VASIREDDY VENKATADRI
INSTITUTE OF TECHNOLOGY

(AUTONOMOUS)

Approved by AICTE and Permanetly Affiliated to JNTU Kakinada, Accredited by NAAC with 'A' Grade & NBA Accreditation

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Minutes of Board of Studies Meeting

Date: 30th May 2021

The third External Board of Studies Meeting of the Department of Electronics and Communication engineering was held online on 29.05.2021 at 04:00PM via MS Teams platform to finalize curriculum for all semesters of R-20 (Autonomous) regulation as well as finalizing the syllabus for II-I and II-II semesters and also to finalize the syllabus for III-I and III-II semesters under R-19 regulations.

The following members were present:

S.No.	Name of the BoS Member	Designation	Signature
1	Prof.M.Y.Bhanu Murthy	Chairman, Prof & HoD ECE	
2	Dr.N.Balaji	University Nominee and External BoS Member	
3	Dr.B.Anuradha	Subject Expert and External BoS Member	
4	Dr.K.Giri Babu	Dean of Academics, Member	
5	Dr.P.Ammi Reddy	Professor, Member	
6	Dr.M.R.N.Tagore	Professor, Member	
7	Dr.Sk.Enaul Haq	Assoc.Professor, Member	
8	Dr.K.Vasu Babu	Assoc.Professor, Member	
9	Mr.G.V.Satya Kumar	Assoc.Professor, Member	
10	Mr.Sk.Riyazuddien	Assoc.Professor, Member	

At the onset of the meeting, the Chairman of BoS, Prof.M.Y.Bhanu Murthy, welcomed all the members and introduced members to the External Subject Experts. The meeting began with the presentation of curriculum by the chair for semesters II-I, II-II, III-I, III-II, IV-I and IV-II under R-20 regulations. He then presented the syllabus of all subjects of II-I and II-II semesters under R-20 regulations followed by presentation of syllabus of all subjects of III-I and III-II semesters under R-19 regulations, prepared by the internal BOS members.

Due to prevailing COVID-19 pandemic and as per the guidelines received from JNTUK for autonomous institutions, the course structure and syllabus has been prepared, and the class work was commenced.

Resolutions in Meeting

Agenda 1: To discuss and finalize the course structure of R-20 (Autonomous) regulations for all years and syllabus of the proposed II-I and II-II Semester courses along with Honors/Minor Degree Courses.

Resolutions: Course Structure of B.Tech Programme of R-20 (Autonomous) regulations and syllabus of II-I and II-II Semester is approved by the Board of Studies Committee.

Encl: **Annexure –I**

Agenda 2: To discuss and finalize the syllabus of the proposed III-I and III-II Semesters of R-19 (Autonomous) regulations along with Minor Degree Courses.

Resolutions: After due consultations and the suggestions of BoS experts, the proposed course contents of III-I and III-II semesters are finalized.

Encl: **Annexure-II**

Agenda 3: To discuss the syllabus for Minor Degree Course in CSE department for R19 batch students.

Resolutions: After due deliberations, the External BoS Committee accepted the syllabus for Minor Degree Course for R19 Regulations.

Encl: **Annexure-III**

General Comments

1. Data Structures subject is included in II-II semester of R-20 regulations as per the recommendation of Training and Placement cell.
2. External BoS expert Dr.N.Balaji enquired about internal and external evaluation procedures. Dr. P.Ammi Reddy explained the norms being followed at VVIT.
3. External BoS expert Dr.B.Anuradha has asked to include year of publication and edition for the recommended text books in each subject.
4. The external BoS members expressed their satisfaction towards the contents for each subject prepared by the internal BoS members.
5. BoS Chairman Prof. M.Y.Bhanu Murthy informed the BoS members that the syllabus of core subjects is framed for the sake of GATE, competitive and job oriented exams mostly.
6. The committee also gave their consent to the department to offer Minor Degree Program for II B.Tech ECE students of R19 regulations.

Curriculum related Comments

Comments by University Nominee and External BoS Member Dr.N.Balaji:

1. Proposed to include Computer Architecture based concepts in skill oriented course – 2 to be offered in II-II semester in R-20 curriculum.
2. Suggested the committee to include 'applications of sequential circuits' in the "Digital System Design with VHDL" course and recommended a textbook "Digital System Design with FPGA: Implementation using Verilog and VHDL " authored by CemUnsalan, BoraTar McGraw Hill Education, 2017" to be included in the syllabus.
3. Recommended including PIC in Microprocessor and Microcontroller Subject.
4. Suggested the committee to add topics related to 'Security Issues' in "Computer Networks" subject and recommended the text book "Data Communications and Networking" authored by B.A.Forouzan to be included in the syllabus.
5. Also recommended the committee to add 'Wireless Sensor Networks' course in Professional Electives.

6. Further suggested including a text book authored by Ahmed and Natarajan in Digital Signal Processing syllabus to cover IIR and FIR Filters.

Comments by Subject Expert and External BoS Member Dr.B.Anuradha:

1. Opined to include same stream subjects related to the specific areas of study in Professional Elective pools.
2. Advised to replace the word 'study' with 'design' in the names of laboratory experiments.
3. Suggested including the topic Photonic Crystal Fibers under Advanced Topics in the syllabus of the subject Optical Communications, as further reading.
4. Advised to include MEMS/Mechatronics subjects in Open Electives from Mechanical Department.
5. Suggested to re-arrange the order of Professional Electives.

According to the comments made by the University Nominee and the Subject Expert, the Chairman Prof.M.Y.Bhanu Murthy decided to implement the following in the course structure and syllabus:

1. Computer Architecture based concepts will be included in the syllabus of skill oriented course-2 under R20 regulations.
2. 'Applications of Sequential Circuits' shall be included in "Digital System Design with VHDL" course along with the adding the text book authored by Bora Tar, in the syllabus.
3. 'PIC' to be included in Microprocessor and Microcontroller Subject.
4. 'Security Issues' to be added in the syllabus of Computer Networks along with inclusion of textbook authored by B.A.Forouzan.
5. 'Wireless Sensor Networks' will be added in the pool of Professional Elective Courses.
6. The word 'study' shall be replaced with 'design' in the list of lab experiments wherever applicable.
7. 'Photonic Crystal Fibers' to be included as further reading in the subject 'Optical Communications.'
8. 'Mechatronics' shall be included in the pool of Open Electives.
9. The order of Professional Electives will be re-arranged to ensure same stream subjects related to specific areas of study fall under each Professional Elective.
10. Prof.M.Y.Bhanu Murthy has proposed to opt for online virtual labs until college reopens.

11. In reply to the suggestion of Dr.N.Balaji about the introduction of Digital ICs in the subject Digital System design (DSD), the chairman has given the clarification about its inclusion in the respective units of syllabus along with coding.
12. After due deliberations, the committee accepted the syllabus of Linear IC Applications, Antennas and Wave Propagation, VLSI Design, Cellular Mobile Communications, Satellite Communications without any changes.

(Prof.M.Y.Bhanu Murthy)

Chairman, BoS

ANNEXURE-I: Course Structure of B.Tech R-20 (autonomous) regulations.

Structure of B. Tech Programme - Regulation R-20

S.No.	Category	Code	Suggested Breakup of Credits by AICTE	Suggested Breakup of Credits by APSCHE	Breakup of Credits
1	Humanities and Social Sciences including Management courses	HS	12	10.5	**10.5**
2	Basic Science courses	BS	25	21	**21**
3	Engineering Science courses including workshop, drawing, basics of electrical/ mechanical/ computer etc	ES	24	24	**22.5**
4	Professional core courses	PC	48	51	**52.5**
5	Professional Elective courses relevant to chosen specialization/ branch	PE	18	15	**15**
6	Open subjects – Electives from other technical and /or emerging subjects	OE	18	12	**12**
7	Project work, seminar and internship in industry or elsewhere	PR	15	16.5	**16.5**
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	NC	Non-Credit	Non-Credit	Non-Credit
9	Skill Oriented Courses	SC	--	10	**10**
Total			**160**	**160**	**160**

SEMESTER-WISE STRUCTURE OF CURRICULUM

Course structure for eight semesters during four years of study is as follows

I Year I Semester (Semester-1)

S.No.	Course Code	Course Name	L	T	P	C
1	HS1101	Communicative English	3	0	0	3
2	BS1101	Mathematics-I	3	0	0	3
3	BS1105	Applied Physics	3	0	0	3
4	ES1101	Problem Solving using C	3	0	0	3
5	ES1102	Engineering Graphics	1	0	4	3
6	HS1102L	Communicative English Lab	0	0	3	1.5
7	BS1106L	Applied Physics and Virtual Lab	0	0	3	1.5
8	ES1103L	Problem Solving using C Lab	0	0	3	1.5
					Total Credits	**19.5**

	Category	Credits
BS	Basic Science Courses	3+3+1.5=7.5
ES	Engineering Science Courses	3+3+1.5=7.5
HS	Humanities and Social Sciences including Management courses	3+1.5=4.5
	Total Credits	**19.5**

I Year II Semester (Semester-2)

S.No.	Course Code	Course Name	L	T	P	C
1	BS1202	Mathematics-II	3	0	0	3
2	ES1204	Basic Electrical Engineering	3	0	0	3
3	BS1209	Applied Chemistry	3	0	0	3
4	ES1205	Network Analysis	2	1	0	3
5	ES1206	Problem Solving using Python	3	0	0	3
6	ES1207L	Basic Electrical Engineering Lab	0	0	3	1.5
7	BS1210L	Applied Chemistry Lab	0	0	3	1.5
8	ES1208L	Problem Solving using Python Lab	0	0	3	1.5
9	MC1201	Indian Constitution	2	0	0	0
					Total Credits	**19.5**

	Category	Credits
BS	Basic Science Courses	3+3+1.5=7.5
ES	Engineering Science Courses	3+3+3+1.5+1.5=12
MC	Mandatory Course (AICTE)	0
	Total Credits	**19.5**

II Year I Semester (Semester-3)

S.No.	Course Code	Course Name	L	T	P	C
1	BS2112	Mathematics-III	2	1	0	3
2	PC2101	Electronic Devices & Circuits	3	0	2	3
3	PC2102	Signals and Systems	2	1	0	3
4	PC2103	Digital Circuits and Logic Design	3	0	2	3
5	BS2113	Random Variables and Stochastic Processes	3	0	0	3
6	PC2104L	Electronic Devices and Circuits Lab	0	0	3	1.5
7	PC2105L	Signals and Systems Lab	0	0	3	1.5
8	PC2106L	Digital Circuits and Logic Design Lab	0	0	3	1.5
9	SC2101	Skill Oriented Course – 1	1	0	2	2
10	MC2102	Essence of Indian Traditional Knowledge	2	0	0	0
					Total Credits	**21.5**

	Category	Credits
BS	Basic Science Courses	3+3=6
PC	Professional Core courses	3+3+3+1.5+1.5+1.5=13.5
SC	Skill Oriented Course	2
MC	Mandatory Course (AICTE)	0
	Total Credits	**21.5**

II Year II Semester (Semester-4)

S.No.	Course Code	Course Name	L	T	P	C
1	PC2207	Analog Circuits	3	0	0	3
2	PC2208	Electromagnetic Fields and Waves	2	1	0	3
3	PC2209	Digital System Design with VHDL	3	0	2	3
4	ES2209	Control Systems	3	0	2	3
5	OE2201	Open Elective – 1	2	0	2	3
6	PC2211L	Analog Circuits Lab	0	0	3	1.5
7	PC2202L	Digital System Design with VHDL Lab	0	0	3	1.5
8	SC2202	Skill Oriented Course – 2	1	0	2	2
					Total Credits	**20**
		Internship/Community Service Project/NCC 2 Months (Mandatory) during summer vacation				
		Honors/Minor courses	3	1	0	4

	Category	Credits
ES	Engineering Science Courses	3
PC	Professional Core courses	3+3+3+1.5+1.5=12
OE	Open Elective Courses/Job Oriented Elective Courses	3
SC	Skill Oriented Course	2
	Total Credits	**20**

III Year I Semester (Semester-5)

S.No.	Course Code	Course Name	L	T	P	C
1	PC3112	Linear IC Applications	3	0	0	3
2	HS3104	Engineering Economics and Management	3	0	0	3
3	PC3113	Analog and Digital Communications	3	0	0	3
4	PC3114	VLSI Design	3	0	2	3
5	OE3102	Open Elective – 2	2	0	2	3
6	PC3115L	Linear IC Applications Lab	0	0	3	1.5
7	PC3116L	VLSI Design Lab	0	0	3	1.5
8	PC3117L	Analog and Digital Communications Lab	0	0	3	1.5
9	SC3103	Skill Advanced Course – 1 (Soft Skills)	1	0	2	2
10	PR3101	Summer Internship 2 Months (Mandatory) after Second Year (to be evaluated during V semester)	0	0	3	1.5
11	MC3103	Environmental Science	2	0	0	0
					Total Credits	**23**
		Honors/Minor courses	3	1	0	4

	Category	Credits
HS	Humanities and Social Science Courses	3
PC	Professional Core Courses	3+3+3+1.5+1.5+1.5=13.5
OE	Open Elective Courses/Job Oriented Elective Courses	3
SC	Skill Advanced Course/Soft Skills Course	2
PR	Summer Internship	1.5
MC	Mandatory Course (AICTE)	0
	Total Credits	**23**

III Year II Semester (Semester-6)

S.No.	Course Code	Course Name	L	T	P	C
1	PC3218	Digital Signal Processing	3	0	0	3
2	PC3219	Microprocessors and Microcontrollers	3	0	0	3
3	PC3220	Microwave Engineering and Optical Communication	3	0	0	3
4	PE3201	Professional Elective – 1	2	0	2	3
5	PC3221L	Microprocessors and Microcontrollers Lab	0	0	3	1.5
6	PC3222L	Microwave Engineering and Optical CommunicationLab	0	0	3	1.5
7	PC3223L	Digital Signal Processing Lab	0	0	3	1.5
8	SC3204	Skill Advanced Course – 2	1	0	2	2
9	HS3205	Universal Human Values	3	0	0	3
10	MC3204	Entrepreneurial Skill Development	2	0	0	0
					Total Credits	**21.5**
		Industrial/Research Internship 2 Months (Mandatory) during summer vacation				
		Honors/Minor courses	3	0	2	4

	Category	Credits
HS	Humanities and Social Science Courses	3
PC	Professional Core Courses	3+3+3+1.5+1.5+1.5=13.5
PE	Professional Elective Courses	3
SC	Skill Advanced Course/Soft Skills Course	2
MC	Mandatory Course (AICTE)	0
	Total Credits	**21.5**

