMA system, Spectral Efficiency in TDMA system, Spectral Efficiency for DS-CDMA system. [3L] Cellular Communication Networks and Systems Second generation (2G) Network: Global system for mobile communication (GSM): Architecture and Protocols Air Interface, GSM spectrum, GSM Multiple Access Scheme, GSM Channel Organization, Traffic Channel multi-frame, Control (Signaling) Channel Multi-frame, Frames, Multi-frames, Superframes and Hyper-frames, GSM Call Set up Procedure, Location Update Procedure, Routing of a call to a Mobile Subscriber. [3L] The concept of packet data services The 2.5 G General Packet Radio Services: GPRS Networks Architecture, GPRS Interfaces and Reference Points, GPRS Mobility Management Procedures, GPRS Attachment and Detachment Procedures, Session Management and PDP Context, Data Transfer through GPRS Network and Routing, The IP Internetworking Model. [3L]	11
Module 3: CDMA, WLAN	Overview of CDMA systems: IS-95 Networks and 3G – The Universal Mobile Telecommunication System (UMTS) CDMA based IS-95 Systems, forward link and reverse link for IS-95, handoff process in CDMA based IS-95 network. UMTS Network Architecture –Release 99, UMTS Interfaces, UMTS Network Evolution UMTS Release 4 and 5, UMTS FDD and TDD, UMTS Channels, Logical Channels, UMTS Time Slots. [3L] Wireless Local Area Networks (WLAN): IEEE 802.11 Standards and Protocols IEEE 802.11 standards, WLAN family, WLAN transmission technology, WLAN system architecture, Collision Sense Multiple Access with Collision Detection (CSMA/CD) and CSMA collision avoidance (CSMA/CA), Frequency Hopping Spread Spectra, 802.11 PHY and MAC layers, IEEE 802.11 Distributed Coordination function (DCF) and Point coordination function (PCF), Back off algorithm, Virtual carrier sense, MAC frame format. Security and QoS issues, WLAN applications. [4L] Wireless Broadband Networks and Access, Evolution of broadband wireless, IEEE 802.16 standards : WiMAX , Spectrum Allocation, IEEE 802.16 Standard Architecture, Overview of WiMAX PHY, IEEE 802.16 MAC Layer, IEEE 802.16 Scheduling Services, Unsolicited Grant Service (UGS), Real-time Polling Service (rtPS), Non-realtime Polling Service (nrtPS), Best Effort (BE) Overview of 3G Long Term Evolution (3G LTE) for broadband wireless communication, Orthogonal Frequency Division Multiple Access (OFDMA). [3L]	10
Module 4:Mobile Internet Protocol	Mobile Internet Protocol: Basic Mobile IP, Mobile IP Type-MIPV4 and MIPv6, Mobile IP: Concept, Four basic entities for MIPv4, Mobile IPv4 Operations, Registration,	3

	Tunneling, MIPv4 Reverse Tunneling, MIPv4 Triangular Routing, Configuring PDP Addresses on Mobile Station, Mobility Classification, Seamless Terminal Mobility Management, Limitations of current TCP/IP networks for mobility support, Mobility solution, Accessing External PDN through GPRS/UMTS PS Domain, Transparent Access, Use of Mobile IP for Non-transparent access, Dynamically accesses IP address from External Network. [3L]	

RESOURCES:

1. Wireless Networks: Applications and Protocols, T. S. Rappaport, Pearson Education
2. Wireless Communication and Networks : 3G and Beyond, I. SahaMisra, TMH Education.
3. Wireless Communications : Principles and Practice, T.S.Rappaport, PHI Learning.
4. Wireless Communications, A. Goldsmith, Cambridge University Press.

Course Title: Microelectronics & VLSI Designs	Code: EC702
Type Of Course: Theory	Course Designation: Compulsory
Semester: 7th	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-requisite: Knowledge about MOS, MOS-Characteristics, MOS Gates , Basic Electronics, solid state device principles.

Course Objective (CObs) of Microelectronics & VLSI Designs :

EC702:CObs1: Be able to apply VLSI design principles in understanding of different IC technology
EC702:CObs2: Be able to understand the evolving technology associated with VLSI chip fabrication.
EC702:CObs3: Be able to analyze and design C-MOS circuits using modeling techniques.
EC702:CObs4: Be capable of evaluating different parameters associated with designing of C-MOS inverters.
EC702:CObs5: Be able to design and evaluate digital C-MOS circuits, latches, registers, finite state machines.
EC702:CObs6: Be able to analyze and design practical analog circuits with C-MOS logic.

Course Outcome (CO's) of Microelectronics & VLSI Designs:
On completion of the course students will be able to

CO#	CO Statements	Bloom's Revised Knowledge Level
EC702.CO1:	**Explain**VLSI Design concept along with design principles to provide appropriate understanding of VLSI chips.	(K2)-**Understanding**
EC702.CO2:	**Explain**different Microelectronic process in Silicon Semiconductor technology for chip Fabrication	(K2)-**Understanding**
EC702.CO3:	**Develop**the techniques for effective and efficient modelling for Basic C-MOS technology.	(K3)- **Applying**
EC702.CO4:	**Recall**the knowledge of Basics of C-MOS and C-MOS inverter characteristics	(K1)- Remembering
EC702.CO5:	**Apply**the knowledge of C-MOS digital logic design to implement combinational & sequential logic circuits.	(K3)- **Applying**
EC702.CO6:	**Analyze**different basic building blocks of analog VLSI chips and their applications.	(K4)-**Analyzing**

Mapping **of CO with PO's and PSO's (Course Articulation Matrix):**

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

AVERAGE	**2.833**	**2.6**	**2**	**2.6**	**1.833**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**2.67**	**1.33**	**2.50**

University Syllabus:

Module	Content	Hrs/Unit
Module 1: Introduction to VLSI Design:	Recapitulation of Conductor, Insulator & Semiconductor with special emphasis on the concept of energy bands and band-gaps, E-k diagramsfor direct and indirect band-gap semiconductors [**2L**] Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioral, Structural) [**4L**]	06
Module 2: Micro-electronic Processes for VLSI Fabrication	Silicon Semiconductor Technology- An Overview, Wafer processig [**1L**] Oxidation, Epitaxial deposition, Ion-implantation & Diffusion [**1L**] Cleaning, Etching [**1L**] Photo-lithography – Positive & Negative photo-resist [**1L**] Basic CMOS Technology – (Steps in fabricating CMOS) [**1L**] Basic n-well CMOS process, p-well CMOS process, Twin tub process [**1L**] Silicon on insulator [**1L**] Layout Design Rule: Stick diagram with examples [**2L**] Layout rules [**1L**]	10
Module 3: CMOS for Digital VLSI Circuits	Recapitulation of MOS [**2L**] CMOS, CMOS inverter characteristics [**1L**] CMOS logic circuits, NAND & NOR Gates [**1L**] Complex logic circuits **[1L]** CMOS Full Adder **[1L]** CMOS Transmission GATE **[1L]** Advanced CMOS Logic circuits; Sequential CMOS logic circuits **[1L]** SR Latch circuit, clocked JK Latch/ Master-Slave JK **[1L]** CMOS D-latch & Edge triggered flip-flop **[1L]**	10
Module 4: Analog VLSI Circuits	Analog VLSI design steps **[1L]** Basic building blocks of Analog VLSI chips **[1L]** MOS switch **[1L]** Active load / resistors, Voltage dividers **[1L]** CMOS Current source & sink; CMOS Voltage references/voltage dividers [Basic circuits only] **[1L]** CMOS Differential amplifier; Output amplifiers [Basic circuits only] **[1L]** CMOS OPAMP **[1L]** Switched capacitor filter **[1L]**	08

