Courses of Study

(Detailed Course Contents)

School of Electronics & Communication Engineering

Under-graduate Programmes
(2024-2025) onwards

Shri Mata Vaishno Devi University

Kakryal, Katra 182320 Jammu & Kashmir

VISION

Establishment of a Scientific & Technical University of Excellence to nurture young and talented human resources for the service of Indian Society & world at large and preserving the integrity and sanctity of human values.

MISSION

The mission of the University is the pursuit of Education, Scholarship and Research at the highest International level of excellence.

OBJECTIVES

- Provide education and training of excellent quality, both at undergraduate and postgraduate level.
- Ensure that the University achieves and maintains an international standing in both teaching and research
- Promote study and research in new and emerging areas and encourage academic interaction of the faculty and the students at national and international levels.
- Encourage close collaboration with industry and facilitate the application of research for commercial use and for the benefit of society.

University Campus Address	Shri Mata Vaishno Devi University Kakryal, Katra 182 320 J&K, INDIA Phone:01991-285634, 285524 Fax: 01991-285694
Public Relations Officer Address	Public Relations Office, Shri Mata Vaishno Devi University Saraswati Dham, Near Railway Station, Jammu-180004 J&K, INDIA Telefax: 0191-

Website: www.smvdu.ac.in
Facebook:
Instagram:
LinkedIn:
Twitter:

CONTENTS

Integrated B.A.(Hons.) English- M.A.(English)

M.A.(English)

M.A.(Dogri)

M.A.(Hindi)

4.15 School of Philosophy & Culture

Integrated B.A.(Hons.) Philosophy - M.A.(Philosophy)

M.A.(Philosophy)

M.A.(Vedic Studies) Sanskrit

4.0 Complete list of Ability Enhancement Courses, General Elective Courses, Skill Enhancement Courses, Value Addition Courses, Vocational Courses, Mandatory courses

1.0 Introduction

Shri Mata Vaishno Devi University (SMVDU) has adopted the Indian Institutes of Technology (IIT) pattern of teaching and examination system in its endeavor to attain academic excellence. The University is offering graduate and postgraduate programs since 2004. The university also offers programs leading to award of PhD degree. The programs being offered from the academic session 2013-14 are mentioned below.

2.0 Programs of study

The following programs of study are being offered by the university in the academic session 2013-14.

Undergraduate Programs

1. Bachelor of Technology in Computer Science & Engineering
2. Bachelor of Technology in Electronics & Communication Engineering
3. Bachelor of Technology in Mechanical Engineering
4. Bachelor of Technology in Industrial Biotechnology
5. Bachelor of Architecture

Post-graduate Programs

1. Master of Business Administration
2. Master of Technology (Manufacturing & Automation)
3. Master of Technology (Computer Science & Engineering)
4. Master of Technology (Electronics & Communication Engineering)
5. Master of Technology (Energy Management) (Part-Time Program)
6. Master of Arts (Philosophy)
7. Master of Arts (English)
8. Master of Sciences (Mathematics)
9. Master of Sciences (Physics)
10. Master of Sciences (Biotechnology)

PhD Programmes

3.0 Academic System, Rules & Regulations

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Electronics and Communication Engineering

Vision of the School

To attain global acclaim as a premier hub in Electronics, cultivating profoundly skilled technical experts imbued with unwavering integrity and a fervent dedication to advancing societal progress.

Mission of the School

- Cultivate and disseminate advanced knowledge in electronics through specialized graduate, postgraduate, and doctoral programs.
- Strive to translate acquired expertise into tangible societal advancements.
- Facilitate dissemination of knowledge in electronics and communication engineering through various platforms.
- Foster human potential and leadership in specialized domains of electronics and communication engineering.

Details of Programs Offered

- B.Tech. (Electronics & Comm. Engineering)
- M.Tech. (Electronics & Comm. Engineering)
- Ph.D.

1st Semester

Program Structure of B. Tech.

Four Year Full Time Degree (Batch 2024 Onwards)

Semester I

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC1	MTLBS101	Engineering Mathematics-I	3	1	0	4
BSC2	BTLBS101	Applied Chemistry	3	0	0	3
BSC2	BTPBS101	Applied Chemistry Lab	0	0	2	1
ESC1	CSLES101	Introduction to C Programming	3	0	0	3
ESC1	CSPES101	C Programming Lab	0	0	2	1
ESC2	EELES101	Fundamental of Electrical Engineering	3	0	0	3
ESC2	EEPES101	Fundamental of Electrical Engineering Lab	0	0	2	1
SEC1	MEMSE101	Engineering Workshop	1	0	2	2
AEC1/VAC 1		Ability Enhancement/Value Added Course				2
		Total Credits				**20**

Semester II

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC3	MTLBS102	Engineering Mathematics-II	3	1	0	4
BSC4	PHLBS102	Engineering Physics	3	0	0	3
BSC4	PHP BS102	Engineering Physics Lab	0	0	2	1
DCC1	ECLDC106	Solid State Devices	3	0	0	3
DCC1	ECPDC106	Solid State Devices Lab	0	0	2	1
DCC2	ECLDC104	Network Analysis & Synthesis	3	1	0	4
SEC2	MEMSE102	Engineering Graphics with CAD	1	0	2	2
AEC2		Ability Enhancement Course				2
VAC2		Value Added Course				2
MAC1	PCN MA102	Universal Human Values-II	2	0	0	0
		Total Credits				**22**

Semester III

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC5	BTLBS201	Introduction to Biology for Engineers	3	0	0	3
ESC3	ECLES201	Numerical Methods	3	0	0	3
ESC3	ECPES201	Numerical Methods Lab	0	0	2	1
DCC3	ECLDC203	Digital Electronics	3	0	0	3
DCC3	ECPDC203	Digital Electronics Lab.	0	0	2	1
DCC4	ECLDC205	Electronics Devices and Circuits	3	0	0	3
DCC4	ECPDC205	Electronic Device and Circuits Lab	0	0	2	1

DCC5	ECLDC210	Signals & Systems	3	1	0	4
SEC3	ECMSE201	MATLAB Programming	1	0	2	2
PR	ECIPR201	Summer Internship-I				1
VAC3		Value Added Course				2
		Total Credits				**24**