IV Year I Semester (Semester-7)

S.No.	Course Code	Course Name	L	T	P	C
1	PE4102	Professional Elective – 2	2	0	2	3
2	PE4103	Professional Elective – 3	2	0	2	3
3	PE4104	Professional Elective – 4	2	0	2	3
4	PE4105	Professional Elective – 5	2	0	2	3
5	OE4103	Open Elective – 3	2	0	2	3
6	OE4104	Open Elective – 4	2	0	2	3
7	SC4105	Skill Advanced Course – 3	1	0	2	2
8	PR4102	Industrial / Research Internship 2 Months (Mandatory) after Third Year (to be evaluated during VII semester)	0	0	3	3
					Total Credits	**23**
		Honors/Minor courses	3	0	2	4

	Category	Credits
PE	Professional Elective Courses	3+3+3+3=12
OE	Open Elective Courses/Job Oriented Elective Courses	3+3=6
SC	Skill Advanced Course/Soft Skills Course	2
PR	Summer Internship	3
	Total Credits	**23**

IV Year II Semester (Semester-8)

S. No	Subject code	Course Name	L	T	P	C
1	PR4203	Major Project Project work, seminar, and internship in industry	0	0	0	12
		Internship (6 months)				
					Total Credits	**12**

Skill oriented course/Skill advanced courses

Subject Code	Track-1 (Core)	Track-2 (Programming)	Track-3 (Cloud Technologies)
SC2101	SCILAB	Data Pre-Processing and Visualization using Python	AWS
SC2202	Open source hardware tools for Electronics Engineers	Machine Learning using Scikit-Learn	NoSQL
SC3103	Soft Skills	Soft Skills	Soft Skills
SC3204	Internet of Things	Web Development (HTML/CSS/PHP)	Big Data Analytics
SC4105	Networking(CCNA)	Deep Learning with Tensor Flow	Social IoT

Open Elective Courses

Open Elective- I	Open Elective- II	Open Elective- III	Open Elective- IV
Data Structures	OOPS Through Java	Artificial Intelligence	OperatingSystems
Mechatronics	Embedded C	Industrial and Medical Internetof Things	Computer Vision
MATLAB for Engineering Applications	Total Quality Management	Supply Chain Management	Advanced Control Systems
DBMS	Disaster Management	Advanced Java	Green Buildings

Professional Elective Courses

Professional Elective- I	Professional Elective- II	Professional Elective- III	Professional Elective- IV	Professional Elective- V
Antenna andWave Propagation	Advanced Computer Architecture	NPTEL/SWAYAM Duration: 12 weeks minimum. *Course/Subject Title can't be repeated.	Image Processing	ComputerNetworks
InformationTheory andCoding	Radars and Satellite Communications		Wireless Sensor Networks	Cellular and Mobile Communications
Speech Fundamentals	Speech Processing		Speech Enhancement	Advanced Digital SignalProcessing
Analog ICDesign	Digital ICDesign		RF Integrated Circuits	Low Power VLSI Design

Courses for Honors degree

Pool-I (Advanced Communications)	Pool-II (IoT & Blockchain)	Pool-III (Advanced VLSI)	Pool-IV (Deep Learning)
5G Communications	Next Generation IoT Networks	RFID and Microcontrollers	Natural Language Processing
Principles of Signal Estimation for MIMO/OFDM Wireless Communication	Internet of Robotics	Nano Technology	Neural Networks and Deep Learning
Modern Digital Communication Techniques	Blockchain Fundamentals and Use Cases	Mixed Signal Design	Convolutional Neural Networks
Multimedia Communication	Blockchain Application Development	Advanced IC Design	Time Series Analysis
MOOC-1*(NPTEL/SWAYAM)Duration: 08 Weeks minimum			
MOOC-2*(NPTEL/SWAYAM)Duration: 08 Weeks minimum			

*Course/subject title can't be repeated

Note:

1. Students has to acquire 16 credits with minimum one subject from each pool
2. Compulsory MOOC/NPTEL course for 4 credits (2 course, each 2 credited)

General Minor Tracks
Department of Electronics and Communication Engineering

S.No.	Course Name	L	T	P	C
1	Principles of Communication Systems	3	0	2	4
2	Analog and Digital Signal Processing	3	0	2	4
3	Very Large Scale Integrated Circuits	3	0	2	4
4	Embedded Systems	3	0	2	4
5	Advanced Communications	3	0	2	4
6	VLSI Architectures for IoT Networks	3	0	2	4

Note:

1. A student can select four subjects from the above six subjects @ 3-0-2-4 credits per subject.
2. Compulsory MOOC/NPTEL courses for 04 credits (02 courses @ 02 credits each)

VVIT Life skill courses

The following courses are admitted to be the **courses beyond curriculum** to improve individual life skills. These courses and will be demonstrated in the class room and will be having an internal assessment for satisfactory.

S. No	Year and Semester	Course Name
1	I Year I Semester (Semester-1)	Quantitative Aptitude
2	I Year II Semester (Semester-2)	Verbal Ability
3	II Year I Semester (Semester-3)	Understanding Self for Effectiveness
4	II Year II Semester (Semester-4)	Design Thinking
5	III Year I Semester (Semester-5)	Stress and Coping Strategies
6	III Year II Semester (Semester-6)	Research Skills

SYLLABUS

II-Year-I Semester	MATHEMATICS – III	L	T	P	C
BS2112		3	0	0	3

Pre-Requisites: Calculus, Multiple Integration, Set Theory

Course Objectives:

1. To instruct the concept of Matrices in solving linear algebraic equations
2. To familiarize the techniques in partial differential equations
3. To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications

UNIT-I: SOLVING SYSTEM OF LINEAR EQUATIONS, EIGEN VALUES AND EIGEN VECTORS 12 HOURS

Rank of a matrix by Echelon form and normal form–solving system of homogeneous and non-homogeneous linear equations–Gauss elimination, Gauss Jordan for solving system of equations- Eigen values and Eigen vectors and their properties.

UNIT-II: CAYLEY-HAMILTON THEOREM AND QUADRATIC FORMS 12 HOURS

Cayley-Hamilton theorem (without proof)–Finding inverse and power of a matrix by Cayley-Hamilton theorem–Reduction to Diagonal form–Quadratic forms and nature of the quadratic forms–Reduction of quadratic form to canonical forms by orthogonal transformation.

Application: Free vibration of two mass systems.

UNIT-III: VECTOR DIFFERENTIATION 10 HOURS

Scalar and Vector point functions-Vector Differential operator- Gradient – Directional derivatives – Divergence – Curl – Laplacian second order operator- Vector identities- Scalar Potential.

UNIT–IV: VECTOR INTEGRATION 13 HOURS

Line integral – Work done – Circulation- Surface integral- Volume integral.

Vector integral theorems (without proof): Green's theorem in a plane- Stokes theorem- Gauss Divergence theorem.

UNIT-V: SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS 14 HOURS

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

Second order PDE: Solutions of linear partial differential equations with constant coefficients – RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.

Reference Books:

1. B.V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
2. H.K. Das, Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

E-resources

1. https://www.freebookcentre.net/maths-books-download/Linear-Algebra-A-free-Linear-Algebra-Textbook-and-Online-Resource.html

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Develop the use of matrix algebra techniques that is needed by engineers for practical applications
CO2	Solve system of linear algebraic equations using Gauss elimination, Gauss Jordan
CO3	To interpret the physical meaning of different operators such as gradient, curl and divergence
CO4	Estimate the work done against a field, circulation and flux using vector calculus
CO5	Identify the solution methods for partial differential equation that model physical processes

CO – PO Mapping

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

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II-Year-I Semester PC2101	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	2	3

Pre-Requisites: Engineering Physics

Course Objectives:

1. To instill the fundamentals of diode operation
2. To understand the implementation of various diode applications
3. To familiarize with the physics and working of transistors
4. To learn how to bias various transistor devices
5. To learn small-signal models of Transistors

UNIT-I:

Junction Diode Characteristics **11 HOURS**

Review of semiconductor Physics formation of PN-Junction, Electrical representation, Energy Band Model and Barrier potential (quantitative treatment), Forward and Reverse bias characteristics of PN-junction Diode (Qualitative), Diode current equation, Junction resistance, Diode circuit models, Transition and Diffusion Capacitance.

Special Semiconductor Devices **04 HOURS**

Breakdown mechanisms in diodes, V-I Characteristics of Zener diode, Varactor Diode, Tunnel Diode, LED, photo diode, SCR and UJT.

UNIT-II: DIODE APPLICATIONS **12 HOURS**

Diode as switch, Components of Power Supply, working and Characteristics of Half-wave, Full-Wave and Bridge rectifiers, Working of Full Wave Rectifier with series Inductor , shunt capacitor filters and L , Pi section filters(qualitative), Zener Diode as shunt voltage regulator and design of voltage regulator. Applications of rectifiers and voltage regulators.

UNIT-III:

Bi-polar Junction Transistors (BJT) **07 HOURS**

N-P-N and P-N-P transistors structure, Operation of BJT, Early effect, Current equations, Input and Output characteristics of CB, CE and CC, BJT as an Amplifier

Junction Field Effect Transistors (JFET) **04 HOURS**

Junction Field Effect Transistor (JFET) structure, Drain and Transfer Characteristics, Significance of Pinch-Off Voltage, JFET as an amplifier and switch, Comparison of BJT and JFET.

Metal-Oxide-Semiconductor Field Effect Transistors (MOSFET) **04 HOURS**

Structure of Depletion-MOSFET and Enhancement-MOSFETs, V-I Characteristics of MOSFET, Significance of threshold voltage.

Uni-Junction Transistor(UJT) **01 HOUR**

Construction and working of UJT

UNIT–IV: TRANSISTOR BIASING **12 HOURS**

Need for Proper Biasing, Q-point stability, Fixed, Collector to Base bias and Voltage Divider biasing for BJT, Emitter Degeneration, Design of Self Biasing circuit, Thermal Stability considerations. Fixed, Voltage Divider biasing for JFET and MOSFETs.

UNIT-V: SMALL SIGNAL LOW FREQUENCY ANALYSIS OF BJT AND FET AMPLIFIERS 12 HOURS

Small signal low frequency analysis of BJT using h parameter model and $r\pi$ model. Determination of h-

parameters from transistor characteristics, Analysis of CE, CC, CB Amplifiers. Simplified h- parameter model, analysis of CE Amplifier with emitter resistance. Small Signal Model, Analysis of JFET Amplifiers, Analysis of CS, CD JFET Amplifiers.

Text Books

1. Jacob Millman and Halkias, "Electronic Devices and Circuits", Tata-Mcgraw Hill Second Edition, 2007.
2. Robert L. Boylestead and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education Inc. Eleventh Edition 2013.

Reference Books

1. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press, 2004 Edition.
2. D. A. Neaman, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
3. Jacob Millman and Halkias, "Integrated Electronics",Tata Mc-Graw Hill, Second Edition, 2009.

E-resources

1. https://nptel.ac.in/courses/117/102/117102061/
2. https://nptel.ac.in/courses/117/102/117102061/
3. https://nptel.ac.in/courses/117/106/117106091/
4. https://nptel.ac.in/courses/108/107/108107142/

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Describe the working of junction diodes and interpret V-I relations **(Understand)**
CO2	Demonstrate the usage of diodes in various applications **(Apply)**
CO3	**Explain** the working principles of BJTs and FETs **(Understand)**
CO4	**Learn** the art of biasing of BJTs and FETs **(Apply)**
CO5	**Apply** the equivalent small signal low frequency models of BJTs and FETS in amplifier analysis **(Analyze)**

CO – PO Mapping

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

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II-Year-I Semester PC2102	SIGNALS AND SYSTEMS	L	T	P	C
		2	1	0	3

Pre-Requisites: Engineering Mathematics-1 and 3

Course Objectives:

1. Describe signals mathematically and understand how to perform mathematical operations on signals and Compute the Fourier series of a set of well-defined signals from first principles.
2. Compute the Fourier transform of a set of well-defined signals and Understand the Nyquist sampling theorem and the process of reconstructing a continuous- time signal from its samples.
3. Perform the process of convolution and correlation between signals and Compute the output of an LTI system given the input and the impulse response through convolution sum and convolution integral.
4. Understand Laplace transforms and their properties for analysis of signals and systems.
5. Understand Z-transforms and their properties for analysis of signals and systems.

UNIT-I: SIGNALS ANALYSIS AND FOURIER SERIES

Signal Analysis **09 HOURS**

Signal definition (continuous and discrete), Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function signum function and ramp function. Classification of signals. Time operations on signals. Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions.

Fourier Series **06 HOURS**

Representation of Fourier series, Dirichlet‟s conditions, Properties of Fourier Series, Trigonometric Fourier Series and Exponential/ Complex Fourier Series, Complex Fourier spectrum.

UNIT-II: FOURIER TRANSFORM AND SAMPLING THEOREM

Fourier Transform **08 HOURS**

Deriving Fourier Transform from Fourier series, Fourier Transform convergence condition, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms involving Impulse function and Signum function, Introduction to Hilbert Transform.

Sampling Theorem **05 HOURS**

Graphical and analytical proof for Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling –Aliasing, Introduction to Band Pass sampling.

UNIT-III:

Signal transmission through Linear Time Invariant (LTI) Systems **07 HOURS**

System definition (continuous and discrete), Classification of Systems, impulse response, transfer function, LTI system response, Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

Convolution and Correlation **09 HOURS**

Concept of convolution, convolution in time and frequency domain properties of Fourier Transform, graphical and analytical convolution, Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Power density spectrum, Relation between auto correlation

function and energy/power spectral density spectrum. Relation between convolution and correlation

UNIT–IV: LAPLACE TRANSFORMS **08 HOURS**

Laplace Transforms (L.T), Inverse Laplace Transform, Concept of Region of Convergence(ROC) for Laplace Transforms, Properties of ROC of Laplace Transform, Properties of Laplace Transform, Relation between LT and Fourier Transform of a signal, Response of LTI system using Laplace Transform, Laplace transform of causal periodic signals, Laplace transform of certain signals using waveform synthesis.

UNIT-V: Z-TRANSFORMS **08 HOURS**

Concept of Z- Transform and Inverse Z-Transform, Distinction between Laplace, Fourier and Z -transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Properties of ROC of Z-Transform, Properties of Z-transforms, Inverse Z-transform, Response of LTI system using Z-Transform, Introduction to DTFT, Relationship between Z-Transform and DTFT, Conversion from Laplace transform to Z-transform and vice- versa.