GATE syllabus mapping:

GATE syllabus content	Mapping unit of university syllabus
MOS capacitor, MOSFET basics, 2 terminal MOS, MOS working regions	Module 3
BJT and MOSFET amplifiers: biasing, ac coupling, small signal analysis, frequency response. Current mirrors and differential amplifiers.	Module 4
logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders	Module 3, 4
latches and flip-flops, counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay	Module 3

Machine instructions and addressing modes, ALU, data-path and control unit, instruction pipelining	Not available in University syllabus

References:

1. Digital Integrated Circuits, Demassa& Ciccone, John Willey &Sons .
2. Modern VLSI Design: system on silicon, Wayne Wolf; Addison Wesley Longman Publisher
3. Basic VLSI Design, Douglas A. Pucknell& Kamran Eshranghian, PHI
4. Digital Integrated Circuit, J.M.Rabaey, Chandrasan, Nicolic, Pearson Education.
5. CMOS Digital Integrated Circuit, S.M.Kang&Y.Leblebici, TMH.
6. Modern VLSI Design, Wayne Wolf, Pearson Education.

Course Title: RF & Microwave Engg	**Code: EC703A**
Type Of Course: Theory	**Course Designation: Optional**
Semester: 7th	**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 EM Theory

Course Outcome (CO's) of RF & Microwave Engg:

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC703A:CO1	**Analyze** two and three dimensional unbounded and bounded transmission lines to interpret the field pattern.	**K4: Analyzing**
EC703A:CO2	**Compute** the power output at different terminals of passive microwave multi-port components to examine the scattering parameters.	**K4: Analyzing**
EC703A:CO3	**Characterize** the high-frequency vacuum tube devices for high-power applications.	**K4: Analyzing**
EC703A:CO4	**Evaluate** the RF performance of high-frequency semiconductor devices for low-power applications.	**K5: Evaluating**
EC703A:CO5	**Measure** the circuit parameters of microwave components using appropriate experimental set-up to measure the output power.	**K5: Evaluating**
EC703A:CO6	**Discuss** the noise performance of high-frequency amplifier based on design considerations to explain the characteristic behaviour of the system	**K6: Creating**

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	2	-	-	-	-	2	2	1	1
CO2	3	3	3	1	-	-	2	-	-	-	-	2	2	1	1
CO3	3	3	2	1	-	-	2	-	-	-	-	2	2	1	1
CO4	3	3	2	1	-	-	2	-	-	-	-	2	2	1	1
CO5	3	-	-	-	2	-	2	-	-	-	-	2	1	1	1
CO6	3	3	2	1	-	-	2	1	-	-	-	2	2	1	1
AVG	**3**	**3**	**2.4**	**1**	**2**	**-**	**2**	**1**	**-**	**-**	**-**	**2**	**1.83**	**1**	**1**

University Syllabus:

Module	Content	Hrs/Unit
Module 1: Introduction&Microwave Waveguide and Waveguide Resonator	RF & Microwave Spectrum, Typical applications of RF and Microwave, Safety considerations [1L] Rectangular Waveguide- Design consideration, TE& TM modes, TE10 mode analysis [2L] Cut-off frequency, propagation constant, intrinsic wave impedance, phase and group velocity, power transmission, attenuation, waveguide excitation, wall current [2L]; Introduction of circular waveguide; Rectangular waveguide resonator- Design consideration, resonant frequency, Q-factor, excitation [2L].	07
Module 2: Planar Transmission line Micro-strip lines	Coplanar waveguide [1L], Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the above mentioned lines[2L]	03
Module 3: High frequency Circuit Elements	Difference in High frequency and relatively low frequency behavior of Lumped circuit components [1L]. Miniaturization and Design of Lumped components at High RF [2L]. Realization of reactive elements as Waveguide and Planar Circuit components [1L].	04
Module 4: Waveguide Passive Components and their S-matrix Representation N-port networks	Properties of S matrix, Transmission matrix & their relationships[1L] Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magic tee, hybrid ring, Circulators, Isolators[4L]; Design procedure of filter (maximally flat and equal ripple) using insertion loss method-specification, low-pass prototype design, scaling and conversion, implementation [3L].	08
Module 5: Microwave Tubes	Electron beam & Field interaction for energy exchange in resonant (two cavity klystron, Reflex Klystron, Magnetron)[2L] Non-resonant (TWT &BWO) microwave active devices: Typical characteristics & applications (only physical explanation is required, no mathematical derivation required)[2L]	04
Module 6:Semiconductor Microwave devices	TED (Gunn diode) [1L] Avalanche Transit Time (IMPATT) device, Schottky diode, PIN diode-characteristics & applications[2L] Microwave bipolar transistor[1L] Microwave field effect transistor(MESFET)[2L]	05
Module 7:Microwave Amplifier Design	Basic consideration in the design of RF amplifier- Transistor S-parameter, Stability[1L] matching network, noise figure[1L] Matching network design using lumped elements and L-Section. Brief introduction to NBA, LNA[2L]	04
Module 8: Typical Microwave Test Bench & measurement	VSWR meter, Tunable detector, Slotted line and Probe detector, Frequency meter, Network analyzer [1L], Measurement of VSWR – low, medium and high[1L] Measurement of power: low, medium and high [1L] Frequency measurement[1L]	04

RESOURCES:

1. Microwave Engineering, 3Rd Ed David M. Pozar, Willey & Sons Inc.
2. Microwaves, K C Gupta, New Age Publishers.
3. Microwave Engineering, A Das & S Das, TMH.

4. Microwave Devices & Circuits, SY Liao, Pearson Education /PHI
5. Microwave Engineering-Passive Circuits, PA Rizzi , Pearson Education.
6. Foundation of Microwave Engineering, 2ed edition, Robert E Collin, McGraw Hill, Inc.
7. Microwave Devices & Circuit Design , GP Srivastava & VL Gupta, PHI
8. https://onlinecourses.nptel.ac.in

Course Title: Radar Engineering	**Code: EC704A**
Type of Course: Theory	**Course Designation: Elective**
Semester: 7th	**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: Antenna and EM Theory

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
EC704A.CO1	**Explain** different radar types and parameters	K2: Understanding
EC704A.CO2	**Evaluate** different parameters related to RADAR performance	K5: Evaluating
EC704A.CO3	**Analyse**different RADAR types and their applications	K4: Analyzing
EC704A.CO4	**Analyse**different types of RADAR signal	K4: Analyzing
EC704A.CO5	**Compare** different type of RADAR clutter	K2: Understanding
EC704A.CO6	**Explain** different RADAR sub systems	K2: Understanding