Semester IV

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC6	ECLDC202	Linear Integrated Circuits Applications	3	0	0	3
DCC6	ECPDC202	Linear Integrated Circuits Applications Lab	0	0	2	1
DCC7	ECLDC204	Analog Communication	3	0	0	3
DCC7	ECPDC204	Analog Communication Lab	0	0	2	1
DCC8	ECLDC206	Microprocessor and Interfacing	3	0	0	3
DCC8	ECPDC206	Microprocessor and Interfacing lab	0	0	2	1
DCC9	ECLDC208	Control Systems	3	0	0	3
DCC9	ECPDC208	Control Systems Lab	0	0	2	1
DCC10	ECLDC207	Electromagnetic Field Theory	3	1	0	4
VAC4	BTLVA202	Environmental Science& Education	2	0	0	2
		Total Credits				**22**

Semester V

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC11	ECLDC301	Digital Communication Engineering	3	0	0	3
DCC11	ECPDC301	Digital Communication Lab	0	0	2	1
DCC12	ECLDC303	Digital Signal Processing	3	0	0	3
DCC12	ECPDC303	Digital Signal Processing Lab	0	0	2	1
DCC13	ECLDC305	VLSI Design	3	0	0	3
DCC13	ECPDC305	VLSI Lab	0	0	2	1
DEC1		School Elective–I	3	1/0	0/2	4
DEC2/GEC1		School Elective–II/Generic Elective-I	3	1/0	0/2	4
PR	ECIPR301	Summer Internship-II				1
DCC	ECDPR301	ProjectWork-1				2
		Total Credits				23

Semester VI

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC14	ECLDC302	Microwave Engineering	3	0	0	3
DCC14	ECPDC302	Microwave Engineering Lab	0	0	2	1
DCC15	ECLDC304	AI&ML in Electronics Engineering	3	0	0	3
DCC15	ECPDC304	AI&ML Lab	0	0	2	1
DEC3	ECXDEXXX	School Elective-III	3	1/0	0/2	4
DEC4/ GEC2	ECXDEXXX/ ECX GEXXX	School Elective–IV/Generic Elective-II	3	1/0	0/2	4
AEC		Management/ Entrepreneurship/Economy	3	0	0	3

DCC	ECDPR302	Project Work–II				2
MAC2	PCN MA302	Indian Knowledge System	2	0	0	NC
		Total Credits				**21**

Semester VII

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC16	ECLDC401	Mobile Communication	3	1	0	4
DEC5	ECXDEXXX	School Elective–V	3	1/0	0/2	4
DEC6/ GEC3	ECXDEXXX/ ECX GEXXX	School Elective–VI/Generic Elective–III	3	1/0	0/2	4
PR	ECIPR401	Summer Internship– III				2
DCC/PR	ECDPR401	Project Work –III				4
		Total Credits				**18**

Semester VIII

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC/PR	ECDPR402/ ECIPR402	Major Project/Internship(Industrial or In-house Project)				10
		Total Credits				10

Award of Degree:

B. Tech. (Honor's) Program: The four-year B. Tech. (Honor's) degree in the Major discipline will be awarded to those who have completed the credit requirement of a Four-year B.Tech. Degree program and earned 12 Additional Credits through DEC's **provided a minimum of six DEC's** earned are from the basket of a particular specialization/domain.
These elective courses can be registered during V to VIII semester subject to a maximum limit of course registration up to 32 credits, including core and other courses. On exit, student shall be awarded B.Tech. (Honor's) in Major discipline with specialization in the specific domain.

2. B. Tech. Program with Minor/Interdisciplinary Area Specialization: The four-year B. Tech. degree in the Major discipline with Minor in a specific domain will be awarded to those who have completed the credit requirement of four-year B. Tech degree program and earned 12 Additional Credits through GECs provided all credits earned through GECs are from the basket of a particular Minor.
The set of courses required to be taken, by students of other School, to obtain Minor/Interdisciplinary Area Specialization will be clearly defined by each School for the benefit of the students. The four-year B. Tech. degree with Minor in a specific domain will be awarded to those who complete a four-year degree program with 172 credits and have satisfied the credit requirement. A student, who wishes to pursue B. Tech. with Minor, shall earn 12 additional credits from General Elective course provided all 6 GECs (GEC1 to GEC6) are earned from the basket of courses prescribed for that particular Minor.

Note:
Each school should clearly mention the set of prerequisites if any for choosing a minor specialization so that the student can obtain the minor specialization of his/her own choice.
Each school should prepare a comprehensive list of Discipline specific electives and Generic electives according to the area of specialization.
Certain core courses of introductory level may be offered as generic elective by the school if required.
Specializations may be offered by the school in emerging areas of importance.

Credit Break Up Revised

S. No.	Category	Credit Break up (AICTE/ECE)	Credit break Up SMVDU
1.	Humanities and Social Sciences, Management Courses (AEC/VAC)	15	13
2.	Basic Science Courses	23	19
3.	Engineering Science Courses	17	12
4.	Skill Enhancement Courses	06	06
5.	Departmental Core Courses	61	64
6.	Departmental Elective Courses/Generic elective courses	12	27
7.	Project Work, Seminar/Internship	20	19
8.	Mandatory Course	UHV-II, IKS, Env	NC
	Total Credits	**160**	**160**

Departmental Elective Courses

VAC Offered by School

S. NO.	Course Code	Course Title	Pre-requisites	L	T	P	C
1	ECL VA102	Introduction to Digital Technology		2	0	0	2

SEC /AEC Courses:

S. NO.	Course Code	Course Title	Pre-requisites	L	T	P	C
1	ECM SE102	Electronics Workshop		1	0	2	2
2	ECM SE201	MATLAB Programming		1	0	2	2
3	ECM SE202	Fundamentals of Machine Learning for Predictive Data Analytics		1	0	2	2
4	ECM SE203	EDA Tools (CSE,EE, B.Sc Physics UG, M.Sc Physics)		1	0	2	2