Text Books

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H.Nawab, 2nd Edn, PHI, 1997.
3. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2ndEdition,2007

Reference Books

1. Principles of Linear Systems and Signals by B. P. Lathi, 2nd Edition, Oxford publications, 2015.
2. Fundamentals of Signals and Systems- Michel J. Robert, 2nd Edition, MGH International Edition, 2008.
3. Signals and Stochastic Processes by Y Mallikarjuna Reddy and Giri Babu Kande, 1st edition, University Press, 2017.

E-Resources

1. https://nptel.ac.in/courses/108/106/108106163/
2. https://nptel.ac.in/courses/108/104/108104100/
3. https://nptel.ac.in/courses/108/105/108105065/
4. https://nptel.ac.in/courses/117/104/117104074/
5. https://nptel.ac.in/courses/117/101/117101055/
6. https://nptel.ac.in/courses/108/106/108106075/

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	The student will be able to understand various types of signals mathematically and able to calculate complex Fourier spectrum. **(Understand, Calculate)**
CO2	Analyse the continuous-time signals and continuous-time systems using Fourier transform and **Apply** sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct the original signal from samples. **(Analyse, Apply)**
CO3	Define systems based on their properties and determine the response of LTI system. Understand the concept convolution, correlation, energy spectral density and power spectral density. **(Remember, Understand)**
CO4	Compute Laplace transforms to analyze continuous time signals and systems and understand the concept of region of convergence. **(Compute)**
CO5	Compute Z-transform to analyze discrete-time signals and systems, and understand the concept of region of convergence. **(Compute)**

CO – PO Mapping

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

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II-Year-I Semester PC2103	DIGITAL CIRCUITS AND LOGIC DESIGN	L	T	P	C
		3	0	2	3

Pre-Requisites: Nil

Course Objectives:

1. To understand common forms of number representation in digital circuits and Boolean algebra.
2. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems and simplify logic expressions using basic theorems, K-map and Tabular methods.
3. To understand the concept of Combinational logic design and realize logic expressions using MUX and Decoder
4. Illustrate the concept of sequential logic design; analyze the operation of flip- flop and conversion from one flip-flop to another, and application of flip-flop.
5. To impart to student the concepts of sequential machines of digital system.

UNIT-I: NUMBER SYSTEMS AND BOOLEAN ALGEBRA 11 HOURS

Number systems: Introduction to different number system and their conversions, Complement of number system and subtraction using complement method, Floating-Point Representation, Weighted and Non-weighted codes and its Properties, Error detection and correction codes.

Boolean Algebra: Boolean algebra and logic gates, Basic theorems and properties of Boolean Algebra, Boolean functions, canonical and standard forms, Universal Gates.

UNIT-II: MINIMIZATION METHODS OF BOOLEAN FUNCTIONS 10 HOURS Minimization of logic expressions by algebraic method, Sum of Products (SOP), Product of Sums (POS), K-Map Method, Don"t Care Combinations, Multilevel NAND/NOR realizations, Prime and essential Prime Implicants, Tabular Method, Prime Implicants Chart, Simplification Rules.

UNIT-III: COMBINATIONAL CIRCUITS 13 HOURS

Design procedure, Half/full adders, Half / full subtractors, Carry look ahead adder, BCD adder, Multiplexer/De- Multiplexer, Encoder / Decoder, Priority encoders, Implementation of Higher - Order Device Using Lower Order devices, Implementation of combinational logic using MUX/Decoder, Magnitude Comparator, Programmable logic devices.

UNIT–IV: SEQUENTIAL CIRCUITS 10 HOURS

Sequential Circuits Fundamentals: Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Timing and Triggering Consideration, Conversion from one type of Flip-Flop to another.

Registers and Counters: Shift Registers Left, Right and Bidirectional Shift Registers, Applications of Shift Registers, Design and Operation of Ring and Twisted Ring Counter, Operation of Asynchronous and Synchronous Counters.

UNIT-V: SEQUENTIAL MACHINES 08 HOURS

Finite State Machines, Synthesis of Synchronous Sequential Circuits, Mealy and Moore models, Serial Binary Adder, Sequence Detector, Parity bit Generator Synchronous Modulo N–Counters, Finite state machine capabilities and limitations.

Text Books

1. Digital Design by M. Morris Mano, Michael D Ciletti, 4th edition, PHI publication, 2008
2. Switching and finite automata theory Zvi. KOHAVI, Niraj. K. Jha, 3rdEdition, Cambridge University Press,2009

3. Switching theory and logic design by Hill and Peterson**,** Mc-Graw Hill TMH edition, 2012.

Reference Books

1. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers, 2016
2. Modern Digital Electronics by RP Jain, 4th edition TMH, 2009
3. Switching Theory and Logic Design by A. Anand Kumar, PHI Learning Pvt ltd, 2016.

E-Resources

1. https://nptel.ac.in/courses/117/106/117106086/
2. https://nptel.ac.in/courses/108/105/108105113/
3. https://www.coursera.org/learn/digital-systems
4. https://swayam.gov.in/nd1_noc20_ee70/preview

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Distinguish the analog and digital systems, apply positional notations, number systems, computer codes in digital systems. **(Remember, Understand, and Apply)**
CO2	Understand the Boolean Algebra theorems, simplify and design logic circuits. **(Understand, Apply, Analyze and valuate)**
CO3	Implement combinational logic circuit design and modular combinational circuits using encoders, decoders, multiplexers and demultiplexers. (**Apply, Analyze, valuate, and create)**
CO4	Understand the basic elements of sequential logic circuits. **(Understand, Apply, Analyze)**
CO5	Design and analyze sequential circuits. **(Apply, Analyze and create)**

CO – PO Mapping

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

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II-Year-I Semester BS2113	RANDOM VARIABLES & STOCHASTIC PROCESSES	L	T	P	C
		3	0	0	3

Pre-Requisites: Mathematics

Course Objectives:

1. To give students an introduction to elementary probability theory, in preparation for courses on statistical analysis, random variables and stochastic processes.
2. To introduce the important concepts of random variables and stochastic processes.
3. To gain knowledge of standard distributions this can describe real life phenomena.
4. To analyze the LTI systems with stationary random process as input.
5. To introduce the types of noise and modeling noise sources.

UNIT-I: THE RANDOM VARIABLE **10 HOURS**

Introduction, Review of Probability Theory, Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Conditional Density, Properties, Practical examples of Random variables and different distribution functions.

UNIT-II: OPERATION ON ONE RANDOM VARIABLE – EXPECTATIONS 10 HOURS Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Non-monotonic Transformations of Continuous Random Variable.

UNIT-III: MULTIPLE RANDOM VARIABLES **08 HOURS**

Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem: Unequal Distribution, Equal Distributions.

OPERATIONS ON MULTIPLE RANDOM VARIABLES **08 HOURS**

Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variables case, Properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables, Practical examples.

UNIT–IV: RANDOM PROCESSES – TEMPORAL & SPECTRAL CHARACTERISTICS 12 HOURS

The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, Nth-order and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. The Power Density Spectrum: Properties, Relationship between Power Density Spectrum and Autocorrelation Function, the Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function

UNIT-V: LINEAR SYSTEMS WITH RANDOM INPUTS & MODELLING OF NOISE SOURCES 12 HOURS

Random Signal Response of Linear Systems: System Response – Convolution, Mean and Mean-squared Value of System Response, Autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectra of Input and Output, Band pass, Band-Limited and Narrowband Processes, Properties,

Resistive (Thermal) Noise Source, Arbitrary Noise Sources, Effective Noise Temperature, Average Noise Figure, Average Noise Figure of cascaded networks., Practical examples.

Text Books

1. Probability, Random Variables & Random Signal Principles, Peyton Z. Peebles, TMH, 4th Edition, 2001
2. Probability Theory and Stochastic Processes, Y. Mallikarjuna Reddy, universities press, 4th edition, 2013.
3. Schaum's Outline of Probability, Random Variables, and Random Processes.

Reference Books

1. Probability, Random Variables and Stochastic Processes, Athanasios Papoulis and S.Unnikrisha, PHI, 4th Edition, 2002.
2. Principles of Communication systems by Taub and Schilling (TMH), 2008.
3. Statistical Theory of Communication – S.P Eugene Xavier, New Age Publications, 2003.
4. R.P. Singh and S.D. Sapre, "Communication Systems Analog & Digital", TMH, 1995.
5. Henry Stark and John W.Woods, "Probability and Random Processes with Application to Signal Processing", Pearson Education, 3rd Edition.
6. George R. Cooper, Clave D. MC Gillem, "Probability Methods of Signal and System Analysis", Oxford, 3rd Edition, 1999.

E-Resources

1. https://nptel.ac.in/courses/108/106/108106163/
2. https://nptel.ac.in/courses/108/104/108104100/
3. https://nptel.ac.in/courses/108/105/108105065/
4. https://nptel.ac.in/courses/117/104/117104074/
5. https://nptel.ac.in/courses/117/101/117101055/
6. https://nptel.ac.in/courses/108/106/108106075/

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Mathematically model the random phenomena and solve simple probabilistic problems.**(Understand, Apply)**
CO2	Identify different types of random variables and compute statistical averages of these random variables.**(Analyse, Apply, Compute)**
CO3	Learn how to deal with multiple random variables, conditional probability and conditional expectation, joint distribution and independence, mean square estimation. **(Analyse, Apply, Compute)**
CO4	Characterize the random processes in the time and frequency domains. **(Define, Understand)**
CO5	Analyse the LTI systems with random inputs and to Construct and analyse the mathematical modelling of noise sources.**(Define, Analyse, Apply, Compute)**

CO – PO Mapping

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

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II-Year-I Semester PC2104L	ELECTRONIC DEVICES AND CIRCUITS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To study basic electronic components.
2. To observe characteristics of electronic devices

Electronic Workshop Practice:

1. Identification, Specifications, Testing of R, L, C Components (Color Codes), Potentiometers, Coils, Gang Condensers, Relays, Bread Boards.
2. Identification, Specifications and Testing of active devices, Diodes, BJTs, JFETs, LEDs, SCR, UJT.
3. Soldering Practice- Simple circuits using active and passive components.
4. Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, Function Generator, Regulated Power Supply and CRO.

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. V-I characteristics of Junction diode (Both Silicon and Germanium Diodes).
2. V-I characteristics of Zener diode.
3. Half Wave Rectifier with and without Capacitor filter
4. Centre-tap Full Wave Rectifier with and without capacitor filter
5. Bridge Rectifier with and without capacitor filter
6. Zener diode as voltage regulator (design).
7. BJT characteristics (CB-input, output characteristics and measurement of device parameters).
8. BJT characteristics (CE-input, output characteristics and measurement of device parameters).
9. JFET Characteristics (Drain, transfer characteristics and measurement of parameters).
10. MOSFET characteristics (drain, transfer characteristics and measurement of device parameters).
11. JFET/MOSFET voltage-divider bias circuit
12. Design of CE amplifier with self-bias.
13. Design of variable DC power supply (application).

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Measure voltage, frequency and phase of any waveform using CRO.**(Understand)**
CO2	Generate sine, square and triangular waveforms with required frequency and amplitude using function generator. **(Apply)**
CO3	Analyze the characteristics of different electronic devices such as diodes, transistors etc. **(Apply)**
CO4	Apply the diode working principles to design simple circuits like rectifiers, power supplies and amplifiers etc. **(Apply)**
CO5	Design the BJT amplifier circuit for the given operating conditions and specifications. (**Apply)**

CO – PO Mapping

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

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II-Year-I Semester PC2105L	SIGNALS AND SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To observe different signals and operations on signals.
2. To study Fourier Transform/Series and sampling theorem.
3. To study continuous time and discrete time systems.
4. To observe convolution.

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. Introduction to Relational Operators, Loops & Functions, Matrix Operations.
2. Exercises on understanding complex numbers, Tylor"s and Euler"s series, finding the roots of linear system of equations.
3. Loading and printing/playing/displaying multimedia files.
4. Construction of elementary signals, operations on those signals, synthesis of some deterministic musical notes and the generation of their echo, delay & reverberation.
5. Periodic signals, synthesis of signals using Fourier series and Gibbs phenomenon
6. Fourier transforms and verification of its properties.
7. Sampling, reconstruction, rate conversion and investigation of aliasing effect.
8. Determining the transfer functions of analog filters using Laplace transforms and their analysis using pole-zero plots.
9. Determination of the transfer function of a system constructed by the interconnection of several sub systems
10. Understanding z-transforms and Frequency Responses of a causal discrete- time LTI system implemented using the difference equation.
11. Convolution on Continuous Time Signals with application of smoothing some noisy speech or any one dimensional real signal (data files are to be provided).
12. Filtering Periodic Signals.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Generate different signals.
CO2	Understand Fourier Transform/Series and process of sampling.
CO3	Generate continuous time and discrete time systems.
CO4	Perform convolution

CO – PO Mapping

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

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II-Year-I Semester PC2106L	DIGITAL CIRCUITS AND LOGIC DESIGN LAB	L	T	P	C
		0	0	3	1.5

List of Experiments: (Minimum of Twelve Experiments has to be performed)

1. Verification of truth tables of Logic gates

   Two input (i) OR (ii) AND (iii) NOR (iv) NAND (v) Exclusive OR (vi) Exclusive NOR

2. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit

3. Verification of functional table of 3 to 8 line Decoder /De-multiplexer

4. 4 variable logic function verification using 8 to 1multiplexer.

5. Design full adder circuit and verify its functional table.

6. Verification of functional tables of

   (i) J K Edge triggered Flip –Flop

   (ii) J K Master Slave Flip – Flop (iii)D Flip -Flop

7. Design a four bit ring counter using D Flip – Flops / JK Flip Flop and verify output

8. Design a four bit Johnson's counter using D Flip-Flops / JK Flip Flops and verify output

9. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.

10. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T-Flip- Flops and Test it with a low frequency clock and Sketch the output waveforms.

11. Design MOD – 8 synchronous counter using T Flip-Flop and verify the result and Sketch the output waveforms.

12. (a) Draw the circuit diagram of a single bit comparator and test the output

    (b) Construct 7 Segment Display Circuit Using Decoder and 7 Segment LED and test it.