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	3	3	-	1	-	1	1	-	-	-	-	2	2	1	2
CO2	3	3	2	2	1	-	-	-	-	-	-	2	3		2
CO3	3	3	3	2	2	2	2	-	-	-	-	2	3	2	2
CO4	3	3	2	2	1	1	-	-	-	-	-	2	3	1	2
CO5	3	2	-	1	-	1	2	-	-	-	-	2	2	2	2
CO6	3	3	-	1	-	-	-	-	-	-	-	2	3		2
AVG	3	2.8	2.3	1.5	1.3	1.3	1.7	0	0	0	0	2.0	2.7	1.5	2.0

University Syllabus:

Unit	Content	Hrs/Unit
1: Introduction to Radar	1. Historical background, radar terminology, radar band designations, Radar block diagram, Transmitted power, pulse-repetition frequency, radar cross section 2. Radar equation: detection of signals in noise and signal-to-noise ratio, Probabilities of detection & False alarm, integration of radar pulses, distributed targets 3. Antenna parameters & system losses, introduction to radar clutter.	6

2: Radar Types	1. Pulse radars and CW radars, Advantages of coherent radar, Doppler effect, Doppler radar 2. MTI, Delay-line cancellers, blind speeds, staggered PRFs, Digital filter bank, limitations of MTI 3. Tracking with radar, monopulse tracking, conical scan, limitation to tracking accuracy	8
3: Radar signals & clutter	1. Basic radar measurement, theoretical accuracy of radar measurements, Range and velocity ambiguities, the ambiguity diagram 2. Pulse compression-principles, the matched filter, chirp waveforms, Waveform design: nonlinear FM, phase codes, waveform generation and compression 3. Descriptions of land & sea clutter, statistical models for surface clutter, detection of targets in clutter.	10
4: Devices and Radar Systems	1. Radar transmitter: Solid-state RF power source, Magnetron, other RF power sources 2. Radar receiver: Super heterodyne receiver, receiver noise figure, duplexers & diplexers, Receiver protectors 3. Applications: Electronic Warfare: ESM, ECM, ECCM; super resolution, IFM, types of jammers, Stealth and counter-stealth: stealth techniques for aircraft and other target types, low frequency and UWB radar, System design examples	8

RESOURCES:

1. Introduction to Radar Systems-3/E, M. I. Skolnik, Tata McGrawhill
2. Principles of Modern radar system, M. H. Carpentier, Artech House
3. Fundamentals of radar signal processing, M. I. Richards, McGraw-Hill
4. Handbook of radar measurement, Barton, David & Ward, H. R, Artech House
5. Radar Systems Analysis and Design using MATLAB, B.R.Mahafza, 3rd Edition, CRC Press, 2013
6. https://onlinecourses.nptel.ac.in/noc19_ee58/preview
7. http://faculty.nps.edu/jenn/EC4610/Vol1v7.2.pdf

Course Title: Embedded Systems	Code: EC704B
Type of Course: Theory	Course Designation: Elective
Semester: 7th	Contact Hours: 3P/week
Continuous Assessment: 25 marks	Final Exam:70Marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisites: Computer Architecture,Digital Electronics

Course Outcomes (CO's) of Embedded Systems
On completion of the course students will be able to

CO Number	CO Statements	Bloom's Revised Knowledge Level
EC704B.CO1	**Define** Embedded systems and various designing metrics to find the difference with general purpose computing system.	**K1:Define**
EC704B.CO2	**Understand** the concept of hardware architecture of associated processors to interface different peripheral devices and communication buses.	**K2: Understanding**
EC704B.CO3	**Identify** the fundamental issues in Hardware software co-design, different programming models, Unified Modelling Language for Embedded System development.	**K3: Applying**
EC704B.CO4	**Analyze** different types of Real Time Operating Systems and its components to examine the qualities of good RTOS.(K4)	**K4:Analyzing**
EC704B.CO5	**Understand** the Examples of Embedded System to summarize the popular microcontrollers, sensors, actuators used in Embedded Systems.	**K2:Understanding**
EC704B.CO6	**Employ** the programming concepts required for developing embedded system .	**K4:Analyzing**

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	-	-	-	-	1	2	2	1
CO2	3	-	2	-	-	2	2	-	-	-	-	1	1	2	1
CO3	3	2	3	-	-	2	2	-	-	-	-	2	3	2	2
CO4	3	-	2	-	-	3	3	-	-	-	-	2	2	3	2
CO5	3	-	2	-	-	1	2	-	-	-	-	1	3	1	1
CO6	3	2	3	-	-	2	2	-	-	-	-	2	3	2	2
AVG	3	2	2.33	0	0	2	2	0	0	0	0	1.5	2.33	2	1.5

University Syllabus:

Unit	Content	Hrs/Unit
Module1	Introduction to Embedded System : Embedded system Vs General computing systems, History of Embedded systems, Purpose of Embedded systems, Microprocessor and Microcontroller, Hardware architecture of the real time systems.	5
Module 2	Devices and Communication Buses: I/o types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols, parallel communication network using ISA, PCI, PCT-X, Intrnet embedded system network protocols, USB, Bluetooth.	10
Module 4	Program Modelling Concepts ; Fundamental issues in Hardware software co-design, Unified Modelling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.	5
Module 5	Real Time Operating Systems : Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS.	8
Module 6	Examples of Embedded System : Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc. Popular microcontrollers used in embedded systems, sensors, actuators.	6
Module 7	Programming concepts and embedded programming in C, C++, JAVA.	4

RESOURCES:

Text Books:

1.Introduction to Embedded Systems : Shibu K. V. (TMH)
2. Embedded Systems :Rajkamal (TMH)

Reference Books:

1. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)
2. Embedded Systems : L. B. Das (Pearson)
3. Embedded System design : S. Heath (Elsevier)
4. Embedded microcontroller and processor design: G. Osborn (Pearson)

Course Title: Data Base Management System	Code: EC705C
Type of Course: Theory	Course Designation: Compulsory
Semester: 7th	Contact Hours: 3L/week
Course Coordinator	

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Knowledge Level
EC705C.CO1	Describe the basic concept of database and different database models along with database languages like DDL, DML etc, Data Abstraction, and Data Independence.	Remember	K1
EC705C.CO2	Identify different approaches for solving queries such as Relational algebra, Tuple and domain relational calculus, considering the query optimization strategies, and different normal forms for relational database normalization.	Apply	K3
EC705C.CO3	Evaluate the applications of different storage strategies such as Indices, B-trees, hashing	Evaluate	K5
EC705C.CO4	Understand the transaction processing and concurrency control strategies including ACID property, serializability of scheduling, locking and timestamp-based schedulers, Database recovery.	Understand	K2
EC705C.CO5	Analyze the database security approaches including authentication, authorization and access control, DAC, MAC and RBAC models, intrusion detection, SQL injection etc.	Analyze	K4
EC705C.CO6	Explain the advanced concepts related to DBMS such as object oriented and object relational databases, logical databases, web databases, distributed databases, data warehousing and data mining.	Understand	K2

Mapping of COs with POs and PSOs:

	PO 1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	1	1	-	-	-	-	-	-	1	1	-	-
CO2	2	-	2	2	-	-	1	-	-	-	-	-	2	1	2
CO3	-	2	2	2	2	-	-	2	-	-	1	-	2	1	2
CO4	1	3	3	1	2	-	-	-	-	-	-	-	2	2	2
CO5	1	2	-	2	1	-	-	-	-	-	2	-	2	1	2
CO6	2	2	2	2	2	3	-	-	-	-	-	-	1	1	2
AVG .	1.6	2.2	2.2	1.6	1.6	3	1	2	-	-	1.5	1.00	1.67	1.2	2

Course Title: Data Base Management System Lab	Code: EC795C
Type Of Course: Practical	Course Designation: Compulsory
Semester: 7th	Contact Hours: 3P/week
Course Coordinator	

COURSE OUTCOMES (COs)

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Knowledge Level
EC795C.CO1	Define an entity Relationship model into a relational database schema and to use a data definition language to implement the schema using DBMS.	Remember	K1
EC795C.CO2	Explain how to enforce integrity constraints on a database using a DBMS and learn how it is implemented.	Understand	K2
EC795C.CO3	Construct database query using SQL DML/DDL commands and learn to use different commands.	Apply	K3
EC795C.CO4	Analyze how to retrieve data from database.	Analyze	K4
EC795C.CO5	Explain how to implement relational algebra expressions and learn how to use aggregate functions, joins and subqueries.	Evaluate	K5
EC795C.CO6	Create how to program PL/SQL including stored procedures, stored functions, cursors, packages.	Create	K6

Mapping of COs with POs and PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	3	-	-	-	2	-	3	-	1	-	1
CO2	3	2	3	-	3	-	-	-	-	-	3	-	2	2	2
CO3	3	2	3	-	3	-	-	-	2	-	3	3	2	1	2
CO4	3	2	3	-	3	-	-	-	2	-	3	3	2	1	2
CO5	3	2	3	-	3	-	-	-	-	-	3	-	2	1	2
CO6	3	2	3	-	3	-	-	-	3	-	3	3	2	1	2
AVG.	3	2	3	0	3	0	0	0	2.25	0	3	3.00	1.83	1.2	1.83

Course Title: Industrial Training	Code: EC781
Type of Course: Sessional	Course Designation: Compulsory
Semester: 7th	Contact Hours: N/A
Assessment: 100 marks	
Writer: (Course Coordinator)	Approved by HoD (Convenor of DAB)

Pre-requisites: Knowledge of fundamental principles of Science & Engineering, Ethics and Environment, Management, Economics

Course Objectives (COb's) of Industrial Training

EC781:COb1: Be able to apply principles of Science and Engineering for solving cutting-edge industrial/academic problems
EC781:COb2: Be able to analyze assigned task within pre-defined time-limit under pseudo-working culturefor that specific organization
EC781:COb3: Be capable to interpret technical as well as commercial problems for recognizing solutions with acquired knowledge and expertise
EC781:COb4: Be judgmental to analyze impact of developed solution from ethical and environmental point-of-view
EC781:COb5: Be able to associate responsibility with technical efficiency for computing solution of assigned problem in sequential way
EC781:COb6: Be accomplished for judging the life-long impact of acquired expertise through technical and soft skills

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
EC781: CO1	**Apply** fundamental principles of engineering knowledge to understand cutting-edge technologies relevant to present industry/higher academia	**K3:** Applying
EC781: CO2	**Investigate** relevant technical problem within specified time limit under pseudo-working environment in smaller organizational structure	**K4:** Analyzing
EC781: CO3	**Interpret** intra-disciplinary/multidisciplinary techno-commercial problems for identifying prototype solutions with acquired skill and proficiency	**K4:**Analyzing
EC781: CO4	**Measure** potential impact of learned skill from ethical, social and environmental aspect for benefit of society	**K5:** Evaluating
EC781: CO5	**Integrate** responsibility, cooperation and synergetic collaboration for determining optimized solution of assigned engineering task in systematic manner	**K6:** Creating
EC781: CO6	**Evaluate** significance of newly adopted skill and technology as a part of possible life-long impact	**K6:** Creating

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	-	-	-	-	3	-	-
CO2	1	3	1	2	1	-	-	1	1	1	1	-	3	-	-
CO3	-	2	3	3	3	-	-	-	-	-	2	2	3	-	3
CO4	-	-	1	1	-	3	3	3	-	1	1	1	-	3	-
CO5	-	-	-	-	-	3	-	1	3	3	3	2	-	2	-
CO6	-	-	-	-	-	1	-	1	-	-	-	3	-	-	3
AVG	2.00	2.67	1.5	1.75	1.67	2.33	3.00	1.5	2.00	1.67	1.75	2.00	3.00	2.5	3.00

3: Strong 2: Medium 1: Weak

Course Title: Project Part-I	**Code: EC782**
Type of Course:	**Course Designation: Sessional**
Semester: 7th	**Contact Hours: 3P/week**
Continuous Assessment: 100 marks	
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Course Outcomes (CO's) of Project Part-I

On completion of the course students will be able to

CO number	CO Statements	Bloom's Revised Knowledge Level
EC782.CO1	**Select** the project ideas through literature survey and socital need to solve engineering problems.	**K3:Applying**
EC782.CO2	**Apply** engineering knowledge to define problem statement.	**K3:Applying**
EC782.CO3	**Develop** the design strategy for the complete project work.	**K6:Creating**
EC782.CO4	**Apply**the appropriate modern tools to execute the project work.	**K3:Applying**
EC782.CO5	**Explain** the project to evaluate the progress of the work.	**K5:Evaluating**
EC782.CO6	**Defend** the outcomes to justify the findings.	**K5:Evaluating**

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1		2	2	2	3			2
CO2	3								3			2
CO3	3	3			2				3			3
CO4	3				3							3
CO5									2	3	3	
CO6	3							3		3		3
AVG	3	3.00	2.00	1.00	2.50	2.00	2.00	2.5	2.75	3	3	2.60

Course Title: VLSI Design Lab	**Code: EC792**
Type of Course: Lab	**Course Designation: Sessional**
Semester: 7th	**Contact Hours: 3P/week**
Continuous Assessment: 40 marks	
Writer: Subhrajit Sinha Roy and Apu Mistry (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Analog Electronics, Digital Electronics

Course Outcomes (CO's) of VLSI Design Lab

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC792.CO1	**Understand** the utilization of spice and FPGA based simulation tools in VLSI circuit designing.	K2:Understand
EC792.CO2	**Develop** HDL code using FPGA to realize different combinational and sequential circuits.	K3: Develop
EC792.CO3	**Experiment with** MOS Inverter using PSPICE simulator to analyze its transient response.	K3:Experiment with
EC792.CO4	**Design** standard cell and transistors layouts to verify the transient behavior and V-I characteristics with power analysis.	K6:Disign
EC792.CO5	**Analyze** CMOS based logic gates through spice simulation tools to verify the behavioral characteristics.	K4: Analyze
EC792.CO6	**Design** register and counter based circuits to deploy these in data processing and data storing.	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	2	1	2	--	2	--	1	--	--	3	3	3	2
CO2	3	3	3	3	3	--	2	--	1	--	--	3	3	3	3
CO3	3	3	1	3	2	--	--	--	1	--	--	3	3	3	1
CO4	3	2	2	2	3	--	--	--	1	--	--	3	3	2	2
CO5	3	3	2	2	2	--	--	--	1	--	--	3	3	3	2
CO6	3	2	3	3	3	--	3	--	2	--	--	3	3	2	3
AVG	3	2.66	2.166	2.33	2.5	--	2.33	--	1.16	--	--	3	3	2.66	2.166