Major Specialization to be offered by SoECE

Basket 1: VLSI Design

S.NO	Course Code	Course Title	Pre-requisite	L	T	P	C	Level
1	ECM DE301	DSD using VHDL /Verilog		3	0	2	4	
2	ECL DE302	IC Fabrication & MEMS		4	0	0	0	
3	ECM DE303	Digital Integrated Circuits		3	0	2	4	
4	ECM DE304	Analog VLSI Design		3	0	2	4	
5	ECM DE305	Advanced CMOS VLSI Design		3	0	2	4	
6	ECM DE401	Low Power Devices and Systems		3	0	2	4	
7	ECM DE402	Analog and Mixed Signal Design		3	0	2	4	
8	ECM DE403	VLSI Physical Design with Timing Analysis (NPTEL)		3	0	2	4	
9	ECM DE404	VLSI Interconnects (NPTEL)		3	0	2	4	

Basket 2: Microwave and Millimeter Wave Technology

S.NO	Course Code	Course Title	Pre-requisite	L	T	P	C	Level
1	ECL DE320	Millimeter Wave Technology	Yes	4	0	0	4	
2	ECL DE321	Microwave Integrated Circuits	Yes	4	0	0	4	
3	ECL DE322	Design Principles of Microwave and Millimeter Wave Antennas		4	0	0	4	
4	ECL DE420	Signal Processing for mm wave communication for 5G and beyond	Yes	4	0	0	4	
5	ECL DE421	Microwave and Millimetre Wave Measurement Technique	Yes	4	0	0	4	
6	ECL DE422	Remote Sensing	Yes	4	0	0	4	
7	ECL DE423	Millimetre Wave Personal Communication System	Yes	4	0	0	4	
8	ECL DE424	Radar and Navigational Engineering	Yes	4	0	0	4	

Basket 3: Multimedia Technology

S.NO	Course Code	Course Title		L	T	P	C	Level
1	ECL DE340	Multimedia Communication Networks	-------	4	0	0	4	E1
2	ECL DE341	Digital Image Processing and Pattern Recognition	E1	4	0	0	4	E2
3	ECL DE342	Multimedia Compression Techniques	E1	4	0	0	4	E2
4	ECL DE343	**Media Security**	E2	4	0	0	4	E3
5	ECL DE344	Cryptography And Multimedia Data Hiding	E2	4	0	0	4	E3
6	ECL DE345	Multimedia Information Storage and Retrieval	E2	4	0	0	4	E3
7	ECL DE346	Social Networks	-----	4	0	0	4	E3
8	ECL DE440	Multimedia Cloud Computing	E3	4	0	0	4	E4
9	ECL DE441	Machine Learning	-----	4	0	0	4	E4
10	ECL DE442	Advanced Databases	-----	4	0	0	4	E4
11	ECL DE443	Medical Image Processing	E1,2	4	0	0	4	E5
12	ECL DE444	Machine Learning in Image and Video Processing	E4 (ML)	4	0	0	4	E5

Basket 4: Embedded Systems & Networks

S.NO	Course Code	Course Title		L	T	P	C	Level
1	ECL DE360	Embedded Systems &Microcontrollers		3	0	2	4	
2	ECL DE361	Computer and Data Networks		3	0	2	4	
3	ECL DE362	Programming Server-Side Applications		4	0	0	4	
4	ECL DE363	Internet of Things		3	0	2	4	
5	ECL DE460	Wireless Networks		3	0	2	4	
6	ECL DE461	Advanced Embedded Systems		3	0	2	4	
7	ECL DE462	Industry 5.0 &IoT		3	1	0	4	
8	ECL DE463	Advanced Computer Networks		3	1	0	4	
9	ECL DE464	Cloud Computing		3	1	0	4	

Minor Specializations

Basket 1: VLSI Design (Only for EE, M.Sc Physics, B.Sc Physic 4 Year UG)

S.NO	Course Code	Course Title	L	T	P	C	
1	ECM GE301	DSD using VHDL /Verilog	3	0	2	4	
2	ECL GE302	IC Fabrication & MEMS	4	0	0	0	
3	ECM GE303	Digital Integrated Circuits	3	0	2	4	
4	ECM GE304	Analog VLSI Design	3	0	2	4	
5	ECM GE305	Advanced CMOS VLSI Design	3	0	2	4	
6	ECM GE401	Low Power Devices and Systems	3	0	2	4	
7	ECM GE402	Analog and Mixed Signal Design	3	0	2	4	
8	ECM GE403	VLSI Physical Design with Timing Analysis (NPTEL)	3	0	2	4	
9	ECM GE404	VLSI Interconnects (NPTEL)	4	0	0	4	

Basket 2. Minor Specialization:- Multimedia Technologies
(for Sciences/Maths/MBA/Econ/BBA students)

S.NO	Course Code	Course Title		L	T	P	C	
1	ECL GE340	Multimedia Communication Networks	---	4	0	0	4	E1
2	ECL GE341	Digital Image Processing and Pattern Recognition	E1	4	0	0	4	E2
3	ECL GE342	Multimedia Compression Techniques	E2	4	0	0	4	E3
4	ECL GE440	Machine Learning for Predictive Data Analytics	------	4	0	0	4	E4
5	ECL GE441	Social Network Analysis	------	4	0	0	4	E5
6	ECL GE343	Multimedia Cloud Computing	E1	4	0	0	4	
7	ECL GE344	Media Security and Biometrics	E2	4	0	0	4	

Basket 3: Embedded Systems & Networks

S.NO	Course Code	Course Title		L	T	P	C	Level
1	ECMGE360	Microprocessors &Microcontrollers		3	0	2	4	
2	ECMGE361	Computer and Data Networks		3	0	2	4	
3	ECL GE362	Server-Side Scripting		4	0	0	4	
4	ECMGE363	Internet of Things		3	0	2	4	
5	ECMGE460	Wireless Networks		3	0	2	4	
6	ECMGE461	Advanced Embedded Systems		3	0	2	4	
7	ECMGE462	Industry 5.0 &IoT		3	1	0	4	
8	ECMGE463	Advanced Computer Networks		3	1	0	4	
9	ECMGE464	Cloud Computing		3	1	0	4	