ADD on Experiments:

1. Design BCD Adder Circuit and Test the Same using Relevant IC

2. Design Excess-3 to 9-Complement convertor using only four Full Adders and test the Circuit.

3. Design an Experimental model to demonstrate the operation of74154 De-Multiplexer using LEDs for outputs.

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II-Year-I Semester	DATA PRE-PROCESSING AND VISUALIZATION	L	T	P	C
SC2101		1	0	2	2

Pre-Requisites: Fundamentals of Python Programming

Course Objectives:

1. To introduce classes in Python
2. To understand I/O and error handling
3. To introduce relational databases
4. To implement machine learning algorithms
5. To familiarize student with various steps in data analysis, visualization and Python data pre-processing techniques

UNIT-I: INTRODUCTION TO PYTHON Use IDLE to develop programs, Basic coding skills, working with data types and variables, working with numeric data, working with string data, Python functions, Boolean expressions, selection structure, iteration structure, working with lists, work with a list of lists, work with tuples, work with dates and times, get started with dictionaries.
UNIT-II: CLASSES IN PYTHON OOPS Concepts, Classes and objects , Classes in Python, Constructors,Data hiding, Creating Classes, Instance Methods, Special Methods, Class Variables, Inheritance,Polymorphism, Type Identification, Custom Exception Classes, Iterators, generators and decorators.
UNIT-III: I/O AND ERROR HANDLING IN PYTHON Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data From a File, Additional File Methods, Handling IO Exceptions, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Working with Directories.
UNIT-IV: AN INTRODUCTION TO RELATIONAL DATABASES SQL statements for data manipulation, Using SQLite Manager to work with a database, Using Python to work with a database, creating a GUI that handles an event, working with components.
UNIT-V: IMPLEMENT MACHINE LEARNING ALGORITHMS Usage of Numpy for numerical Data, Usage of Pandas for Data Analysis, Matplotlib for Python plotting, Seaborn for Statical plots, interactive Dynamic visualizations, SciKit for Machine learning.

TEXT BOOKS

1. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
2. Haltermanpythonhttps://github.com/halterman/PythonBook-SourceCode
3. Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010
4. Charles Severance et al, Python for Everybody: Exploring Data in Python 3
5. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media; 1st edition (November 21, 2016)

ONLINE RESOURCES:

1. https://www.w3schools.com/python
2. https://docs.python.org/3/tutorial/index.html
3. https://www.python-course.eu/advanced_topics.php

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II-Year-I Semester MC2102	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		2	0	0	0

Pre-Requisites: Nil

Course Objectives:

1. The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system
2. To understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act 2003.
3. The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection.
4. To know the student traditional knowledge in different sector.

UNIT-I:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge.

UNIT-II:

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT-III:

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act); B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

UNIT–IV:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT-V:

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Text Books

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Knowledge Traditions and Practices of India, by Kapil Kapoor, Michel Danino.

E-Resources

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Understand the concept of Traditional knowledge and its importance.
CO2	Know the need and importance of protecting traditional knowledge.
CO3	Understand legal framework of TK, Contrast and compare the ST and other traditional forest dwellers.
CO4	Know the various enactments related to the protection of traditional knowledge.
CO5	Understand the concepts of Intellectual property to protect the traditional knowledge.

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II-Year-II Semester	ANALOG CIRCUITS	L	T	P	C
PC2207		3	0	0	3

Pre-Requisites: Electronic Devices and Circuits, Network Analysis

Course Objectives:

1. To **understand** the concept of Linear and Non Linear wave shaping
2. To **analyz**e various amplifier circuits using BJT and MOSFET at high frequencies and multistage amplifiers.
3. To **familiarize** the concept of feedback in amplifiers and **analysis** of different types of feedback amplifiers.
4. To **analyze** and **design** different types of oscillator circuits.
5. To **understand** different types of power amplifiers and perform **analysis** of tuned circuits.

UNIT-I:

Linear Wave Shaping: **07 HOURS**

High pass and low pass RC circuits, Response to sine, step, pulse, square, and ramp inputs with different time constants, High pass as a differentiator, Low pass as an Integrator

Nonlinear Wave Shaping: **07 HOURS**

Diode clippers, Transfer characteristics of clippers, series and shunt clippers, clipping at two independent levels, Clamping operation, Clamping circuit theorem.

UNIT-II:

Multistage Amplifiers: **07 HOURS**

Classification of Amplifiers, Distortion in amplifiers, Different coupling schemes used in amplifiers, Frequency response and Analysis of multistage amplifiers, Cascaded RC Coupled amplifiers, Cascode amplifier, Darlington pair.

Transistor at High Frequency: **07 HOURS**

Transistor at high frequencies, Hybrid- π common emitter transistor model, Hybrid π conductances, Hybrid π capacitances, validity of hybrid π model, Miller effect, Hybrid - model of Common Emitter transistor model, $f\alpha$, $f\beta$ and unity gain bandwidth, Analysis of common source and common drain amplifiers at high frequencies.

UNIT-III: FEEDBACK AMPLIFIERS **10 HOURS**

Feedback principle and concept, types of feedback, classification of amplifiers, feedback topologies, Characteristics of negative feedback amplifiers, Generalized analysis of feedback amplifiers, Performance comparison of feedback amplifiers, Method of analysis of feedback amplifiers and Simple problems.

UNIT–IV: OSCILLATORS **08 HOURS**

Condition for Oscillations, RC type Oscillators-RC phase shift and Wien-bridge Oscillators, LC type Oscillators –Generalized analysis of LC Oscillators, Hartley and Colpitts Oscillators, crystal oscillators.

UNIT-V:

Large Signal Amplifiers: **07 HOURS**

Class A Power Amplifier- Series fed and Transformer coupled Conversion Efficiency, Class B Power Amplifier- Push Pull and Complimentary Symmetry configurations, Conversion Efficiency, Principles of Class AB and Class –C Amplifiers.

Tuned Amplifiers: **07 HOURS**

Introduction, single Tuned Amplifiers – Q-factor, frequency response of tuned amplifiers, Concept of stagger tuning and synchronous tuning.

Text Books

1. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub, McGraw-Hill
2. Pulse and Digital Circuits – A. Anand Kumar, PHI, 2005.
3. Millman and Halkias: Integrated Electronics, Tata Mc.Graw Hill, 2004.
4. Sedra and Smith: Microelectronic Circuits, 4/e, Oxford University Press 1998.
5. B. Razavi , "Fundamentals of Microelectronics", Wiley.

Reference Books

1. Donald A Neamen.: Electronic Circuit Analysis and Design, 3/e, Tata Mc.Graw Hill.
2. R E Boylstead and L Nashelsky: Electronic Devices and Circuit Theory, 9/e, Pearson Education.
3. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub, Mothiki S Prakash Rao McGraw-Hill, Second Edition, 2007.
4. Solid State Pulse circuits - David A. Bell, PHI, 4th Edn., 2002.

E-Resources

1. https://nptel.ac.in/courses/117/106/117106087/
2. https://nptel.ac.in/courses/117/106/117106088/
3. https://nptel.ac.in/courses/108/105/108105158/
4. https://www.youtube.com/playlist?list=PL7qUW0KPfsIIOPOKL84wK_Qj9N7gvJX6v
5. https://www.youtube.com/playlist?list=PLm2lpI_krGU5p0EHm1MArCs4hb99KOVzp

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	**Analyze** the RC circuits for low pass and high pass filtering and design clippers and clampers for various applications **(Analyze)**
CO2	**Apply** and **Analyze** various amplifier circuits using BJT and MOSFET at high frequencies and multistage amplifiers. **(Apply, Analyze)**
CO3	**Familiarize** the concept of feedback in amplifiers and **analysis** of different types of feedback amplifiers.**(Familiarize, Analyze)**
CO4	**Analyze** and **Design** different types of oscillator circuits.**(Analyze)**
CO5	**Understand** different types of power amplifiers and perform **analysis** of single tuned circuits. **(Understand, Analyze)**

CO – PO Mapping

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

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II-Year-II Semester PC2208	ELECTROMAGNETIC FIELDS & WAVES	L	T	P	C
		2	1	0	3

Pre-Requisites: Signals and Systems

Course Objectives:

1. To introduce the basic mathematical concepts related to electromagnetic vector fields.
2. To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
3. To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
4. To impart knowledge on the concepts of Faraday‘s law, induced EMF and Maxwell‘s equations.
5. To impart knowledge on the concepts of electromagnetic waves.

UNIT-I: ELECTROSTATICS-1 **15 HOURS**

Review of Vector Analysis, orthogonal Coordinate Systems, Electric Charge, Coulomb’s Force Law, Electric Field Intensity, Charge Distributions, Field Due to line, sheet and volume charge distributions, Concept of Electric Flux, Electric Flux Density, Gauss Law and Applications, Divergence, Divergence theorem, Maxwell’s First equation of Electrostatics.

UNIT-II: ELECTROSTATICS-2 **15 HOURS**

Work in Electric field and Electric Potential, Gradient of Potential, Maxwell’s second Equation for Electrostatic Fields, Electric Dipole, Electrostatic Energy and Energy Density. Convection and Conduction Currents, Electric Field in Dielectrics and Conductors, Electrostatic Boundary Conditions, Continuity Equation, Relaxation Time, Poisson’s and Laplace’s Equations; Capacitance – Parallel Plate, Coaxial Capacitors, Illustrative Problems.

UNIT-III: THE STEADY MAGNETIC FIELD **12 HOURS**

Biot-Savart’s Law, Ampere’s Circuital Law and Applications, Magnetic Flux Density, Curl and Stokes Theorem, Maxwell’s First Equation for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Maxwell’s Second Equation for Magnetostatic Fields, Forces due to Magnetic Fields, Ampere’s Force Law, Inductances and Magnetic Energy, Magnetostatic Boundary Conditions Illustrative Problems.

UNIT–IV: MAXWELL’S EQUATIONS FOR TIME VARYING FIELDS **08 HOURS**

Review of Maxwell’s Equations For Static Fields in differential and Integral forms, Introduction to Time varying Fields, Faraday’s Law, Transformer e.m.f, Lenz’s Law, Motional e.m.f, Inconsistency of Ampere’s Law and Displacement Current Density, Maxwell’s Equations in Different Final Forms and Word Statements.

UNIT-V: EM WAVE CHARACTERISTICS **15 HOURS**

Solution of Maxwell’s Equations for time varying fields, EM Wave Equations for Different media, Uniform Plane Waves – Definition, All Relations Between E & H, Sinusoidal Variations, Wave Phenomenon in Free Space, Lossless, Lossy dielectrics, Wave Propagation in good conductors, skin depth, Wave Polarization & Types. Illustrative Problems.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Power carried by EM Wave, Poynting Vector, Poynting Theorem – Applications.

Text Books
1. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000. 2. Elements of Electromagnetic – Matthew N.O. Sadiku, Oxford Univ. Press, 3rd ed., 2001. 3. Electromagnetic Wave s and Transmission Lines - Y.Mallikharjuna Reddy, Universities Press (India) Pvt. Ltd.
Reference Books
1. Engineering Electromagnetics – William H. Hayt Jr. and John A. Buck, TMH, 7th ed., 2006. 2. Engineering Electromagnetics - Nathan Ida, Springer(India)Pvt.Ltd., New Delhi, 2nd ed., 2005. 3. Schaum's Outline of Electromagnetics - Joseph Edminister and Mahmood Nahvi, fourth edition

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Use the concepts of vectors and space coordinates to solve the fundamental problems of static electric fields.
CO2	Apply principles of static electric field to understand the behaviour of dielectrics and conductors.
CO3	Understand the principles of steady magnetic field.
CO4	Solve the Maxwell's equations of Time Varying fields and obtain the wave phenomenon in various media.
CO5	Analyze wave propagation characteristics and power transportation phenomenon.

CO – PO Mapping

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

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II-Year-II Semester PC2209	DIGITAL SYSTEM DESIGN WITH VHDL	L	T	P	C
		3	0	2	3

Pre-Requisites: Digital Circuits and Logic Design

Course Objectives:

1. To understand various Digital Logic Families and their Interfacing
2. To know the basics of VHDL and programming models
3. To implement digital systems using VHDL
4. To design combinational circuits using VHDL code and relevant ICs
5. To design and implement sequential circuits using VHDL code and relevant ICs

UNIT-I: DIGITAL LOGIC FAMILIES **16 HOURS**

Introduction to logic families, CMOS logic, CMOS steady state and dynamic electrical behavior, CMOS logic families. Bipolar logic, Transistor-Transistor logic and TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, Emitter coupled logic, Parameters to choose logic families for the design applications.

UNIT-II: INTRODUCTION TO VHDL **13 HOURS**

Introduction to HDL, design flow with VHDL, Program structure in VHDL. Levels of abstraction, VHDL elements: data types, data objects, operators and identifiers. VHDL programming models: data flow, structural and behavioral with examples on simple combinational and sequential circuits.

UNIT-III: DIGITAL DESIGN USING VHDL **12 HOURS**

Concurrent vs. Sequential statement, *Concurrent statements:* WHEN, GENERATE, BLOCK. Process: single and multiple, variable assignment vs signal assignment. *Sequential statements:* IF, WAIT, CASE, LOOP, NULL, EXIT, ASSERTION, CASE vs IF, CASE vs WHEN. Delay Models: Inertial and Transport, Comparison of VHDL with other procedural languages.

UNIT–IV: COMBINATIONAL LOGIC IC DESIGN **12 HOURS**

Adders: Ripple Carry, Carry Look ahead, Adder-Sub tractors, Multiplexers, Decoders/De-multiplexers, Encoders: Priority Encoders, Parity Checkers, ALU, Comparators, Design considerations of these combinational circuits using VHDL code and relevant IC.

UNIT-V: SEQUENTIAL LOGIC IC DESIGN **13 HOURS**

SSI Latches and Flip-flops, Shift Registers, Synchronous and Asynchronous Counters, Ring and Johnsons Counter, Sequence detector. Design considerations of these sequential circuits using VHDL code and relevant IC.

Introduction to PLDs: Overview of PLDs, CPLD: Introduction to CPLD, SPLD versus CPLD, FPGA: Building Blocks, FPGA based Digital System Design Philosophy.

Text Books

1. Digital Design Principles & Practices – John F. Wakerly, PHI/ Pearson Education Asia, 3rd Ed., 2005.
2. Circuit Design with VHDL - V. A. Pedroni, MIT Press, Cambridge, 2004.
3. VHDL Primer – J. Bhasker, Pearson Education/ PHI, 3rd Edition.
4. Digital System Design with FPGA: Implementation using Verilog and VHDL - Cem Unsalan, Bora Tar, McGraw Hill Education, 2017.

Reference Books

1. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, ZvonkoVranesic, McGraw Hill, 3rd Edition, 2009.
2. Digital systems principles and Applications-Ronald J. Tocci, Neal S.Widmer, Eighth Edition, Prentice Hall.
3. VHDL: Programming by Example- Douglas L. Perry, Fourth Edition, Tata McGraw-Hill.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	Understanding the structural description and electrical characteristics of various digital logic families.
CO2	Studying basics of HDL and Programming models of VHDL.
CO3	Implementing digital systems using VHDL.
CO4	Implementing the Combinational logic using ICs and VHDL code.
CO5	Modeling of Sequential circuits using ICs and VHDL code.