University Syllabus:

Unit	Content	Hrs/Unit
1: Spice Simulation	1. Familiarity with Spice simulation tool 2. Spice Simulation of Inverter, NAND, NOR Gates.	9
2: Basic and Combinational Circuits	1. Familiarity with EDA tools for VLSI design /FPGA based system design 2. Layouts, Transistors and tools. 3. Standard cell Design 4. Design of CMOS XOR/XNOR Gates. 5. Design of CMOS Full adder	12
3: Sequential circuits	1. Design of CMOS Flip flops (R-S ,D , J-K) 2. Design of 8 bit synchronous Counter 3. Design of 8 bit bi-directional register with tri-stated input/output bus 4. Design of a 12 bit CPU with few instructions and implementation and validation on FPGA	15

RESOURCES:

1. M.J.S Smith, “Application Specific Integrated circuits”, Pearson.
2. W. Wolf, “Modern VLSI Design: Systems on silicon”, Pearson
3. J. Bhasker, “A VHDL Primer”, BS Publications/ Pearson Education.
4. R. Jacob Baker, “CMOS Circuit Design, Layout and Simulation”, Wiley
5. https://www.seas.upenn.edu/~jan/spice/PSpice_UserguideOrCAD.pdf
6. http://vhdl-manual.narod.ru/books/programming_by_example.pdf
7. http://www.csit-sun.pub.ro/courses/cn1CA/Micro_DSCH_Manual.pdf

Course Title: RF & Microwave Engg Lab	Code: EC793A
Type of Course: Lab	Course Designation: Optional
Semester: 7th	Contact Hours: 3P/week
Continuous Assessment: 40 marks(PCA1 & PCA2)	Final Exam: 60 Marks
Writer: (Course Coordinator)	Approved by HoD (Convenor of DAB)

Pre-requisites: Knowledge on Physics, EM Theory, Programming software

Course Outcomes (CO's) of RF & Microwave Engg Lab:

On completion of the course, students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC793A: CO1	**Analyze** microwave test-bench for evaluating bounded propagation wave properties	K4: Analyzing
EC793A:CO2	**Analyze** network properties of RF propagating wave inside bounded media for examining field patterns	K4: Analyzing
EC793A:CO3	**Measure** the electrical characteristics of microwave active devices for high power applications	K5: Evaluating
EC793A:CO4	**Evaluate** negative resistance property of microwave semiconductor device for low power applications	K5: Evaluating
EC793A:CO5	**Estimate** RF wave propagation in pre-defined frequency spectrum using active components	K5: Evaluating
EC793A:CO6	**Evaluate** the RF properties of microwave multi-port passive networks and components for circuit 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	1	-	-	2	-	-	1	2	1	-	-	2	1	1
CO2	3	3	3	2	2	1	-	1	2	1	-	-	3	1	1
CO3	3	3	3	2	2	1	1	1	2	1	-	1	3	2	1
CO4	3	3	3	2	2	1	1	1	2	1	-	1	3	2	1
CO5	3	3	3	2	3	1	1	1	2	1	-	1	3	2	1
CO6	3	3	3	3	2	1	-	1	2	1	-	2	3	2	1
AVG	**3**	**2.67**	**3**	**2.2**	**2.17**	**1**	**1**	**1**	**2**	**1**	**-**	**1.25**	**2.83**	**1.67**	**1**

University Syllabus:

Module	Content	Hrs/Unit
Module 1	**Ex 1:** Determination of phase and group velocities in a waveguide carrying TE10 Wave from Dispersion diagram [ω−β Plot]. **Ex 2:** Measurement of unknown impedance using shift in minima technique using a waveguide test bench/ Measurement of the susceptance of an inductive and or a capacitive window using shift in minima technique using a waveguide test bench **Ex 3:** Study of the characteristics of a Reflex Klystron oscillator **Ex4:** Study of Gunn-oscillator Characteristics using X-band waveguide test bench. **Ex 5:** Measurement of coupling factor, Directivity, Insertion loss and Isolation of a Directional coupler using X-band waveguide test bench set up. **Ex 6:** Scattering matrix of a magic tee / E-plane tee / H-plane tee using waveguide test bench at X-band. **Ex 7**.Measuring of dielectric constant of a material using waveguide test bench at X-band.	3 3 3 3 3 3
Module 2	**Ex 1:** Simulation Study of filter (LPF, HPF,BPF) response.	3

RESOURCES:

1. ML Sisodia & GS Raghuvanshi , Basic Microwave Techniques and Laboratory Manual; Wiley Eastern Limited 1987
2. EL Gintzton Microwave Measurements, McGraw-Hill Book Co.
3. M Sucher and J Fox, Handbook of Microwave Measurements, Vol I, Wiley-Interscience Inc.
4. Mastering MATLAB – Hanselman& Littlefield – Pearson

Course Title: Group Discussion	**Code: HU-781**
Type of Course: Sessional	**Course Designation: Compulsory**
Semester: 7th	**Contact Hours: 3P/week**
Sessional Continuous Assessment: 25 Marks **Attendance : 5 Marks**	**Final Exam: 100 Marks**
Writer: (Course Coordinator)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Basic idea of technical communication

Course Outcomes:

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
HU781:CO1	**Adapt** active listening and speaking skills in every situation	**K6:**Creating
HU781:CO2	**Develop** team-building and team-management skill	**K3:**Applying
HU781:CO3	**Master** the technicalities of Group Discussion	**K3:**Applying
HU781:CO4	**Demonstrate** professional technical communication	**K2:**Understanding
HU781:CO5	**Develop** industry-ready attitude towards professional communication	**K3:**Applying
HU781:CO6	**Build** social awareness through group discussion sessions	**K6:**Creating

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			3			2	3	3	3	3	2	2	2
CO2		2	3	2			2	2	3	3	3	3		2	2
CO3	2	1		2	3	2	2	2	3	3	3	3	2	2	3
CO4	1	3	3	3	3	3	2	3	3	3	3	3	1	2	2
CO5		2	2	3	2	2	2	3	3	3	3	3	-	2	
CO6	3	2	2	3	2	3	2	2	3	3	3	3	2	2	2
AVG	2.25	1.83	2.5	2.6	2.6	2.5	2	2.33	3	3	3	3	1.75	2	2

University Syllabus:

University syllabus was not incorporated.