Basket 4: Microwave and Millimeter Wave Technology

S.NO	Course Code	Course Title	Pre-requisite	L	T	P	C	
1	ECL DE320	Millimeter Wave Technology	Yes	4	0	0	4	
2	ECL DE321	Microwave Integrated Circuits	Yes	4	0	0	4	
3	ECL DE322	Design Principles of Microwave and Millimeter Wave Antennas	no	4	0	0	4	
4	ECL DE420	Signal Processing for mm wave communication for 5G and beyond	yES	4	0	0	4	
5	ECL DE421	Microwave and Millimetre Wave Measurement Technique	Yes	4	0	0	4	
6	ECL DE422	Remote Sensing	Yes	4	0	0	4	
7	ECL DE423	Millimetre Wave Personal Communication System	Yes	4	0	0	4	
8	ECL DE424	Radar and Navigational Engineering	Yes	4	0	0	4	

List of Department/School Electives

S.NO	Course Code	Course Title		L	T	P	C	Level
1	ECL DE380	Antenna & Wave Propagation		3	0	2	4	Elective -1
2	ECL DE381	Probability Theory & Stochastics Processes		4	0	0	4	Elective -1
3	ECL DE382	Optoelectronic Devices		4	0	0	4	Elective -1
4	ECL DE383	Power Electronics		4	0	0	4	Elective -1
5	ECL DE384	Introduction to Wireless Networks		4	0	0	4	Elective -2
6	ECL DE385	Radar & Navigational Guides		4	0	0	4	Elective -2
7	ECL DE386	Object Oriented Programming		4	0	0	4	Elective -2
8	ECL DE387	Introduction to MEMS Design		4	0	0	4	Elective -3
9	ECL DE388	Information Theory & Coding		4	0	0	4	Elective -3
10	ECL DE389	Electronic Measurement and Instrumentation		3	0	2	4	Elective -3
11	ECL DE480	Advanced Embedded Systems		4	0	0	4	Elective -4
12	ECL DE481	Satellite Communication		4	0	0	4	Elective -4
13	ECL DE482	Pervasive Computing & WSN		4	0	0	4	Elective -4
14	ECL DE483	Virtual Instrumentation using LAB View		3	0	2	4	Elective -5
15	ECL DE484	Mobile Ad hoc Network		4	0	0	4	Elective -5
16	ECL DE485	Modeling and analysis of nanoscale devices		4	0	0	4	Elective -5
17	ECL DE486	Modelling of Nanodevices		4	0	0	4	Elective -6
18	ECL DE487	Image & Video Processing		3	0	2	4	Elective -6
19	ECL DE480	Optical Fiber Communication		3	0	2	4	Elective -6

Course Code : **BTL BS101**
Course Title : **Applied Chemistry**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Basic Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr.	Contents	Approx. Contact Hours
1	**Atomic and Molecular Structure:** Principles of atomic structure (Review), molecular orbitals of diatomic molecules. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band.	10
2	**Intermolecular forces and periodic properties:** Ionic, dipolar and van Der Waals interactions, Equations of state of real gases and critical phenomena. Effective nuclear charge, penetration of orbitals, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.	10
3	**Use of free energy in chemical equilibria:** Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and EMF. Cell potentials, the Nernst equation and applications. Acid-base, oxidation-reduction and solubility equilibria. Corrosion causes, effects and prevention.	8
4	**Instrumental methods of chemical analysis and applications:** Spectroscopy: Principle of spectroscopy, Principle and simple applications of UV-visible spectroscopy. Flame spectroscopy, Atomic absorption spectroscopy, Infrared spectroscopy, Principle and simple application of nuclear magnetic resonance and magnetic resonance imaging. Chromatography: Types, Principle and applications.	12

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Recommended Books		

1	Engineering Chemistry, Satya Prakash & Manisha Agrawal, Khanna Book Publishing	2012
2	University chemistry, B. H. Mahan, Pearson	2009
3	Chemistry: Principles and Applications, M. J. Sienko & R. A. Plane, McGraw-Hill International	1979
4	Fundamentals of Molecular Spectroscopy, C. N. Banwell, McGraw Hill Education	2017
5	A Textbook of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Limited	2017

Course Outcome

Sr. No	Course Outcome	CO
1	Acquire basic knowledge of atomic structure, bonding and spectroscopic techniques.	CO1
2	Apply their knowledge to solve various physical and chemical problems.	CO2
3	Selectively apply these methods for analysis, evaluation and interpretation of the results.	CO3

Course Code : **BTP BS 101**
Course Title : **Applied Chemistry Lab**
L-T-P/S=Credits : **0-0-2**
Course Category : **Basic Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr. No.	Contents
1	Determination of the enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2	Determination of integral enthalpy of solution of salts (endothermic and exothermic).
3	Determination of the rate constant of a reaction.
4	Verification of Lambert-Beer's Law for potassium dichromate/potassium permanganate solution.
5	Determine the pH of the given aerated drinks fruit juices, shampoos and soaps using digital pH meter and pH paper.
6	Estimation of hardness of water using EDTA titration.
7	Standardization of KMnO4 solution by Mohr's salt.
8	Conductometric titration for a) Determination of the strength of a given HCl solution by titration against a standard NaOH solution. b) Analysis of a mixture of strong and weak acid by strong base.
9	Thin layer chromatographic separation.
10	Synthesis and purification of polymer/drug.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Recommended Books		
1	AICTE's Prescribed Textbook: Chemistry – I with Lab Manual, Manisha Agrawal, Khanna Book Publishing.	2022
2	Laboratory Manual for Engineering and Physical Chemistry, Rao M. V. B., Studium Press (India) PVT. Ltd.	2013
3	Vogel's Qualitative Inorganic Analysis, G. Svehla, Prentice Hall.	1996

Course Outcome

Sr	Course Outcome	CO
1	Function on research areas in multidisciplinary subjects.	CO1
2	Design economically, environmentally friendly and new methods of synthesis for various needful products.	CO2
3	Perform titration for various kinds such as acid-base titration etc.	CO3