CO – PO Mapping

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

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II-Year-II Semester ES2209	CONTROL SYSTEMS	L	T	P	C
		3	0	2	3

Pre-Requisites: Mathematics-1, Networks and Transmission Lines, Signals and Systems.

Course Objectives:

1. To introduce the concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems, and concepts of feedback.

2. To study the characteristics of the given system in terms of the transfer function and introducing various approaches to reduce the overall system for necessary analysis.

3. To develop the acquaintance in analyzing the system response in time-domain and frequency domain in terms of various performance indices.

4. To analyze the system in terms of absolute stability and relative stability by different approaches.

5. To design different control systems for different applications as per given specifications. To introduce the concepts of state variable analysis, design and also the concepts of controllability and observability.

UNIT-I: **13 HOURS**

Introduction: System Control System, Open Loop Control System, Closed loop Control System, Different Examples.

Effects of Feedback: Feedback Characteristics and its advantages, Linearizing effect of feedback.

Mathematical models of Physical Systems: Differential equations of physical systems, Transfer functions, Block diagram Algebra, Signal flow graphs with illustrative examples.

UNIT-II: **14 HOURS**

Controller Components: DC Servomotor (Armature Controlled and Field Controlled) with necessary derivation for transfer function, AC Servomotor and its transfer function, AC Tachometer, Potentiometer, Synchros, AC Position Control Systems.

Time Response Analysis: Standard test Signals, Time response of first and second order systems, steady state errors and error constants, Effect of adding a zero to a system, Design specifications of second order systems, Performance indices.

UNIT-III: **12 HOURS**

Concepts of Stability and Algebraic Criteria: The concept of Stability, Necessary Conditions for Stability, Routh-Hurwitz Srability Criterion, Relative stability analysis.

The Root Locus Technique: Introduction, The Root Locus concepts, Construction of Root Loci.

UNIT–IV: **12 HOURS**

Frequency Response Analysis: Introduction, Correlation between time and frequency response, frequency domain specifications, Polar Plots, Bode Plots, Nyquist Stability Criterion.

UNIT-V: **14 HOURS**

Introduction to Design: The design problem, Preliminary consideration of classical design, Realization of basic Compensators, Cascade compensation in time domain and frequency domain.

State Variable Analysis and Design: Introduction, Concepts of State, State Variables and State models, State models for linear continuous-time systems, State variables and linear discrete-time systems, Solution of state equations and Concepts of Controllability and Observability.

Text Books

1. J. Nagrath and M. Gopal: Control System Engineering, New Age International Publishers, Fifth edition.
2. Katsuhiko Ogata: Modern Control Engineering, Pearson, Fifth Edition.
3. S. Salivahanan, R. Rengaraj, and G. R. Venkata Krishnan: Control Systems Engineering," Pearson, First Impression.

Reference Books

1. Benjamin C. Kuo, Frarid Golnaraghi: Automatic Control Systems," Wiley Student Edition, Eighth Edition.
2. Padma Raju and Reddy: Instrumentation and Control Systems ", McGraw Hill Education, 2016.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	**Understand** the concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems, concepts of feedback, Construct the mathematical model of a system and Apply various approaches to reduce the overall system.
CO2	**Develop** the acquaintance in analyzing the system response in time-domain, in terms of various performance indices.
CO3	**Analyze** the system in terms of absolute stability and relative stability by different approaches.
CO4	**Develop** the acquaintance in analyzing the system response in frequency domain in terms of various performance indices.
CO5	**Design** the control systems for various applications using time-domain and frequency domain analysis as per given specifications. **Determine** the controllability and observability of the control system using the concepts of state variable analysis.

CO – PO Mapping

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

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II-Year-II Semester	DATA STRUCTURES	L	T	P	C
OE2201	(Open Elective-1)	2	0	2	3

Pre-Requisites: Prior knowledge of programming language(s) and fundamental mathematics

Course Objectives:

1. To impart the usage of linear list to students.
2. To help students understand the difference between dynamic memory using linked list.
3. To demonstrate the students about the operations Trees.
4. To make the student to understand various algorithms in graphs.
5. To make the students to learn the importance of hashing and sorting algorithms.

UNIT-I: ALGORITHMS AND LINEAR LISTS **10 HOURS** Algorithmic complexity, performance and Analysis, Linear lists (Arrays) , Applications of Linear List : Searching and Sorting.
UNIT-II: STACKS AND QUEUES, LINKED LISTS **16 HOURS** Single Linked List, Double Linked List, Circular Linked List, Stack and Queues using Linked list.
UNIT-III: TREES **14 HOURS** Binary Trees Operations, Tree traversal, Threaded Binary Trees, Binary Search Trees, Binary Heap
UNIT–IV: GRAPHS **10 HOURS** Elementary Graph Operations, Graph Traversals, Minimum cost spanning tree Algorithms, Shortest paths algorithms.
UNIT-V: HASHING AND PATTERN MATCHING **10 HOURS** Concept Hashing, Hash Functions, Collision Resolution Techniques, Pattern Matching algorithms.

Text Books

1. Data structures, Algorithms and Applications in Java, S. Sahni, University Press (India) Pvt. Ltd, 2nd edition, Universities Press, Pvt. Ltd.
2. Data structures and Algorithm Analysis in Java, Mark Allen Weiss, Pearson Education. Ltd, Second Edition.

Reference Books

1. Data Structures and Algorithms, A. V. Aho, J. E. Hopcroft, and J. D. Ullman, Pearson, 2002.
2. Introduction to Algorithms, by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, MIT Press. 3rd Edition.
3. Classical Data Structures, 2nd Edition, Debasis Samanta, PHI.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1	**Understand** the implementation of linear lists **(Understand)**
CO2	**Examine** static and dynamic data structures with suitable applications. **(Apply)**
CO3	**Determine** trees applications. **(Apply)**
CO4	Appreciate the importance and **significance** of graph algorithms in building and solving real world applications. **(Analyze)**
CO5	**Understand** and implement algorithms for text processing.**(Understand)**

CO – PO Mapping

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

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II-Year-II Semester PC2211L	ANALOG CIRCUITS LAB	L	T	P	C
		0	0	3	1.5

Perform design experiments (from 1 to 8) using discrete components and perform design and simulation experiments (from 9 to 11) using any PSPICE simulators or any equivalent software.

List of Experiments: (Minimum of ten experiments to be done in both hardware and software.)

1. Design and verify the operation of RC Circuit as differentiator and integrator.
2. Design and study the clipper circuits for the given specifications.
3. Study the operation of positive and negative clampers circuits.
4. Design common emitter amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response.
5. Design common source amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response.
6. Design a two stage RC coupled amplifier for given specifications. Determine Gain and Bandwidth from its frequency response curve.
7. Design a RC Phase shift oscillator and Wien bridge oscillator for the given specification. Determine the frequency of oscillation.
8. Perform Hartley and Colpitts oscillators for the given specifications. Determine the frequency of oscillation.
9. Determine Gain and Bandwidth from its frequency response curve of a darlington amplifier.
10. Perform voltage series feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier.
11. Perform single tuned amplifier for the given specifications.

Equipment/Software required:

1. Multisim software or any equivalent software
2. Personal computer system with necessary software to run the programs and Implement.
3. Regulated Power Suppliers, 0-30V
4. 20 MHz, Dual Channel Cathode Ray Oscilloscopes.
5. Functions Generators-Sine and Square wave signals
6. Multimeters
7. Electronic Components

*****

II-Year-II Semester PC2202L	DIGITAL SYSTEM DESIGN WITH VHDL LAB	L	T	P	C
		0	0	3	1.5

The students are required to design and draw the logical structure of the following Digital Circuits (relevant ICs wherever mentioned) and write VHDL code to perform simulation and synthesis.

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. Realization of Logic Gates using dataflow model
2. Design of Full Adder using dataflow, behavioral and structural (using logic gates and also with half adder) modeling.
3. Implement the VHDL code of 74x138 -- 3 to 8 Decoder.
4. Implement the VHDL code of Priority Encoder.
5. Design 8 x 1 Multiplexer using structural modeling by instantiating 4 x 1 Multiplexer (with enable input).
6. Design a 4- bit comparator using VHDL.
7. Design of 4-bit ALU using VHDL.
8. Implementation of SR, JK, D and T- flip-flops using behavioral model.
9. Design of 8-bit serial in-parallel out and parallel in-serial out shift register.
10. Design of Universal Shift Register.
11. Design of Synchronous Decade counter.
12. Design of Ring and Johnsons counter.
13. Design of Sequence detector.
14. Design of Vending Machine.

Note: **Perform all above experiments related to real time examples**

Equipment/Software required:

1. Relevant software
2. Personal computer system with necessary software to run the programs and Implement.

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II-Year-II Semester	OPEN SOURCE HARDWARE TOOLS FOR ELECTRONIC ENGINEERS	L	T	P	C
SC2202		1	0	2	2

Pre-Requisites: Knowledge of electronics components

Preamble: "Open hardware," or "open source hardware," refers to the design specifications of a physical object which are licensed in such a way that said object can be studied, modified, created, and distributed by anyone. Like open source software, the "source code" for open hardware—schematics, blueprints, logic designs, Computer Aided Design (CAD) drawings or files, etc.—is available for modification or enhancement by anyone under permissive licenses. Users with access to the tools that can read and manipulate these source files can update and improve the code that underlies the physical device. They can even modify the physical design of the object itself and, if they wish, proceed to share such modifications.

Course Objectives:

1. To introduce open-sourcehardware platforms to the students
2. To design and develop general purpose electronic systems
3. To introduce electronic system coding, testing and debugging tools
4. To interface different analog and digital sensors which are basic building blocks for any interactive system design.
5. To familiarize student with the basic PCB designing concepts.

UNIT-I: INTRODUCTION TO OPEN-SOURCE TOOLS Embedded systems, microprocessors and microcontrollers, What is open-source, why open-source, advantages of open-source tools, open-source hardware development platforms – Arduino, Raspberry Pi and Beagle bone.
UNIT-II: INTRODUCTION TO ARDUINO Introduction to Arduino , Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, Introduction to Embedded C and Arduino platform
UNIT-III: PROGRAMMING ARDUINO BOARDS Arduino data types, Variables and constants, Operators, Control Statements, Arrays, Functions, Pins Configured as INPUT, Pull-up Resistors, Pins Configured as OUTPUT, pinMode() Function, digitalWrite() Function, analogRead() function.
UNIT-IV: INTERFACING SENSORS WITH ARDUINO Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor, Connecting Switch (Magnetic relay switches), buzzers, LEDs and LCD.
UNIT-V: INTRODUCTION TO PCB DESIGNING CONCEPTS Introduction & history: Types, PCB materials, Trends in designing, Component packaging types. PCB designing flow chart, Description of PCB layers, study of IPC standards.

Hardware: Arduino UNO, NANO, MEGA2560.
Software's used: Arduino IDE
For PCB designing: PCBWeb Designer, ZenitPCB, TinyCAD, Osmond PCB, BSch3V, Express PCB, Kicad, Fritzing, DesignSpark PCB, EasyEDA.

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ANNEXURE-II: Syllabus of V and VI semester of R-19 regulations.

III Year I Semester						
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	**EC08**	Linear IC Applications	3	0	0	3
2	**EC09**	Micro Processors and Micro Controllers	3	0	0	3
3	**EC10**	Antennas and Wave Propagation	3	0	0	3
4	**EC11**	VLSI Design	3	0	0	3
5	**OE01**	Open Elective – 1	3	0	0	3
6	**EC12**	Computer Networks	3	0	0	3
7	**EC08L**	Linear IC Applications Lab	0	0	3	1.5
8	**EC09L**	Micro Processors and Micro Controllers Lab	0	0	3	1.5
9	**EC11L**	VLSI Design Lab	0	0	3	1.5
Total Credits						**22.5**

III Year II Semester						
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	**EC13**	Digital Signal Processing	3	0	0	3
2	**HSM03**	Managerial Economics and Financial Analysis	3	0	0	3
3	**PE01**	Professional Elective – 1	3	0	0	3
4	**PE02**	Professional Elective - 2	3	0	0	3
5	**PE03**	Professional Elective – 3	3	0	0	3
6	**EC13L**	Digital Signal Processing Lab	0	0	3	1.5
7		**Mini Project**	0	0	6	3
Total Credits						**19.5**

PROFESSIONAL ELECTIVES

Professional Elective- I	Professional Elective- II	Professional Elective- III	Professional Elective- IV	Professional Elective- V	Professional Elective- VI
Cellular & Mobile Communication	Optical Communications	Satellite Communications	Information Theory & Coding	Cognitive Radio	Radar Engineering
ASIC Design	Low Power VLSI	Analog IC Design	CPLD & FPGA	MEMS	Scripting Languages
Machine Learning	Embedded System Design & Robotics	Embedded & Real Time Operating Systems	Internet of Things	Pattern Recognition	Deep Learning
Digital TV Engineering	Bio-Medical Electronics	Speech Signal Processing	Image & Video Processing	DSP Processors & Architectures	Multimedia Processing

OPEN ELECTIVES

Open Elective- I	Open Elective- II	Open Elective- III	Open Elective- IV
OOPS Through Java	Neural Networks and Fuzzy Logic	Operating Systems	Database Management Systems
MATLAB for Engineering Applications	Energy Auditing	Advanced Control Systems	Programming Logic Controllers
Total Quality Management	Supply Chain Management	Product Design & Development	Entrepreneurship
Disaster Management	Environmental Pollution and Control	Green Buildings	Remote Sensing & GIS Applications

III Year-I SEMESTER

L	T	P	C
3	0	0	3

LINEAR IC APPLICATIONS

Pre-Requisites: Network Analysis & Basic Electronics

Course objectives:

1. To understand the basic operation and performance parameters of differential amplifier and operational amplifier.
2. To learn the linear and non-linear applications of operational amplifier.
3. To understand the analysis & design of different types of active filters using Op-Amps.
4. To learn the internal structure, operation and applications of different analog IC's.
5. To understand the various types of Digital to Analog and Analog to Digital converters