(Ref: https://makautwb.ac.in/syllabus/ECE_Final_Upto_4th_Year%20Syllabus_14.03.14.pdf)

Course Title: Material Science and Engineering	Code: EC802B
Type of Course: Theory	Course Designation: Elective
Semester: 8th	Contact Hours: 3P/week
Continuous Assessment: 25 marks	Final Exam:70Marks
Writer: (Course Coordinators)	Approved by HoD (Convenor of DAB)

Pre-requisites: Physics, Basic Electronics

Course Outcomes (CO's) of Material Science and Engineering
On completion of the course students will be able to

CO#	CO Statements	Bloom's Revised Knowledge Level
EC-802B.CO1	**Define** Structure of Solids to correlate the atomic binding, Bonds, Crystal Systems, Bravais Lattice Miller Indices.	**K1:define**
EC-802B.CO2	**Understand** the properties of solids to classify Crystalline, Polycrystalline and Amorphous Materials; Metals, Semiconductors and Insulators; and different crystal defects.	**K2:Understand**
EC-802B.CO3	**Analyze** different types of materials to categorizes Dielectric Material, magnetic materials and Superconductor and their application	**K4:Analyze**
EC-802B.CO4	**Understand** the concept of different Optical properties of the materials to demonstrate Absorption, Emission, Luminescence, Electro-optic and Acousto-optic effects, Photorefractive effects	**K2:Understand**
EC-802B.CO5	**Identify** the materials for Optical Communication, Data storage, for Display Devices	**K3: Identify**
EC-802B.CO6	**Understand** the properties of Metallic Glasses, Nano materials and their usefulness.	**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	2	1	-	-	1	2	-	-	-	-	3	3	1	1
CO2	3	1	2	-	-	2	2	-	-	-	-	3	3	2	1
CO3	3	1	3	-	-	3	3	-	-	-	-	3	3	3	1
CO4	3	2	1	-	-	3	3	-	-	-	-	3	3	3	1
CO5	3	2	1	-	-	2	2	-	-	-	-	3	3	2	1
CO6	3	-	2	-	-	3	3	-	-	-	-	3	2	3	1
AVG	3	1.6	1.66	0	0	2.33	2.5	0	0	0	0	3	2.83	2.33	1

University Syllabus:

Unit	Content	Hrs/Unit
Module1	Structure of Solids : Atoms and their binding, Bonds, Crystal Systems, Bravais LatticeMiller Indices, Crystalline, Polycrystalline and Amorphous Materials; Metals, Semiconductors and Insulators, Lattice defects-Qualitative ideas of point, line, surface and volume defects.	5
Module 2	Dielectric Propertis : Dielectric Polarization and Mechanism- Internal or local field, Dielectric Loss, Temperature and Frequency dependence of dielectric constant, Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric Materials and its Applications.	4
Module 4	Magnetic Properties : Elementary ideas of classification of magnetic materials – Diamagnetism, Paragnetism, Ferrognetism, Ferrimagnetism, Magnetic Domains.	2
Module 5	Superconductors : Basic concepts of superconductivity, Transition temperature, Meissner effect High-T superconductors, Haed and Soft Materials, SQUID.	3
Module 6	Optical properties : Absorption, Emission, Luminescence, Electro-optic and Acousto-optic effects, Photorefractive effects.	3
Module 7	Materials for Optical Communication : LED and Laser Materials, Optical Fibre.	3
Module 8	Materials for Data Storage : Magnetic Cores, Tapes, Disks, Hard disk, Floppy disk, Magneto-optic devices, Bubble memories, Magnetoelectronic Materials, CD, DVD, CCD.	5
Module 9	Materials for Display Devices : CRT, LED, LCD, TFT, Plasma Display.	3
Module 10	Advanced Materials : Metallic Glasses, Nanomaterials, etc.	2

RESOURCES:

Text Books:

1.Electrical Engineering Materials – A. J. Dekker (PHI)
2. Material Science and Engineering–A First Course – V. Raghavan (PHI Learning Pvt. Ltd)
3. Principles of Electronic Materials and Devices – S. Kasap (McGraw-Hill)

Reference Books:

1. An Introduction to Solid State Physics - Charles Kittel (John Wiley & sons)
2. An Introduction to Electronic Materials for Engineers – W. Kao, Z. Lee and N. Sannes (World Scientific)

Course Title: Project Part-II	**Code: EC882**
Type of Course:	**Course Designation: Sessional**
Semester: 8th	**Contact Hours: 12P/week**
Continuous Assessment: 100 marks	
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Course Outcomes (CO's) of Project Part-II

On completion of the course students will be able to

CO number	CO Statements	Bloom's Revised Knowledge Level
EC882.CO1	**Build** the hardware/software modules to develop the project work.	**K3:Applying**
EC882.CO2	**Compile** the different modules to finalise the work.	**K6:Creating**
EC882.CO3	**Measure** the project outcomes for evaluation of accomplishment.	**K5:Evaluate**
EC882.CO4	**Analyze** the performance of the project work.	**K4:Analyzing**
EC882.CO5	**Summarize** the entire project work in terms of report.	**K2:Understanding**
EC882.CO6	**Defend** the outcomes to justify the findings.	**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				3			3	3	3	3
CO2			2						3		3	3	2	3	3
CO3				3	2							2	3		2
CO4		3										3	3		3
CO5									3	3	3	3		3	3
CO6	3							3		3		3	3	3	3
AVG	3	3.00	2.50	3.00	2.50	0	0	3	3	3	3	2.83	2.8	3	2.83

Course Title: Digital Image Processing	**Code: EC801B**
Type of Course: Theory	**Course Designation: Free Elective**
Semester: 8th	**Contact Hours: 3L/week**
Continuous Assessment: 30 Marks **End Semester Exam: 70 marks**	
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Digital Signal Processing, Signals and Systems, Digital Communication

Course Outcomes (CO's) of Digital Image Processing

On completion of the course students will be able to

CO#	CO Statement	Bloom's Revised knowledge Level
CO1	**Understand** human visual system and importance of adequate sampling frequencies to representat digital images	**K2: Understand**
CO2	**Apply** signal processing techniques for image enhancement in spatial and frequency domain.	**K3: Apply**
CO3	**Analyze** images in the frequency domain using various transforms.	**K4: Analyze**
CO4	**Evaluate** different image segmentation methodologies to classify and identify different objects present in an image	**K5: Evaluate**
CO5	**Categorize** various lossy and lossless image compression techniques to reduce redundancies	**K4: Analyze**
CO6	**Execute** the relationship between important features of an image to interpret significant abstractions from the raw image	**K3: Execute**

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	2	1					3	**2**	**1**	**1**
CO2	3	3	2	3	3	3	2					3	**3**	**2**	**1**
CO3	3	3	2	3	3	1						3	**3**	**1**	**1**
CO4	3	3	3	3	3	3	2					3	**3**	**2**	**1**
CO5	3	3	3	3	3	3	3					3	**3**	**2**	**1**
CO6	3	2	3	3	3	3	2					3	**3**	**2**	**1**

AVG	**3.00**	**2.83**	**2.33**	**2.83**	**2.67**	**2.50**	**2.00**	**0**	**0**	**0**	**0**	**3.00**	**2.83**	**1.67**	**1.00**

University Syllabus:

Unit	Content	Hrs/Unit
1: Digital Image Processing Systems	Introduction to structure of human eye, Image formation in the human eye, Brightness adaptation and discrimination, Image sensing and acquisition, storage, Processing, Communication, Display Image Sampling and quantization, Basic relationships between pixels.	4
2. Image Transforms (implementation)	Introduction to Fourier transform, DFT and 2-D DFT, Properties of 2-D DFT, FFT, IFFT, Walsh transform, Hadamard transform, Discrete cosine transform, Slant transform, Optimum transform: Karhunen - Loeve (Hotelling) transform.	7
3: Image Enhancement in the Spatial and Frequency Domain:	Gray level transformations, Histogram processing, Arithmetic and logic operations, Spatial filtering: Introduction, Smoothing and sharpening filters. Frequency domain filters: Homomorphic filtering.	6
4: Image Data Compression:	Fundamental s, Redundancies: Coding, Interpixel Psycho-visual, fidelity criteria, Image compression models, Error free compression, Lossy compression, Image compression standards: Binary image and Continuous tone Still Image compression standards, Video compression standards	6
5. Morphological Image Processing:	Introduction, Dilation, Erosion, Opening, closing, Hit -or-miss transformation, Morphological algorithm operations on binary Images, Morphological algorithm operations on gray-scale Images	6
6. Image Segmentation, Representation and Description:	Detection of discontinuities, Edge linking and Boundary detection, Thresholding Region based segmentation, Image Representation schemes, Boundary descriptors, and Regional descriptors.	7

RESOURCES:

1. R.C Gonzalez and R. Woods :-Digital Image Processing, (Indian reprint: Pearson publication, 2001)
2. Anil K. Jain :- Digital Image Processing (Prentice-Hall, India)
3. W. K. Pratt :- Digital Image Processing, - 2nd Edition, (John Wiley & Sons).
4. B. Chanda& D. Dutta Majumder, Digital Image Processing and Analysis, (Prentice-Hall, India)
5. M. A. Sid-Ahmed :- Image Processing- Theory, Algorithms & Architecture, (McGraw-Hill).
6. NPTEL-SAWAYAM : Digital Image Processing by Prof.Prabir Kr. Biswas(IIT, Kharagpur) (https://onlinecourses.nptel.ac.in/noc19_ee55/announcements?force=true)

Course Title: Satellite Communication and Remote Sensing	**Code: EC801C**
Type of Course:Theory	**Course Designation: Optional**
Semester: 8th	**Contact Hours: 3L week**
Continuous Assessment: 40 marks	**Final Exam :60Marks**
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: AnalogCommunicationand , Digital CommunicationsElectronics

Course Outcomes (CO's) of Satellite Communication and Remote Sensing

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC801C.CO1	**illustrate** the basic concepts and techniques of Satellite communication and frequency allocations to outline the basic concepts and techniques of Satellite communication	K2, Understanding
EC801C.CO2	determination OF Orbital Parameters and other orbital attributes And different final orbit and Launch related issues to describe the motion of satellite in the space	K5, **evaluate**
EC801C.CO3	**evaluate** satellite links design in different alternative situations to discuss the design processes and factors influencing the design.	**K5: evaluate**
EC801C.CO4	**Explain** satellite access techniques to emphasizes intuitive understanding and practical implementations of the theoretical concepts	K2:Understanding
EC801C.CO5	**Building** a gross overview on various remote sensing related issues to develop a strong knowledge on Remote sensing aspects and their proper explanations.	**K3:applying**
EC801C.CO6	Combine knowledge on Different Remote sensing Equipment and check remote sensing attributes in varying situations to develop the idea of gathering Remote sensing data on different climatic/physical/environmental conditions	**K2:creating**

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

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2			2					3	**3**	**2**	**3**
CO2	3	3		2			2					3	**3**		**3**
CO3	3	3		2								3	**3**		**3**
CO4	3	3	2	2	2	3	1					3	**3**		**3**
CO5	3	3		1			3					3	**3**	**3**	**3**
CO6	3	2	3	3	3		3					3	**3**	**3**	**3**
Average	3	2.83	2.5	2	2.5	2	2.2	0	0	0	0	3	**3.00**	**2.67**	**3.00**

University Syllabus:

Unit	Content	Hrs/Unit
1: Introduction to	Historical background, Basic concepts, Frequency allocation for satellite services, orbital	2

Satellite Communication	& spacecraft problems,comparison of networks and services, modulation techniques used for satellite communication	
2: Orbits	Two body problem, orbital mechanics, geostationary orbit, change in longitude, orbital manoeuvres, orbital transfer,obital perturbations	02
3: Launch Vehicles	principles of Rocket propulsion, powered flight, Launch vehicles for communication satellite	1
4: RF Link	noise, the basic RF link, satellite links (up and down) , optimization RF link, inter-satellite link, noise temperature, Antenna temperature, overall system temperature, propagation factors, rain attenuation model. Tropospheric andIonosphere EFFECT	5
5: Multiple Access	FDMA, TDMA, CDMA techniques, comparison of multiple access techniques, error connectingcodes	5
6: Sub Systems and Link Design	- AOCS, TT&C , power system, spacecraft antenna, transponder, Friistransmission equation, G/T ratio of earth station	6
7: Remote Sensing Introduction	Basic of remote sensing, Electromagnetic Radiation principles, Atmospheric window, Indian satellite sensing satellite system,Active, Passive, ground based and space based remote sensing	3
8	Spatial, spectral, Radiometric and temporal resolution, satellite sensors, detectors and scanning technique, FOV and error sources Image analysis and Interpretation weather RADAR, LIDAR, acoustic sounding systems, TRMM, AURA-MLS, MeghaTropiques Alitmeter , Scatterometer, Radiometer	9

RESOURCES:

1. ***Satellite communications*** / Timothy ***Pratt***, Jeremy Allnutt. Description: 3rd edition
2. 2Satellite Communications, Fourth Edition Paperback – 1 July 2017by Dennis Roddy
3. Remote Sensing and Image InterpretationbyThomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, 7th Edition | Wiley
4. Remote Sensing and GIS Hardcover – 3 March 2008by BasudebBhatta , Oxford IBH

Course Title: Organizational Behaviour	**Code: HU801A**
Type of Course: Theory	**Course Designation: Compulsory**
Semester: 8th	**Contact Hours: 2P/week**
Continuous Assessment: 100 marks	
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Course Outcomes (CO's) of HU801A

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
HU801.CO1	Recall the concepts of Personel Management and learn different theories used in industries.	K1:Remembering
HU801.CO2	Discuss the appropriate organizational behaviour theory required for solving real life problems.	K6:Creating
HU801.CO3	Apply and demonstrate the use of Management concepts.	K3:Applying
HU801.CO4	Analyze the functions of Staffing.	K4:Analyzing
HU801.CO5	Design the performance appraisal techniques.	K6:Creating
HU801.CO6	Undersand MBO and learn its application in organizations.	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**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**1**	**0**	**2**
CO2	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**1**
CO3	**0**	**0**	**1**	**0**	**1**	**3**	**0**	**0**	**0**	**2**	**0**	**0**	**1**	**1**	**1**
CO4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**1**
CO5	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**0**	**0**	**1**	**2**
CO6	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
AVG	**3.00**	**0.00**	**1.00**	**0.00**	**1.00**	**3.00**	**3.00**	**0.00**	**1.00**	**1.00**	**3.00**	**0.00**	**1.00**	**1.00**	**1.17**

University Syllabus:

1.Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. [2]

2. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development ofPersonality, Types of Attitudes, Job Satisfaction. [2]

3. Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making. [2]

4. Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory. [4]

5. Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making. [2]

6. Communication: Communication Process, Direction of Communication, Barriers to Effective Communication. [2]

7. Leadership: Definition, Importance, Theories of Leadership Styles. [2]

8. Organizational Politics: Definition, Factors contributing to Political Behaviour. [2]
9. Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. [2]
10. Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture. [4]

Resources:

1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.
2. Luthans, Fred: Organizational Behavior, McGraw Hill,12th Edn.
3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI
4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4th Edn.
5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources, PHI, 10thEdn.