Course Code : **MTL BS 101**
Course Title : **Engineering Mathematics - I**
L-T-P/S=Credits : **3-1-0 = 4**
Course Category :**Basic Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Differential Calculus:** Partial Differentiation, asymptotes, concavity, convexity, point of inflexion, curvature, radius of curvature, curve tracing, envelopes and evolutes, change of variables, Jacobian, expansion of functions of several variables, chain rule, mean value theorem, Taylor series with remainder term, maxima & minima, saddle point.	
2	**Integral Calculus:** Fundamental theorem of Integral calculus, reduction formulae, properties of definite integral, applications to length, area, volume, surface of revolution. Moments, centre of gravity, improper integrals, β-γ functions.	
3	**Matrices:** Elementary row and column transformation, linear dependence, rank of a matrix, consistency of system of linear equations, solution of linear system of equations, characteristic equations, Cayley Hamilton theorem, eigen values and eigen vectors, diagonalization, complex matrices.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	E. Kreysig , Advanced Engineering Mathematics , Wiley 10th Edition, 2011	
2	A . K. Gupta , Engineering Mathematics, Macmillan 7th Edition 2013	
3	McQuarri Macmillan, Mathematical Methods by Scientists & Engineers, 1st Edition 2013	

Reference Books		
1	Shanti Narayan, Differential Calculus, S. Chand; 30th Revised edition, 2005	

Course Outcome

Sr	Course Outcome	CO
1	Introduce the basic concept of differential calculus to understand the different subjects of engineering as well as basic sciences.	CO1
2	Enable the students to develop the concept of partial differentiation to understand their applications in engineering.	CO2
3	Understand the fundamentals of Integral calculus to understand their applications to length, area, volume, surface of revolution, moments and centre of gravity.	CO3
4	Understand the improper integrals and Beta and Gamma functions and their applications.	CO4
5	Understand the idea of Linear Algebra which are useful to all branches of engineering.	CO5

Course Code : **EEL ES 101**
Course Title : **Fundamental of Electrical Engineering**
L-T-P/S=Credits : **3-0-0 = 3**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction and Electrical Circuit Analysis:** Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation. **AC fundamentals**: Sinusoidal, square and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasors, Phasor representation of sinusoidally varying voltage and current.	
2	**Steady- State Analysis of Single Phase AC Circuits**: Analysis of series and parallel RLC Circuits, Concept of Resonance in series & parallel circuits, bandwidth and quality factor; Apparent, active & reactive powers, Power factor, Concept of power factor improvement and its improvement (Simple numerical problems). **Network theorems**: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem (Simple numerical problems).	
3	**Three Phase AC Circuits**: Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, Three-phase power and its measurement (simple numerical problems). **Measuring Instruments**: Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Use of shunts and multipliers (Simple numerical problems on shunts and multipliers).	

4	**Magnetic Circuit**: Magnetic circuit concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis and eddy current losses, Magnetic circuit calculations (Series & Parallel). **Single Phase Transformer**: Principle of operation, Construction, EMF equation, Equivalent circuit, Power losses, Efficiency (Simple numerical problems), Introduction to auto transformer.	
5	**DC Machines**: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems) **Three Phase Induction Motor**: Principle & amp; Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only) **Single Phase Induction motor:** Principle of operation and introduction to methods of starting, applications. **Three Phase Synchronous Machines:** Principle of operation of alternator and synchronous motor and their applications**.**	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	D.P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.	
2	L.S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.	
3	E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.	
4	V.D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.	
5	B Dwivedi and A Tripathi, “Fundamentals of Electrical Engineering”, Wiley India.	
Reference Books		
1	J. B. Gupta, “Electrical Engineering”, Kataria and Sons.	
2	W.H. Hayt and J.E. Kimerly, “Engineering Circuit Analysis”, Mc Graw Hill.	

Course Outcome

Sr	Course Outcome	CO
1	To solve the electrical circuits (DC & AC).	CO1
2	Solve and analyze the electrical circuits using network theorems and understand the behavior of AC electrical circuits and resonance.	CO2
3	To understand the three phase electrical systems and apply the concepts of measurements in measuring electrical quantities.	CO3
4	Solve and analyze the behavior of magnetic circuits and understand the concept of transformers and their applications.	CO4
5	To study the working principles of basic electrical machines including DC as well as AC machines.	CO5

Course Code : **EEP ES 101**
Course Title : **Fundamental of Electrical Engineering Lab**
L-T-P/S=Credits : **0-0-2 = 1**
Course Category :**Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	To study the front panel control of Multimeter.
2	To study the front panel control of DC Multiple Power Supply.
3	To study the front panel control of Cathode Ray Oscilloscope (CRO).
4	To study the front panel control of Function Generator.
5	Verification of Kirchoff's Voltage Law.
6	Verification of Kirchoff's Current Law.
7	Verification of Superposition Theorem.
8	Verification of Thevenin's Theorem.
9	Verification of Norton's Theorem.
10	Verification of Maximum Power Transfer Theorem.
11	Verification of Reciprocity Theorem.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	L.S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.	
2	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.	

3	V.D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.	
Reference Books		
1	J. B. Gupta, “Electrical Engineering”, Kataria and Sons.	
2	W.H. Hayt and J.E. Kimerly, “Engineering Circuit Analysis”, Mc Graw Hill.	

Course Outcome

Sr	Course Outcome	CO
1	To learn working of various measurement devices.	CO1
2	Knowledge of Ohm’s law is required to measure voltage drops and division of currents in DC circuits.	CO2
3	Analysis of voltage drops and division of currents need knowledge of Ohm’s law.	CO3
4	To verify various Theorems used in networks	CO4

Course Code : CSL ES 101
Course Title : Introduction to 'C' Programming
L-T-P/S=Credits : 3-0-0 = 3
Course Category :Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction**: Concept of problem solving, Problem definition, Program design, Techniques of Problem Solving (Flowcharting, algorithms, pseudo code), Structured programming concepts.	
2	**Fundamentals:** C character set, Tokens, identifiers and keywords, constants and variables, Data types, Data Type Modifiers Structure of a C Program, , Types of Statements: declarations, arithmetic statements and arithmetic operations, , Operators: Arithmetic, relational and equality, logical, assignment and compound assignment, Operators classification based on number of operands: Unary, Binary and Ternary (conditional, unary operations), operator's precedence & associativity, library functions, single character input and output, entering and writing data.	
3	**Control Statements:** Statement and blocks, Decision making structures: if else and its types, Looping structures: while, for, do while, Case control structures: switch, break and continue statements, nested control structures.	
4	**Arrays:** Definition, types, initialization, processing an array, 2 Dimension Arrays, Sorting, Searching, Copy, Insertion, Deletion of elements in array.	
5	**Functions and pointers:** Functions definition, prototype, passing parameters, recursion, pointers, pointers and arrays, pointers and Functions.	
6	**String:** Operations on String, built in functions, string and functions.	
7	**User defined data types and Additional Features of C:** Structures, Array of Structures, Array within Structures, Structures within Structures, Union, Enumerations, Pre-processor Directives.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Gottfried, Byron S., "Programming with C", Tata McGraw Hill	
2	Balagurusamy, E., "ANSI C", Tata McGraw-Hill	
3	Yashwant Kanetker, "Let us C", BPB	
4	C, The Complete Reference, Scholdt, TMH	
5	Programming with C, S. Kaicher, Macmillan	
Reference Books		
1	C For Yourself, Asian Inst. of Tech AIT	
2	Structured Programming Approach Using C, B. Forouzen, Thomas Learning	