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Differential Amplifier and Operational Amplifier Characteristics: [15hours]** **Differential Amplifier and Operational Amplifier Characteristics:** Internal Block Diagram of various stages of Op-Amp and Role of each Stage. Different configurations of differential amplifiers (Qualitative), DC & AC Analysis of Differential Amplifier using BJT and FET, Basic Current mirror circuit using BJT and FET, Current Repeater Circuits using BJT & FET. Improved version of current mirror, Wilson current mirror. Operational Amplifier (Symbolic Representation), Characteristics of Op-Amp, Ideal and Practical Op-Amp specifications, DC&AC characteristics of operational Amplifier: input bias current, input offset current, input offset voltage, Drift, Slew rate, CMRR, PSRR, Measurements of Op-Amp Parameters, pin diagram of IC 741. equivalent diagram of operational amplifier. Three-Terminal Voltage Regulators 78xx& 79xx Series, IC 723 general purpose voltage regulator.	**CO1**
II	**Linear and Non-Linear applications of Operational Amplifier: [11 hours]** Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Log and Anti log Amplifiers, Half wave and Full wave Precision rectifiers. Comparators, Multivibrators, Triangular and Square wave generators, Schmitt trigger.	**CO2**
III	**Active Filters, Analog Multipliers, Oscillators and Modulators: [12 hours]** Design & Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF	**CO3**

	filters. Bandpass, Band reject and all pass filters. Four Quadrant Multiplier, IC 1496, Sample & Hold circuits. Introduction to Oscillators, RC Phase shift oscillator, Wien Bridge Oscillator.	
IV	**Timers & Phase Locked Loops: [13 hours]** Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger. PLL - introduction, block schematic, principles and description of individual blocks, 565 PLL, Applications of PLL – frequency multiplication, frequency translation, AM, FM & FSK demodulators. Applications of VCO (566).	**CO4**
V	**Data Converters and its applications: [13 hours]** Introduction, basic DAC techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs - Parallel comparator type ADC, Counter type ADC, Successive approximation ADC and Dual slope ADC. Introduction to delta sigma ADC.DAC and ADC Specifications (including DNL and INL), Specifications of AD 574 (12-bit ADC).	**CO5**

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1 **Understand** the DC and AC analysis of Differential Amplifier, and performance parameters of OP-Amp and its characteristics.
{Understand level, KL2}

CO2 **Illustrate the** linear and nonlinear applications using op-amp.
{Apply level, KL3}

CO3 **Analyze and Design** active filters, Modulators and oscillators using Op-Amp.
{Analysis, KL4}

CO4 **Interpret** the internal structure and operations of different analog IC's
{Understand level, KL2}

CO5 **Construct** the various Digital to Analog and Analog to Digital Converters.
{Apply level, KL3}.

Text books:

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI,1987.
3. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill, 1988.

Reference books

1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma;SK Kataria &Sons;2nd Edition,2010
2. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin& FredrickDriscoll, PHI, 6th Edition,2000.
3. Linear Integrated Circuits by Salivahan-3rd-Edition, McGrawHill,2018.
4. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition,2011.
5. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.

e- Resources & other digital material:

1. https://nptel.ac.in/courses/108/101/108101094/
2. https://nptel.ac.in/courses/117/101/117101106/

CO-PO mapping Table:

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations **(High: 3, Medium: 2, Low: 1)**														
Mapping	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2
C01	3	2											2	
C02		3		2									2	
C03	2	3											3	
C04	2			3									3	
C05	2			2									2	

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III Year-I SEMESTER

L	T	P	C
3	0	0	3

MICROPROCESSORS & MICROCONTROLLERS

Pre-Requisites: STLD, Computer Architecture and Organisation

Course Objectives:

1. To acquire knowledge about microprocessors, and study the Architectures of 16-bit Microprocessors.
2. To learn the concept of Assembly language and programming skills.
3. To acquire the knowledge on interrupts, interfacing with various peripherals configure and develop programs to interfacing peripherals/sensors.
4. To understand the fundamental concepts of Microcontrollers and their architecture.
5. To study the concepts of ARM processors and their architecture

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**8086/8088 Microprocessor:** Architecture, Bus Interfacing Unit, Memory Segmentation and Physical Address Computations, Execution Unit, Register Organization of 8086, Pin Diagrams, Signal Descriptions, Minimum Mode of 8086 System and Timings, Maximum Mode of 8086 System and Timings, Introduction to Stack, Stack Structure of 8086, The Processor 8088, Difference Between 8086 and 8088, Addressing modes of 8086. **12 Hours**	**CO1**
II	**8086 Programming:** Program development steps, 8086 instructions: Data Transfer Instructions, Arithmetic Instructions, Bit Manipulation Instructions, String Instructions, Program Execution Transfer Instructions (Branch & Loop Instructions), Processor Control Instructions, Iteration Control Instructions and Interrupt Instructions, Assembler Directives, Machine Language Instruction Formats, Introduction to TASM, writing simple programs with an assembler, assembly language program development tools. **13 Hours**	**CO2**
III	**8086 Interfacing:** Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, stepper motor, A/D and D/A converters, software and hardware interrupt applications, Need for 8259 programmable interrupt controllers, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller. **13 Hours**	**CO3**
IV	**Intel 8051 Microcontroller:** Architecture, Hardware concepts, Input/output ports and circuits, external memory, counters/timers, serial data input/output, interrupts. Assembly language programming: Instructions, addressing modes, simple programs. Interfacing to 8051: A/D and D/A Convertors, Stepper motor interface, keyboard, LCD Interfacing, Traffic light controls. **13 Hours**	**CO4**
V	**ARM Architectures and Processors**: ARM Architecture, ARM Processors Families, ARM Cortex-M Series Family, ARM Cortex-M3 Processor Functional Description, functions and interfaces. **PIC Microcontroller:** Introduction, Characteristics of PIC Microcontroller, PIC Microcontroller Families **Basic features and comparison of ARM, PIC, AVR, Arduino, Raspberry Pie Microcontrollers.** **13 Hours**	**CO5**

Course Outcomes:

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the architecture of microprocessor and their basic hardware components and operation. **{Understanding level, KL1}**
CO2	**Demonstrate** programming skills in assembly language for processors. **{Analysis level, KL4}**
CO3	**Analyze** various interfacing techniques and apply them for the design of processor **{Analysis level, KL4}**
CO4	**Understand** the architecture of microcontroller and their operation **{Understanding level, KL1, KL2}**
CO5	Able to illustrate how the different on ARM Cortex processors and debug. **{Analyzing level, KL3}**

Learning Resources

TEXTBOOKS:

1 .Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rdEdition,1994.

2. The 8051 Microcontrollers and Embedded systems Using Assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; Pearson 2-Edition, 2011.

3. The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors by JosephYou.

REFERENCE BOOKS:

1. Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach in English, by Dr. Alexander G. Dean, Published by Arm Education Media,2017.

2. Cortex -M3 Technical Reference Manual.

E-Resources:

1. https://nptel.ac.in/courses/106/108/106108100/
2. https://nptel.ac.in/courses/117/104/117104072/#
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ee42/
4. https://nptel.ac.in/courses/108/107/108107029/

CO-PO mapping Table:

Mapping	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2
C01	3	2	2				1							
C02	3	2	1				1							
C03	3	2	2				1							
C04	3	2	2				1							
C05	1	2	3				3							

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III Year-I SEMESTER

L	T	P	C
3	0	0	3

ANTENNAS & WAVE PROPAGATION

Pre-Requisites: Electromagnetics Fields and Waves

Course Objectives:

1. Analyze the antenna parameters with respect to electromagnetic waves
2. Understand the behavior of electromagnetic wave analysis to various types of dipoleantennas.
3. Understand the antenna array design to increase filed strength in the desired direction
4. Familiarize various types of microwave antennas for real time applications
5. Understand the concept of radio wave propagation in the atmosphere

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Antenna Basics** Antenna Parameters: Introduction, Radiation Patterns, Beam width, Beam area, Radiation Intensity, Beam Efficiency, Directivity, Gain, Resolution, Antenna Efficiency, Antenna apertures, Types of antenna apertures, Effective height,Front to Back Ratio, Relationship between Directivity and Effective aperture, Radiation resistance, Radial power flow, Field regions of Antenna, illustrated problems. **14 hrs**	**CO1**
II	**THIN LINEAR WIRE ANTENNAS:** Retarded Potentials, Basic Antenna Elements, Radiation from small electric dipole, Half wave Dipole, Quarter wave monopole- Evaluation of field components, power radiated, Radiation Resistance, Directivity, Effective Area and Effective Height. Antenna Theorems- Applicability and proofs for equivalence and directional characteristics, Illustrated Problems. **14 hrs**	**CO2**
III	**ANTENNA ARRAYS :** Introduction, Various forms of Antenna arrays, Array of 2-point sources- different cases, Principle of Pattern Multiplication for 2 and 4 point sources, N- Element Uniform Linear Arrays- Broadside, End-fire Arrays, EFA with increased Directivity, Derivation of their characteristics and comparison, Directivity Relations (no derivations), Binomial Arrays, Related Problems, Arrays with Parasitic Elements, Yagi - Uda Arrays, Folded dipoles and their characteristics. Phased array Antennas. **16 hrs**	**CO3**

IV	**VHF, UHF AND MICROWAVE ANTENNAS** **Helical Antennas**- Significance, Geometry, basic properties; Design consideration for helical antenna in Axial Mode and Normal Modes (Qualitative Treatment). **Reflector Antennas:** Flat Sheet and Corner Reflectors. **Parabolic Reflectors:** Geometry, characteristics, types of feeds, F/D Ratio, Spill over, Back Lobes, Aperture Blocking, Off-set Feeds, and Cassegrain Feeds. **Antenna Measurements:** Radiation Patterns, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods) **10 hrs**	**CO4**
V	**Wave Propagation:** Concepts of Propagation – frequency ranges and types of propagations. Ground Wave Propagation–Characteristics, Fundamental Equation for Free Space Propagation, Basic Transmission Loss Calculations, Space Wave Propagation–Mechanism, LOS and Radio Horizon, Tropospheric Wave Propagation – Radius of Curvature of path, Effective Earth's Radius, Effect of Earth's Curvature, Field Strength Calculations. **10 hrs**	**CO5**

Course Outcomes:

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Identify** the Antenna Parameters
CO2	**Design and Analyze** the wire antenna and its corresponding radiation characteristics
CO3	**Design and Analyze** the various forms of Antenna Arrays
CO4	**Quantify** the various fields radiated by the microwave antennas
CO5	**Identify** the characteristics of radio wave propagation

Learning Resources

Text books:

1. Antennas and Wave Propagation - John D. Kraus and Marhefka Khan, 4th Edition, TMH, 2006.
2. Antenna Theory - C.A. Balanis, John Wiley and Sons, 2nd Edition, 2001.
3. Antennas and Wave Propagation- K. D. Prasad, Satya Prakashan, Tech India Publications, NewDelhi, 2001.

Reference books:

1. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2ndEdition, 2000.
2. Electronic and Radio Engineering – F.E. Terman, McGraw-Hill, 4th Edition, 1955.
3. Antennas and Wave Propagation – Das, TMH, 2016.

E-Resources & other digital material:

NPTEL Lecture material

1. Lecture Series on Antennas and Wave Propagation by Prof. Girish Kumar, Department of ElectricalEngineering, IIT Bombay. https://onlinecourses.nptel.ac.in/noc20_ee20/preview

CO-PO mapping Table:

Mapping	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2
C01	3		3				1							
C02	3		3				1							
C03	3		3				1							
C04	3		3				1							
C05	3		3				1							

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III Year-I SEMESTER

L	T	P	C
3	0	0	3

VLSI DESIGN

Pre-Requisites: Basic Chemical Processes, Analysis of Analog and Digital Circuits

Course Objectives:

1. Apply the electrical properties of CMOS and Bi-CMOS circuits to understand design concepts and processes
2. Familiarize with the basic circuit concepts to determine circuit delays, and also to utilize scaling of MOS circuits for miniaturization.
3. Interpret the operational aspects of the MOS transistors to analyze the design of single stage amplifiers
4. Understand the CMOS static and dynamic analytical aspects to design combinational and sequential circuits.
5. Build a strong knowledge on the fundamentals of FPGA design structures and their applications.

Syllabus

Unit No	Contents	Mapped CO
I	**IC TECHNOLOGY AND BASIC ELECTRICAL PROPERTIES OF MOS CIRCUITS 17Hrs** **IC Technology:** VLSI Design Flow, Introduction to IC Technology, Basic MOS transistors, Fabrication Process of NMOS, PMOS and CMOS, Introduction to BiCMOS Technology, Comparison between CMOS and Bipolar technologies. **Basic Electrical Properties:** I_{ds} vs. V_{ds} relationships, Aspects of MOS transistor Threshold voltage, MOS transistor transconductance and output conductance, figure of merit, The Pass transistor, The NMOS Inverter, Determination of pull up to pull down ratio for NMOS inverter driven by another NMOS inverter directly or through one or more pass transistors, Alternative forms of pull ups, The CMOS Inverter, BiCMOS Inverter, Latch-up in CMOS circuits, MOS Layers, Stick diagrams, Layout Encoding and Design Rules, Stick Diagram and Layout Diagrams Examples	**CO1**
II	**BASIC CONCEPTS AND SCALING OF MOS CIRCUITS 12Hrs** **Basic Concepts:** Sheet resistance, Sheet resistance concept applied to MOS transistors and Inverters, Area Capacitance of layers , Standard unit of capacitance, some area capacitance calculations, The Delay unit, Inverter delays, Driving large Capacitive Loads, Propagation delays , wiring capacitances, Choice of layers, Transistor switches. **Scaling:** Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Limits due to subthreshold currents, Limits on logic levels and supply voltage due to noise, Limits due to current density, Some architectural issues, Introduction to switch logic and Gate logic	**CO2**
III	**BASIC BUILDING BLOCKS OF ANALOG IC DESIGN 10Hrs** Regions of operation of MOSFET, Modelling of transistor, body bias effect, Channel Length Modulation, single stage amplifier with resistive load, single stage amplifier with diode connected load, Common Source amplifier, Common Drain amplifier, Common Gate amplifier, Cascode Amplifiers.	**CO3**

IV	**CMOS COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUIT DESIGN 13Hrs** **Static CMOS Design:** Complementary CMOS, Ratioed Logic, Pass-Transistor Logic. **Dynamic CMOS Design:** Dynamic Logic-Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates, Choosing a Logic Style, Latch Versus Register, Latch based design, multiplexer based latches, Master-Slave Based Edge Triggered Register, clock to q delay, setup time, hold time, Clocked CMOS register. Cross coupled NAND and NOR, SR Master Slave register, Pipelining	**CO4**
V	**INTRODUCTION TO PLDs AND ADVANCED TECHNOLOGIES 12Hrs** **Introduction to PLDs**: Overview of PLDs, CPLD: Introduction to CPLD, SPLD versus CPLD, Example of CPLD: Xilinx CoolRunner, FPGA: Introduction to FPGA, Organization of FPGA, Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects and I/O Blocks **Advanced Technologies:** Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology, FinFET, TFET.	**CO5**

Course Outcomes:

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Apply** the basic electrical characteristics of MOS circuits to understand design concepts and processes .**{Applying level, KL3}**
CO2	**Demonstrate** the application of the basic concepts of MOS devices to determine the delays of the circuits and their miniaturization. **{Understanding level, KL2}**
CO3	Elaborate the operation of MOS circuits to design the single-stage amplifiers **{Creating level, KL6}**
CO4	**Analyze** the static and dynamic CMOS design aspects to develop combinational and sequential circuits **{Analyzing level, KL4}**
CO5	**Understand** the architectural aspects of CPLD and FPGA, and several advanced technologies. **{ Understanding level, KL2}**

Learning Resources

Text books:

1. D. A. Pucknell and K. Eshraghian, Basic VLSI Design, (3/e), PHI Learning Pvt. Ltd., 2009.
2. B. Razavi,Design of Analog CMOS Integrated Circuits, McGraw Hill, 2003.
3. J. M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits, (2/e), 2003.
4. C. H. Roth, L. K. John and B. K. Lee, Digital Systems Design using Verilog, Cengage Learning, 2016.