Course Title: Design Lab	**Code: EC881**
Type of Course: Lab	**Course Designation: Sessional**
Semester: 8th	**Contact Hours: 6P/week**
Continuous Assessment: 100 marks	
Writer: (Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Pre-requisites: Analog Electronics, Digital Electronics

Course Outcomes (CO's) of Design Lab

On completion of the course students will be able to

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
EC881.CO1	**Design**of basic analog building blocks for filtering, amplifying and oscillating applied signals using discrete devices and components	K3: Applying
EC881.CO2	Based on a specific and required logic pattern, **develop** digital circuits with minimum no of discrete components	K3: Applying
EC881.CO3	For pre-defined electrical outputs, **construct**analog circuits using operational amplifier with optimum deviation from predicted results	K4: Analyzing
EC881.CO4	**Optimize** constructed digital circuits with minimum no of components for lower floorplanning	K4: Analyzing
EC881.CO5	**Estimate** the performance of analog circuits for pre-specified input signals	K5: Evaluating
EC881.CO6	**Interpret** the behaviour of digital circuits for external random applied signal train	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	1	--	--	--	2	3	1	--	--	2	2	1
CO2	3	3	3	1	--	--	--	2	3	1	--	--	2	2	1
CO3	3	3	3	1	--	--	--	2	3	1	--	--	2	2	1
CO4	3	3	3	1	--	--	--	2	3	1	--	--	2	2	1
CO5	3	3	3	1	--	1	--	2	3	1	--	1	2	2	1
CO6	3	3	3	1	--	1	--	2	3	1	--	1	2	2	1
AVG	3.00	3.00	3.00	1.00	--	1.00	--	2.00	3.00	1.00	--	1.00	2.00	2.00	1.00

University Syllabus:

Unit	Content	Hrs/Unit
1: Discrete Analog Circuits	1. Rectifiers. (To design a rectifier for a given average output dc voltage and a given load resistance, compare between the theoretical values of Vdc, Vrms, RF, HD, output regulation, transformer utility factor etc. with the measured values, and thus comprehend the relevance/effect of these various parameters.) 2. DC power supplies regulation and protection circuits. (To learn designing a series transistor-based output regulation circuit, an output current limiting circuit, fold back circuit needed for a given output parameters.) 3. Single stage audio frequency voltage amplifier with BJT for a given Av, Zin and Zout	12

	and maximum symmetrical output swing. 4. Single stage audio frequency emitter follower with JFET for a given Av, Zin and Zout and maximum symmetrical output swing. 5. Complimentary symmetry power amplifier with pre amplifier, if necessary, for a given out put power to a given load with single ended power supply. 6. RC phase shift Oscillator, Wien Bridge oscillator, Hartley and Colpitt oscillator	
2: OPAMP Based Analog Circuits	1. Inverting and non-inverting amplifier of given dc gain, input impedance and output impedance. 2. Adder and subtractor. (To learn the basic design and function of a multi-input adder/subtractor (with ac and dc inputs present simultaneously). 3. Comparator/voltage level detector for a given upper threshold level and a given lower threshold level with facility of independent adjustment of hysteresis and centre point. 4. Active filters: LP, BP, HP, 1st order, 2nd order. (To learn the design of a filter and its inherent phase shifting characteristics.) 5. 555 based monostable and astable of duty cycle below and above 50%.	12
3: Digital Logic Circuits	1. Design and implement a BCD to 7-segment decoder with basic and universal gates. 2. Design and implement a 4-digit frequency counter with a clock generator. 3. Designing logic circuits using multiplexers, demultiplexers and gates to implement logic functions. 4. Design and implement a sequence detector. 5. To design and implement a combination of a logic circuit and a RAM in order to generate a 4-bit data after simplifying alogic expression, to store the output data at a predefined location in the RAM, to retrieve the same and verify.	12
4: Power Electronics	1. Design a Single-phase full & shaft-controlled converter. 2. Design of Microprocessor based Triggering socket.	12

RESOURCES:

1. “Microelectronic Circuits: Theory and Applications” by A. S. Sedra, K. C. Smith, OUP, 7th Ed., 2017
2. “Op-Amps and Linear Integrated Circuits” by R. Gayakwad, Pearson, 4th Ed., 2000
3. “Fundamentals of Digital Electronics” by A. A. Kumar, PHI, 4th ed., 2016
4. “Electronic Devices and Circuit Theory” by R. L. Boylestad, L. Nashelsky, Pearson, 11th Ed., 2015
5. “Digital Circuits” -Vol-I & II by D.Ray Chaudhuri, Platinum Publishers, 2nd Ed., 2013
6. https://nptel.ac.in/courses/117108107/
7. https://nptel.ac.in/courses/117106086/

Course Title: Grand Viva	**Code: EC893**
Type of Course: Sessional	**Course Designation: Sessional**
Semester: 8th	**Contact Hours:**
Continuous Assessment: 100 marks	
All Faculty(Course Coordinators)	**Approved by HoD (Convenor of DAB)**

Course Outcome

CO Number	CO statement	Knowledge Level of revised Bloom's Taxonomy
CO1	**Evaluate** domain knowledge in fundamental science for developing foundation of engineering maintaining environmental aspects (Basic Science)	K5
CO2	**Interpret** qualitative attributes for ethical, social and professional values with sound communication attitudes as an individual or team member (Humanities)	K5
CO3	**Estimate** engineering science knowledge for developing hierarchical professional growth related with electronics and communication engineering	K5
CO4	**Measure** ability to solve complex engineering problems through professional core subjects relevant with electronics and communication engineering for benefit of the Society	K5
CO5	**Evaluate** design-oriented professional knowledge associated with core discipline for conducting complex investigations (professional elective)	K5
CO6	**Assess** co-related subject expertization relevant with information science and engineering for sustainability in professional sector/academia as a part of life-long learning (free elective & overall)	K5

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**				**2**						**3**	**2**	**0**
CO2						**2**		**2**	**2**	**2**			**3**	**2**	**0**
CO3	**3**	**3**	**3**										**3**	**0**	**0**
CO4	**3**	**3**	**3**	**3**	**3**								**3**	**0**	**0**
CO5	**3**	**2**	**2**	**3**	**2**								**2**	**0**	**0**
CO6	**1**		**2**				**2**					**3**	**2**	**2**	**3**
Avg.	**2**	**2.75**	**2.4**	**3**	**2.5**	**2**	**2**	**2**	**2**	**2**	**0**	**3**	**2.66**	**2**	**3**