Course Outcome

Sr	Course Outcome	CO
1	Knowledge and understanding of programming.	CO1
2	Ability to write simple programs in C language by using basic control structures (conditional statements, loops, switches, branching, etc.).	CO2
3	Understanding the concept of programming using functions, arrays, strings, pointers and structures, and implementing the various operations on them.	CO3
4	Ability to create a programmable model for a problem given.	CO4

Course Code : CSPP ES 101
Course Title : 'C' Programming Lab
L-T-P/S=Credits : 0-0-2 = 1
Course Category :Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiment

Sr	Contents
1	Write a program to know the number of bytes of data type it contains.
2	Write a program to display the ASCII code of a variable on the screen.
3	Write a program to find the sum of digits of a 4 digit number.
4	Write a program to reverse a 4 digit number.
5	Write a program to swap the values of two variables with/without using third variable
6	Write a program to display if a number is even or odd
7	Write a program to display that a person is eligible for voting
8	Write a program to display greatest among two/ three numbers
9	Write a program to read number between 1-7 & display corresponding day of week
10	Write a program to read marks of five subjects and compute percentage and display grade of 8 students based on percentage
11	Write a program to check whether the year entered is leap year or not
12	Write a program to print the relation between 2 numbers as equal to, less than or greater than.
13	Write a program to read lower case character and display it in upper case
14	Write a program to convert Celsius into Fahrenheit
15	Write a program to swap the values to two variables with the help of temporary variable
16	Write a program to make a calculator
17	Write a program to print 1 to 10 in ascending and descending order on screen
18	Write a program to print sum of all even/ odd numbers between 1 to n
19	Write a program to print multiplication table of n
20	Write a program to find factorial of a number
21	Write a program to find sum of all numbers between m to n

22	Write a program to read a number and print each digit on separate line
23	Write a program to find the sum of digits of a number
24	Write a program to reverse a number
25	Write a program to find if the number is Palindrome or not
26	Write a program to read +ve numbers from user till user enters 0 & display for each number whether it is even or odd
27	Write a program to read character from user till user enters special character and display count of vowels and digits
28	Write a program to print all leap years between year m to n
29	Write a program to read a number and find if it is an Armstrong number or not
30	Write a program to print all prime number between n to m
31	Write a program using switch case to read one number and perform 1. Sum of digit 2. Reverse of number 3. Number is palindrome or not
32	Write a program using switch case to read operator and perform (+, -, /, *) operators of operands
33	Write a program to sort an array of type integer
34	Write a program to reverse an array element in the array
35	Write a program to check if the array is palindrome or not
36	Write a program to insert an element in sorted array at its right place
37	Write a program to delete all the duplicate numbers from the array
38	Write a program to sum the two arrays into another array.
39	Write a program to add two matrix using multi-dimensional arrays
40	Write a program to multiply to matrix using multi-dimensional arrays
41	Write a program to find transpose of a matrix
42	Write a program to find the length of a string
43	Write a program to find the total number of vowels in the string

44	Write a program to find the number of vowels, consonants, digits and white space in string using Switch - case
45	Write a program to concatenate two strings
46	Write a program to find the total number of words in a sentence
47	Write a program to reverse a sentence
48	Write a program to remove all characters in a string except alphabet
49	Write a program to sort elements in different orders in string
50	Write a program to insert a character in a string
51	Write a program to insert a word in a string
52	Write a program to find the length of each string in a 2-dimensional array
53	Write a program to find sort each string in a 2-dimensional array
54	Write a program to display prime numbers between intervals using function
55	Write a program to check prime or Armstrong number using user-defined function
56	Write a program to find the sum of n natural numbers using function
57	Write a program to calculate factorial of a number using function
58	Write a program to calculate power of a number using function
59	Write a program to convert binary number to decimal and vice-versa using function
60	Write a program to multiply two matrices by passing matrix to function

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Gottfried, Byron S., "Programming with C", Tata McGraw Hill	
2	Balagurusamy, E., "ANSI C", Tata McGraw-Hill	
3	Yashwant Kanetker, "Let us C", BPB	
Reference Books		
1	Programming with C, S. Kaicher, Macmillan	
2	Structured Programming Approach Using C, B. Forouzen, Thomas Learning	

Course Outcome

Sr	Course Outcome	CO
1	Knowledge and understanding of programming.	CO1
2	Ability to write simple programs in C language by using basic control structures (conditional statements, loops, switches, branching, etc.).	CO2
3	Understanding the concept of programming using functions, arrays, strings, pointers and structures, and implementing the various operations on them.	CO3
4	Ability to create a programmable model for a problem given.	CO4

Course Code : MEM SE 101
Course Title : Mechanical Workshop
L-T-P/S=Credits : 1-0-2 = 2
Course Category : Skill Enhancement Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Basic Measurements:** Measuring units, Familiarization with meter scale, Vernier calliper, Screw gauge, S.W.G, Height gauge and their utility. Measuring the dimensions of a thin wire, thickness of metal sheet, cylindrical objects etc.	6
2	**Mechanical Skill-I:** Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, smithy, carpentry and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood.	8
3	**Mechanical Skill-II:** Cutting tools, lubricating oils, Cutting of a metal sheet, Drilling of holes of different diameter in metal sheet and wooden block, Use of bench vice, shearing machine, bending machine and tools for fitting. ·	8
4	**Mechanical Skill-III:** Concept of machining processes, introduction to common machine tools like lathe, shaper, drilling, milling machine. Cutting tool signatures, machines specifications etc.	8
5	**Introduction to Prime Movers:** Mechanism, gear system Fixing of gears. Lever mechanism, Lifting of heavy weight using lever. Braking systems, pulleys mechanism.	9