Reference books:

1. K. Eshraghian, D. A. Pucknell and S. Eshraghian, Essentials of VLSI Circuits and Systems, Prentice-Hall of India Private Limited, 2005.
2. M. D. Ciletti, Advanced Digital Design with the Verilog HDL, Eastern Economy Edition, PHI, 2004.
3. A. Pang and P. Membrey, Beginning FPGA: Programming Metal: Your Brain on Hardware, APress, 2017.
4. W. Wolf, FPGA-based System Design, Prentice Hall Modern Semiconductor Design Series, 2004.

E-Resources & other digital material:

NPTEL Lecture material

1. Lecture Series on VLSI Design by Dr.Nandita Dasgupta, Department of Electrical Engineering, IIT Madras. https://freevideolectures.com/course/2328/vlsi-technology/32
2. Lecture Series on Digital VLSI System Design by Prof. S. Srinivasan, Department of Electrical Engineering, IIT Madras.

http://www.nptelvideos.in/2012/12/digital-vlsi-system-design.html

CO-PO mapping Table:

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	P012	PSO	
													1	2
CO1	2		2		2									
CO2	3	2	2	1										
CO3	3	2	2	1										
CO4	3	2	2	1										
CO5	3	2			2									

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III Year-I SEMESTER

L	T	P	C
3	0	0	3

OOPS THROUGH JAVA
(Open Elective-1)

Unit – I: Introduction to OOPS Concepts, Classes and Strings

Differences between C and Java, History of Java, Introduction to Object Oriented Programming, Java Programming Basics, Data types and operators, Control statements.

Arrays-One Dimensional and multi-dimensional arrays, Searching, Sorting, Command-line arguments.

Unit – II: Classes, Inheritance, Interfaces, Packages

Classes: Classes, Objects, Methods, Constructors, Method and Constructor Overloading, this and static keywords, Access modifiers, inner classes.

Inheritance: Need of inheritance, types, super keyword, abstract classes, final keyword, interfaces, Packages.

Unit – III: Exception Handling and I/O Streams

Exception Handling: Exception, Keywords-try, catch, throw, throws, finally.

Stream based I/O: Byte streams and Character streams, reading console Input and Writing Console Output, Reading and writing Files, Random access file operations.

Unit – IV: Multithreading, Applet

Multithreading: Concepts of Multithreading, differences between process and thread, thread life cycle, Thread class, Runnable interface, creating multiple threads, Synchronization.

Applet: Applet life cycle and its methods, Creation and execution of an Applet, passing parameters to an Applet

Unit – V: GUI Programming, Event Handling

GUI Programming: Difference between AWT & Swing, AWT & Swing components-Button, Checkboxes, Radio Buttons, Choice Buttons, Labels, Text Fields

Event Handling- Event delegation model, sources of event, Event Listeners, adapter classes.

TEXT BOOKS:

1. Java The Complete Reference, Herbert Schildt, MC GRAW HILL Education, 9 th Edition, 2016

REFERENCE BOOKS:

1. “Java – How to Program”, Paul Deitel, Harvey Deitel, PHI.

2. “Core Java”, NageswarRao, Wiley Publishers.

3. “Thinking in Java”, Bruce Eckel, Pearson Education

4. “A Programmers Guide to Java SCJP”, Third Edition, Mughal, Rasmussen, Pearson.

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III Year-I SEMESTER

L	T	P	C
3	0	0	3

COMPUTER NETWORKS

Pre-Requisites: MFCS, Data Structures

Course Objectives:

1. To understand OSI and TCP/IP reference models and Example networks, network models and line coding techniques.
2. To understand the Error Control, Flow Control and Medium Access Control Protocols
3. To Compute optimal path using Routing Algorithms.
4. To understand the concepts of reliable unreliable transmission
5. To acquire the knowledge on various application layer protocols

UNIT-I: Introduction to Computer Networks and Physical Layer **11Hrs**

Introduction: Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, Network Topologies WAN, LAN, MAN. Reference models- The OSI Reference Model- Critic of OSI Reference model, TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, Example Networks. Bit rate, Baud rate. Line Coding Techniques: Unipolar (eg. NRZ scheme), Polar (eg. NRZ-L, NRZ-I, RZ, and Biphase –Manchester and differential Manchester).Bipolar.

UNIT-II : Data Link Layer **13Hrs**

Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame.

UNIT– III: Network Layer **11Hrs**

Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol(IP):Forwarding and Addressing in the Internet- Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6,ARP, RARP Protocols.

UNIT-IV: Transport Layer **14Hrs**

Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP - UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control.

UNIT – V: Application Layer **11Hrs**

Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communication, Transport Services Available to Applications, Transport Services Provided by the File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP,

DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages, Network Security.

Advanced Topics (Content Beyond syllabus)

1. Layered Architectures in IoT (1 hr.)
2. CISCO Switches. (1 hr)
3. Network Clustering (1 hr.)
4. Protocols for Wireless Sensor Networks (1 hr.)

Text Books:

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6thEdition , Pearson,2017.
2. Data Communications and Networking Behrouz A.Forouzan4th Edition McGraw Hill Education,2017.

References:

1. Data communication and Networks - BhusanTrivedi, Oxford university press,2016
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, PearsonEducation,2003.
3. Understanding Communications and Networks,3rdEdition,W.A.Shay,CengageLearning,2003.

Web Resources:

1. https://youtube.com/playlist?list=PLbRMhDVUMngfpeFloB7kyiA40EptH1up
2. https://www.cisco.com/c/en/us/support/docs/ip/routing-information-protocol-rip/13788-3.html

Course Outcomes:

By the end the of the course, the student will be able to

CO1: To understand OSI and TCP/IP reference models and Example networks, characteristics of transmission media and classify multiplexing techniques (L1)

CO2: To understand the Error Control, Flow Control and Medium Access Control Protocols

CO3: To Compute optimal path using Routing Algorithms.

CO4: To understand the concepts of reliable unreliable transmission

CO5: To acquire the knowledge on various application layer protocols (L3)

CO-PO-PSO Mapping Matrix:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PPO2**
CO-1	2										2		2	2
CO-2	2	2									2		2	2
CO-3	2	2	2								2	2	2	2
CO-4	-		2								2	2	2	2
CO-5	-		2								2	2	2	2

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III Year-I SEMESTER

L	T	P	C
0	0	3	1.5

LINER IC APPLICATIONS LAB

Pre-Requisites: Electronic Devices and Circuits Lab

List of experiments

Minimum Twelve Experiments to be conducted

1. Study of OP AMPs – IC 741, IC 555, IC 565, IC 566, IC 1496 – functioning, parameters and Specifications
2. Design an inverting adder, non-inverting adder, subtractor and comparator using operational amplifier.
3. Design an integrator and differentiator circuit using IC 741.
4. Design first order low pass and high pass filters using IC 741.
5. Design RC phase shift and Wein Bridge oscillators using operational amplifier.
6. Design a function generator to generate square and triangular waveforms.
7. Design a Monostable Multivibrator using IC 555.
8. Design an Astable Multivibrator using IC 555.
9. Design a Schmitt trigger using IC 741.
10. Design & construct a low voltage IC regulator (Using IC 723)
11. Perform the line regulation and load regulation of three terminal voltage regulators (7805, 7809 and 7912).
12. Perform Phase locked Loop (IC 565) and measure lock range and capture range
13. Design a 4-bit D to A Converter using op amp.
14. Perform half wave precision rectifier using IC 741.

Equipment required for Laboratories:

1. RPS
2. CRO
3. Function Generator
4. Multi Meters
5. IC Trainer Kits (Optional)
6. Bread Boards
7. Components: - IC741, IC555, IC565, IC1496, IC723, 7805, 7809, 7912 and other essential components.
8. Analog IC Tester

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III Year-I SEMESTER

L	T	P	C
0	0	3	1.5

MICROPROCESSORS AND MICROCONTROLLERS LAB

LIST OF EXPERIMENTS

PART- A: (Minimum of 5 Experiments has to be performed)

8086 Assembly Language Programming using Assembler Directives

1. Programs for 16 -bit arithmetic operations (using Various Addressing Modes).
   a. Addition of n-BCD numbers.

b. Multiplication and Division operations.

2. Programs for Sorting
3. Program for Sum of squares/cubes of a given n-numbers
4. Program for factorial of given n-numbers
5. Stack operations
6. BCD to Seven segment display codes

PART- B: (Minimum of 3 Experiments has to be performed)

8086 Interfacing

1. Hardware/Software Interrupt Application
2. A/D Interface through Intel 8255
3. D/A Interface through Intel 8255
4. Keyboard and Display Interface through Intel 8279
5. Generation of waveforms using Intel 8253/8254

PART- C: (Minimum of 3 Experiments has to be performed)

8051 Assembly Language Programs

1. Finding number of 1's and number of 0's in a given 8-bit number
2. Addition of even numbers from a given array
3. Ascending / Descending order
4. Average of n-numbers

PART-D: (Minimum of 3 Experiments has to be performed)

ARM Programs (using µVision IDE software)

1. Addition two 64 bit numbers
2. Smallest of n numbers
3. Convert hex to ASCII
4. Generate n fibonic numbers
5. Factorial of a given number using subroutine

6. Multiplication of two 32 bit numbers

Equipment Required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. 8086 Microprocessor kits
4. 8051 microcontroller kits
5. TASM software
6. µVision IDE - Keil software
7. ADC module
8. DAC module
9. Stepper motor module
10. Keyboard module
11. LED, 7-Segemt Units
12. Digital Multimeters
13. ROM/RAM Interface module
14. Bread Board etc

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III Year-I SEMESTER

L	T	P	C
0	0	3	1.5

VLSI DESIGN LAB

LIST OF EXPERIMENTS:

PART (A): FPGA Level Implementation (Any Seven Experiments)

Note 1: The students need to develop VHDL Source code, perform simulation using relevant simulator and analyze the obtained simulation results using necessary Synthesizer.

Note 2: All the experiments need to be implemented on the latest FPGA Hardware in the Laboratory

1. Realization of Logic gates

Design and Implementation of the following:

2. 4-bit ripple carry and carry look ahead adder using behavioural, dataflow and structural modeling
3. a) 16:1 mux through 4:1 mux b) 3:8 decoder realization through 2:4 decoder
4. 8:3 encoder
5. 8-bit parity generator and checker
6. J-K and T Flip-Flops
7. 8-bit synchronous up-down counter
8. 4-bit sequence detector through Mealy and Moore state machines.

EDA Tools/Hardware Required:

1. EDA Tool that supports FPGA programming including Xilinx Vivado tool along with corresponding FPGA hardware.
2. Desktop computer with appropriate Operating System that supports the EDA tools.

PART (B): Back-end Level Design and Implementation (Any Five Experiments)

Note: The students need to design the following experiments at schematic level using CMOS logic and verify the functionality. Further students need to draw the corresponding layout and verify the functionality including parasites. Available state of the art technology libraries can be used while simulating the designs using Industry standard EDA Tools.

Design and Implementation of the following

1. Universal Gates
2. An Inverter
3. Full Adder
4. Full Subtractor
5. Decoder
6. D-Flip-flop

EDA Tools/Hardware Required:

1. Mentor Graphics Software Tool.
2. Desktop computer with appropriate Operating System that supports the EDA tools.

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III Year-II SEMESTER

L	T	P	C
3	0	0	3

DIGITAL SIGNAL PROCESSING

Pre-Requisites: Signals & Systems, Mathematics, Concept of Communications

Course Objectives:

1. Analyze the Discrete Time Signals and Systems
2. Know the importance of FFT algorithm for computation of Discrete Fourier Transform
3. Learn the FIR and IIR Filter design procedures
4. Able to realize the digital filters with different structures
5. Know the need of Multirate Processing & Learn the concepts of DSP Processors

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Introduction to Discrete Time Signals & Systems. (12 Hrs.)** Introduction to Digital Signal Processing, Discrete time Signals, Signal Processing, Discrete time Systems, Linear Shift Invariant Systems, Condition for Stability. Linear Constant Coefficient Difference Equations, Discrete Time Fourier Transformation and its Properties, Linear Convolution, Review of Z-Transforms –Solutions of Difference Equations using Z-Transforms, Stability Criteria in Z-Transform.	**CO1**
II	**DFT& FFT (14 Hrs.)** DFS, Properties of DFS, DFT, Properties of DFT, DFT as Linear Transformation, Circular Convolution, Sectional Convolution-Overlap Add and Overlap Save Methods , Linear Convolution using Circular Convolution. Introduction to FFT, Efficient Computation of DFT, Radix-2 Algorithms- Decimation in Time and Decimation in Frequency Algorithms, Inverse DFT using FFT .	**CO2**
III	**Design And Realization of IIR filters (12Hrs.)** Introduction to Digital Filters, Analog Filter Approximations-Butterworth &Chebyshev, Digital IIR Filters Design from Analog filters, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms	**CO3**
IV	**Design And Realization of FIR filters (14 Hrs.)** Introduction to FIR Filters, Characteristics of FIR Filters, Frequency Response, Design of FIR Filters- Fourier Series Method , Frequency Sampling method and Window Method. Basic structures of FIR systems, Lattice structures, Lattice-ladder structures.	**CO4**
V	**Multirate Digital Signal Processing& Introduction to DSP processors (12 Hrs.)** Introduction, Down Sampling, Decimation, Spectrum of Down Sampling, Up Sampling, Interpolation, Spectrum of Up Sampling, Cascading Sample Rate Converters, Sampling Rate Conversion, Applications of Multirate DSP. Introduction to DSP processors, Basic architecture of TMS320 6713 DSP processor, Applications of DSP processors - Detection of QRS complex of ECG signals, Generation and detection of DTMF signals, Speech compression using Linear Predictive Coding.	**CO5**

Course Outcomes:

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Analyze the Discrete Time Signals and Systems& Apply the difference equations concept in the analysis of Discrete time systems
CO2	Know the importance of FFT algorithm for computation of Discrete Fourier Transform &Use the FFT algorithm for solving the DFT of a given signal
CO3	Design a Digital filter (FIR&IIR) from the given specifications
CO4	Able to realize the digital filters
CO5	Know the need of Multirate Processing, Use the Multirate Processing concepts in various applications &Learn the concepts of DSP Processors

CO-PO mapping Table:

Mapping	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2
C01	3		2				1							
C02	3		1				1							
C03	3		2				1							
C04	3		2				1							
C05	3		1				1							

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III Year-II SEMESTER

L	T	P	C
3	0	0	3

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Pre-Requisites: Basic Science and Humanities

Course Objectives:

1. To equip the students with the basic inputs of managerial economics and demand concepts.
2. To understand the concepts of production and cost for various business decision.
3. To understand the different types of market, market structures & pricing strategies and their applications in business decision making and to know the different forms of Business organization and the concept of Business Cycles.
4. To understand the fundamental of accounting and analysis of accounting statements for managerial decision making.
5. To understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

UNIT – I Introduction to Managerial Economics and demand Analysis: 10 Hrs

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting.