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	A text book of workshop Technology – S.K Garg - University Science Press.	
2	A text book of workshop Technology – Khurmi and Gupta S. - Chand and Company.	
3	Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.	
Reference Books		
1	Workshop Technology–W.A.J. Chapman-CBS	

Course Outcome

Sr	Course Outcome	CO
1	Study and practice on machine tools and their applications so that students should know and operate the machine tools and perform various processes in welding, sheet metal, smithy and machines shop.	CO1
2	Students should understand the functioning and applications ofcutting tools, machines, processes ; like fabrication of joints using arc welding, seam joints, forging and taper turning	CO2
3	Students should document the job performed, safety precautions observed while performing experiment on different machine tools	CO3
4	Students should perform the jobs, safety precautions taken while performing the experiments using various tools/ machine tools.	CO4

Course Code : **MTL BS 102**
Course Title : **Engineering Mathematics - II**
L-T-P/S=Credits : **3-1-0 = 3**
Course Category : **Basic Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Vector Calculus:** Beta & Gamma functions. Differentiation of vector functions of scalar variables. Gradient of a scalar field, Divergence & Curl of a vector field and their properties. Line & surface integrals. Green's theorem, Stokes' theorem & Gauss' theorem both in vector & Cartesian forms (statement only) with simple applications.	13
2	**Ordinary Differential Equation:** Formation of ODE's, definition of order, degree and solution, ODE's of first order, method of separation of variables, homogenous and non- homogenous equations and their solution, exactness and integrating factor, Bernoulli's general linear ODE's of nth order, operator method, method of undetermined coefficients, method variation of parameters, solution of simple simultaneous ODE's.	13
3	**Partial Differential Equation:** Formation of partial differential equations (PDE), Solution of PDE by direct integration. Lagrange's linear equation. Non-linear PDE of first order. Method of separation of variables. Heat, Wave & Laplace's equations (Two dimensional Polar & Cartesian Co-ordinates).	13

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	E. Kreysig, Advanced Engineering Mathematics, Wiley 10th edition 2011.	
2	Frank Ayres, Vector Analysis, Mc Graw Hills, 6th edition 2011.	
3	T. Marsden and W.H. Freeman,VectorCalclus, Freeman, 6 edition 2011.	

4	G. Simons, Differential Equations with Applications, TMH, McGraw-Hill Higher Education; 2 edition 1991.	
Reference Books		
1	S.L. Ross, Differential Equations, Wiley 3 rd edition 1984.	
2	R. Zalman, A Course in Ordinary and PDEs, Academic Press, 1st edition 2014.	

Course Outcome

Sr	Course Outcome	CO
1	Understand the concepts of vector calculus like directional derivative, gradient, divergence and curl, and their applications.	CO1
2	Learn and apply the concepts of vector integral calculus for the computation of work done, circulation, and flux.	CO2
3	Formulate the differential equations concerning physical phenomena like electric circuits, wave motion, heat equation etc.	CO3
4	Learn various methods of solution of ordinary and partial differential equations.	CO4
5	Solve various partial differential equations arising in heat conduction problems and wave propagation problems.	CO5

Course Code : **PHL BS 102**
Course Title : **Engineering Physics**
L-T-P/S=Credits : **3-0-0 = 3**
Course Category :**Basic Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Force and electric field due to continuous charge distribution, Field lines-Flux-Gauss's & Law (differential and integral forms) and its applications, Electric potential, Work done in assembling a charge distribution.	5
2	Force Law-line current, surface current and volume current densities (Equation of Continuity), Biot-Savart law, Properties of B, Magnetic flux-Div B, Curl B, Magnetic vector potential A, Ampere's law (differential and integral forms), Faraday's laws of electromagnetic induction, displacement current, Modified Ampere's law, Four Maxwel's equations in differential and integral forms	9
3	Electromagnetic Spectrum, Brief introduction to black body radiation, Photo-electric Effect and Compton Effect, Wave particle duality (de-Broglie waves), Davisson-Germer Experiment, Concept of wave function and its physical significance, Phase and Group velocities, Uncertainty Principle.	9
4	Bohr Theory of atom (with finite and infinite nuclear mass), Derivation of time dependent and time independent Schrödinger wave equations, Expectation values and operators (momentum, energy and angular momentum operators) and commutators, Particle in a box of infinite height (One dimensional).	9
5	Free electron theory-Free electron gas, Energy levels and density of states in one dimension, Band theory of solids, Classification of metals, semiconductors and insulators on the basis of band theory.	9

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Introduction to Electrodynamics, D.J. Griffiths, Pearson.	
2	Electromagnetics, B. B. Laud, New Age International Publisher.	
3	Perspectives of Modern Physics, Arthur Beiser, Tata McGraw Hills.	
4	Introduction to Solid State Physics, Charles Kittel, Wiley.	
Reference Books		
1	Solid State Physics, S.O. Pillai, Wiley.	
2	Fundamentals of Physics, Resnick Halliday, Wiley.	