UNIT - II Theory of Production and Cost Analysis: 13 Hrs

Production Function – Isoquant and Isocost, MRTS, Least Cost Combination of Inputs - Laws of Returns to scale - Internal and External Economies of Scale, Cost Analysis: Cost concepts, Cost & output relationship in short run & long run - Break-even Analysis (BEA)-Determination of Break-Even Point - Significance and limitations.

UNIT – III Introduction to Markets, Pricing Policies & Types of Business Organization and Business Cycles: 12 Hrs

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, and Internet Pricing: Flat Rate Pricing, Usage sensitive pricing and Priority Pricing. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – Business Cycles: Phases of Business Cycles.

UNIT – IV Introduction to Financial Accounting & Analysis: 13 Hrs

Financial Accounting and analysis: Accounting –significance -- Book Keeping-Double entry system – Journal- Ledger- Trial Balance- Final Accounts with simple adjustments.

Financial Statement Analysis through ratios: Ratio-analysis of financial statement using different ratios (Liquidity -Profitability- Solvency -Activity ratios).

UNIT - V Capital and Capital Budgeting: 12 Hrs

Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money-Methods of appraising Project profitability: Traditional Methods (payback period, accounting rate of return) and modern methods (Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index).

Course Outcomes: After completion of the course, students will be able to

CO1: To equipped with the knowledge of estimating the Demand and demand elasticities for a product.

CO2: The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.

CO3: To understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.

CO4: To prepare Financial Statements and the usage of various Accounting tools for analysis.

CO5: To evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

Text Books:

1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011.

2. Dr. N. Appa Rao, Dr. P. Vijay Kumar: 'Managerial Economics and Financial Analysis', Cengage Publications, New Delhi – 2011.

3. Prof. J.V. Prabhakara rao, Prof. P. Venkatarao. 'Managerial Economics and Financial Analysis', Ravindra Publication.

Reference Books:

1. V. Maheswari : Managerial Economics, Sultan Chand.

2. Suma Damodaran : Managerial Economics, Oxford 2011.

3. Dr. B. Kuberudu and Dr. T. V. Ramana : Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.

4. Vanitha Agarwal : Managerial Economics, Pearson Publications 2011.

5. Sanjay Dhameja : Financial Accounting for Managers, Pearson.

6. Maheswari: Financial Accounting, Vikas Publications.

7. S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012.

Web links:

1. www.managementstudyguide.com
2. www.tutorialspoint.com
3. www.lecturenotes.in

III Year-II SEMESTER

L	T	P	C
3	0	0	3

MACHINE LEARNING
(Professional Elective-1)

Course Objectives:

1.To familiarize students with basic concepts
2. Understand the theories and advancements in ML and AI
3. Understand the mathematics behind algorithms and apply them in real world scenarios
4. Analyze the Graphical models
5. Realize the technique of Reinforcement Learning

UNIT – I

Introduction to ML/AI - AI Foundation, history of AI, latest advancements and applications Machine Learning – I: Linear Regression - Learn to implement linear regression and predict continuous data values, Clustering - Learn how to create segments based on similarities using K-Means and Hierarchical clustering

UNIT – II

Machine Learning – II: Naïve Bayes and Logistic regression - Understand how supervised learning is used for classification, Support vector machines - Learn to classify data points using support vectors, decision trees - Tree-based model that is simple and easy to use. Learn the fundamentals on how to implement them Natural Language Processing: Basics of text processing, lexical processing - Learn to extract features from unstructured text and build machine learning models on text data, syntax and semantics - Conduct sentiment analysis, learn to parse English sentences and extract meaning from them.

UNIT – III

Deep learning & Neural Networks: Information flow in neural networks - Understand the components and structure of artificial neural networks, Training a neural network - Learn the latest techniques used to train highly complex neural networks, Convolutional neural networks - Use CNN's to solve complex image classification problems, Recurrent neural networks - Study LSTMs and RNN's applications in text analytics, Creating and deploying networks using Tensor Flow and Keras (Deep Learning Library) - Build and deploy your own deep neural networks on a website, learn to use Tensor Flow API and Keras.

UNIT – IV

Graphical Models: Introduction to Bayesian methods, Graphical models - Study probabilistic way of modelling systems - Markov properties, Factor Graphs and Bayesian belief networks, Learning and Inference - Learn how graphics models are used for supervised and unsupervised learning

UNIT – V

Reinforcement Learning: Introduction to RL, understand how machines can be programmed to learn by themselves, Exact methods - Learn the math behind Exact Statistics - Dynamic Programming, Monte Carlo methods, Temporal Difference Learning, Approximate Methods - Learn policy gradient methods and their applications in learning

Text Books

1. Machine Learning, by Tom M Mitchell, Indian Edition, McGraw Hill, first Edition2017.
2. Deep Learning by Goodfellow, Bengio, Courville. The MIT Press,2016
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill,3rd Edition 2008.

Reference Books

1. Understanding Machine Learning: From Theory to Algorithms, by Shai Shalev Shwartzand Shai Ben-David, 1st Edition, Cambridge UniversityPress,2014.
2. Artificial Intelligence - A Modern Approach by Stuart Russell & Peter Norvig, Prentice Hall,3rd Edition,2009.

Course Outcomes:

The student should be able to:

CO:1 Understand machine learning concepts and range of problems that can be handled by machine learning. Apply the machine learning concepts in real life problems.
CO:2 Understand artificial neural networks concept and apply techniques to train the neural networks
CO:3 Understand how graphical models are used for supervised and un supervised learning
CO:4 Understand Reinforcement Learning concept and applications
CO:5 Modify the algorithms based on need

CO-PO mapping Table:

Mapping	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2
C01		2		3			1							
C02		2		3			1							
C03		2		3			1							
C04		2		3			1							
C05		2		3			1							

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III Year-II SEMESTER

L	T	P	C
3	0	0	3

OPTICAL COMMUNICATIONS
(Professional Elective-2)

Pre-Requisites: Analog Communications and Digital Communications, Basics related to RF field Analysis

Course Objectives:

1. To analyze the reliability of fiber optic communications
2. To understand the characteristics and construction of optical fiber cable.
3. To develop the knowledge of Fiber splicing and optical sources
4. To identify and understand the operation of various optical detectors and receiver operation.
5. To Understand the optical system design and WDM

Syllabus

Unit No	Contents	Mapped CO
I	**Introduction to optical fiber communication** - Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. **Types of Fibers:** Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems, Fiber Materials- Glass, Halide, Active Glass, Chalgenide Glass, Plastic Optical Fibers. **12 hrs**	**CO1**
II	**Signal Distortion in Optical Fibers:** Attenuation, Absorption, Scattering and Bending Losses, Core and Cladding Losses, Information Capacity Determination, Group Delay, Types of Dispersion - Material Dispersion, Wave-Guide Dispersion, Polarization Mode Dispersion, Intermodal Dispersion, Pulse Broadening,. **09 hrs**	**CO2**
III	**Optical Fiber Connectors & Splicing:** Connector Types, Single Mode Fiber Connectors, Connector Return Loss Splicing Techniques, Splicing Single Mode Fibers, Fiber Alignment and Joint Loss- Multimode Fiber Joints, Single Mode Fiber Joints. **Optical Sources**- LEDs, Structures, Materials, Quantum Efficiency, Power, Modulation, Power Bandwidth Product, Injection Laser Diodes- Modes, Threshold Conditions, External Quantum Efficiency, Laser Diode Rate Equations, Resonant Frequencies, Reliability of LED & ILD. **18 hrs**	**CO3**
IV	**Optical Detectors** - Physical Principles of PIN and APD, Detector Response Time, Temperature Effect on Avalanche Gain, Comparison of Photo Detectors, Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers. **12 hrs**	**CO4**

V	**Optical system design**- Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern. **12 hrs**	**CO5**

Further Reading: Photonic Crystal Fibers- Introduction, Fabrication methods, properties, fiber lasers and amplifiers.

Course Outcomes:

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand and analyze the constructional parameters of optical fibers
CO2	Estimate the losses due to attenuation, absorption, scattering and bending
CO3	Be able to Understand the concept of fiber splicing and optical sources
CO4	Compare various optical detectors and choose suitable one for different applications.
CO5	Understand the design of optical system and WDM concepts

CO-PO mapping Table:

Mapping	**P01**	**P02**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**P09**	**P010**	**P011**	**P012**	**PS01**	**PSO2**
C01	2		3				1							
C02	2		3				1							
C03	2		3				1							
C04	2		3				1							
C05	2		3				1							

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III Year-II SEMESTER

L	T	P	C
3	0	0	3

SATELLITE COMMUNICATIONS
(Professional Elective-3)

Pre-Requisites: Analog & Digital Communications, Antennas and Wave Propagation.

Course Objectives:

1. Acquire foundation in orbital mechanics and launch vehicles for the satellites.
2. Understand the various satellite subsystems and their functionalities.
3. Understand the concepts of satellite link design and calculation of C/N ratio, the concepts of multiple access and various types of multiple access techniques in satellite systems.
4. Familiarize the earth station technologies and the applications in earth segment.
5. Understand various satellite applications.

Syllabus

Unit	Contents	Mapped CO
I	**INTRODUCTION:** Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency Allocations for Satellite Services, Applications, Future Trends of Satellite Communications. **ORBITAL MECHANICS AND LAUNCHERS:** Orbital Mechanics, Look Angle determination, Orbital Perturbations, Orbit determination, Launches and Launch vehicles, Orbital Effects in Communication Systems Performance. **14 HRS**	**CO1**
II	**SATELLITE SUBSYSTEMS:** Attitude and Orbit Control System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification. **10 HRS**	**CO2**
III	**SATELLITE LINK DESIGN:** Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Down Links, Up Link Design, Design of Satellite Links for Specified C/N, System Design Examples. **SATELLITE ACCESS:** Analog – Digital Transmission System- Modulation and Multiplexing, Digital Video Broadcast, Types of Multiple Access: FDMA Concepts - Inter Modulation and Back Off - SPADE System, TDMA Concepts - Frame and Burst Structure, CDMA Concepts, Comparison of Multiple Access Schemes. **15 HRS**	**CO3**
IV	**EARTH STATION TECHNOLOGY:** Introduction, Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Primary Power Test Methods. **EARTH SEGMENT:** Receive Only Home TV Systems – Outdoor Unit – Indoor Unit for Analog (FM) TV, Master Antenna TV System, Community Antenna TV System, Transmit – Receive Earth Stations. **12 HRS**	**CO4**
V	**SATELLITE APPLICATIONS:** INTELSAT Series, INSAT, VSAT, Mobile Satellite Services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast Satellites (DBS) - Direct to Home Broadcast (DTH), Digital Audio Broadcast (DAB) - World Space Services, Business TV (BTV), GRAMSAT, Specialized Services – E mail, Video Conferencing, Internet. **13 HRS**	**CO5**

Course Outcomes:

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand basic concepts and frequency allocations for satellite communication, orbital mechanics and launch vehicles. KL2
CO2	Envision the satellite subsystems. KL2
CO3	Design satellite links for specified C/N and Understand various multiple access techniques. KL6
CO4	Explain the basic concepts of earth station technologies and earth segment. KL2
CO5	Describe the services rendered by satellite and its future applications. KL2

Learning Resources

Text books:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Ed., 2003.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud, 2nd Ed., Pearson Publications, 2003.
3.Satellite Communications – Dennis Roddy , McGraw Hill, 4th Ed., 2009.

Reference books:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Ed., 2003.
2. Satellite Communication Systems Engineering – Pritchend and Sciulli, PHI Learning, 1986.
3. Satellite Communication – Robert M. Gagliendi, John Wiley and Sons, 1988.

E-Resources & other digital material:

1.https://onlinecourses.nptel.ac.in/noc17_ec14
2. https://www.coursera.org/learn/satellite-communications
3. https://www.class-central.com/tag/satellite%20communications
4. https://ep.jhu.edu/programs-and-courses/525.440-satellite-communications-systems

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III Year-II SEMESTER

L	T	P	C
0	0	3	1.5

DIGITAL SIGNAL PROCESSING LAB

List of Experiments:

1. To study the architecture of DSP chips – TMS320 5X/6X instructions
2. To verify linear convolution
3. To verify circular convolution
4. To design FIR filter (LP/HP) using windowing technique
    a. Using rectangular Window
    b. Using triangular Window
    c. Using Kaiser Window
5. To implement IIR filter (LP/HP) on DSP Processor
6. N-point FFT algorithm
7. MATLAB program to generate sum of sinusoidal signals
8. MATLAB program to find frequency response of analog LP/HP filters
9. To compute power density spectrum of a sequence
10. To find the FFT of given 1-D signal and plot
11. Detection of QRS complex of ECG signals
12. Generation and detection of DTMF signals
13. Speech compression using Linear Predictive Coding

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