Course Outcome

Sr	Course Outcome	CO
1	Know the vocabulary and concepts of physics as it applies to electricity and magnetism, and modern physics.	CO 1
2	Develop the mathematical description of these concepts and principles to build up problem-solving skills that will benefit their future career.	CO 2
3	Apply an understanding of these concepts to develop various modern systems, structures, technology, and devices.	CO 3
4	Gain confidence to apply mathematical methods to understand Physics problems in real-life situations.	CO 4

Course Code : **PHP BS 102**
Course Title : **Physics Lab**
L-T-P/S=Credits : **0-0-2 = 1**
Course Category :**Basic Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	To study the Measuring Instruments (Vernier Calipers, Screw Gauge & Spherometer)
2	To find the angle of prism by rotating the telescope method.
3	To find the refractive index of the material of the given prism using a spectrometer.
4	To determine the refractive index of the given liquid (water) using a hallow prism and spectrometer.
5	To study the Newton's Interference Rings and to determine the wavelength of Sodium light.
6	To determine the Wave Length of Sodium Light using a plane diffraction grating.
7	To determine the frequency of A.C. mains with a Sonometer using non magnetic wire.
8	To draw the characteristics curves of a Semiconductor Diodes (Si or Ge).
9	To study the V-I characteristics of a Zener Diode.
10	To study the performance of a Half-wave, Full-wave & Bridge wave rectifier without filters.
11	To verify Stefan's law by estimating the temperature of a torch bulb filament from resistance measurement.
12	To study the Hall Effect and to calculate the Hall Coefficient and Charge Carrier Concentration of a given sample.
13	To study the dependence of Refractive Index(μ) of the material of the prism on the Wavelength(λ) of light; and hence(1) to determine the Dispersive Power of the material of prism; (2)to verify the Cauchy Relationship μ=a+b/λ2 ,and to estimate the values of a & b(3)to plot a graph of dμ/dλ versus λ.
14	To determine the band gap by measuring the resistance of a Thermistor at different temperatures.
15	To determine the energy band gap of a semiconductor diode (Ge) using Four Probe Method.

16	To study the wavelength of He-Ne Laser.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Introduction to Electrodynamics, D.J. Griffiths, Pearson.	
2	Electromagnetics, B. B. Laud, New Age International Publisher.	
3	Ferspectives of Modern Physics, Arthur Beiser, Tata McGraw Hills.	
4	Introduction to Solid State Physics, Charles Kittel, Wiley.	
Reference Books		
1	Solid State Physics, S.O. Pillai, Wiley.	
2	Fundamentals of Physics, Resnick Halliday, Wiley.	

Course Outcome

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Course Code : **ECL DC 102**
Course Title : **Solid State Devices**
L-T-P/S=Credits : **3-0-0 = 0**
Course Category : **Departmental Core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Quantum Theory of Solids: basic principles of quantum mechanics, Schrodinger equation and its applications, atoms and formation of energy bands, electrical conduction in solids, density of states functions, bonding forces and energy bands in solids. Semiconductor in Equilibrium: charge carriers in semiconductors, carrier concentrations, dopant atoms and energy levels, intrinsic and extrinsic semiconductors, charge neutrality, Fermi energy level. Carrier Transport Phenomena: carrier drift, diffusion, graded impurity distribution, Hall effect, scattering in semiconductors, velocity-electric field relations, high field transport, charge injection, and quasi Fermi levels. Non-Equilibrium Excess Carriers in Semiconductors: carrier generation and recombination, characteristics of excess carriers, and excess carrier lifetime.	12
2	PN junction and hetero-structures: basic structure and principle of operation, PN junction under bias, junction capacitance, steady state conditions, transient and AC conditions, reverse bias breakdown, metal-semiconductor junctions. Diodes: PN junction I/V characteristics, diode equivalent circuits, semiconductor diodes, rectifiers (efficiency, ripple factor), filters, clippers, and clampers.	9
3	Bipolar Junction Transistors: fundamental operation, amplification with BJTs, generalized biasing and equivalent circuit models, non-ideal effects, switching. BJT construction, characteristics (CB, CE, CC), load line, and BJT biasing. Transistor Modeling: BJT small signal model, hybrid equivalent model, and FET small signal model.	9
4	Field-Effect Transistors: transistor operations, JFET, MOSFET and their operations, device characteristics, non-ideal effects, MOS junction C-V characteristics, threshold voltage, body effect, and equivalent circuits.	9

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Solid State Electronic Devices Ben G Streetman and S. K. Banerjee, Pearson	7th Edition
2	Electronic Devices and Circuits Christos C. Halkias, Jacob Millman, Satyabrata Jit Tata McGraw Hill Education Pvt Ltd.	Third Edition (2010)
3	Fundamentals of Microelectronics, 3rd Edition Behzad Razavi ISBN: 978-1-119-69514-1	April 2021
4	Microelectronic Circuits (The Oxford Series in Electrical and Computer Engineering) Sedra Smith	2009
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	To learn the basic physics of semiconductor electronic devices.	CO1
2	The study the importance of electrons and holes in semiconductors, the charge density and distribution, the charge transport mechanisms.	CO2
3	To learn the physics of a p-n junction and semiconductor-metal junctions.	CO3
4	To learn the internal workings of the most basic solid state electronic devices.	CO4

Course Code : **ECP DC 102**
Course Title : **Devices Lab.**
L-T-P/S=Credits : **0-0-2 = 1**
Course Category : **Department Core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	To study the front panel control of Multimeter.
2	To study the front panel control of DC Multiple Power Supply
3	To study the front panel control of Cathode Ray Oscilloscope (CRO).
4	To study the front panel control of Function Generator.
5	To determine and plot the operating characteristics of a PN junction diode.
6	To study the characteristics of Zener Diode and its application as voltage regulator.
7	To study the input / output waveforms of Half-wave rectifier using diode and find out its ripple factor and efficiency.
8	To study the input / output waveform of Full-wave Bridge rectifier using diode and find out its ripple factor and efficiency.
9	To study different Clipper circuits using PN junction diode for both positive and negative configurations.
10	To study different Clamper circuits using PN junction diode.
11	To plot and determine the characteristics of common-emitter configuration of a transistor.
12	To plot and determine the characteristics of common-base configuration of a transistor.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Basic Electronics: Devices, Circuits & IT Fundamentals, Kal, PHI	

2	Electronic Devices & Circuits, Milman & Halkias	
3	Electronic Devices & Circuits, Theodore Bogart, Jr	
Reference Books		
1	Basic Electronics for Scientists	
2	Electronic Devices & Circuits, Boylestad, Nashelky, PHI	

Course Outcome

Sr	Course Outcome	CO
1	To learn basic concepts of Semiconductor Devices	CO1
2	To Study various BJT and MOS Devices	CO2
3	Learn and able to apply small signal BJT and FET analysis.	CO3
4	Able to understand advanced semiconductor devices.	CO4
5	To analyze and design amplifiers.	CO5

Course Code : **ECL DC 104**
Course Title : **Network Analysis & Synthesis**
L-T-P/S=Credits : **3-1-0 = 4**
Course Category : **Department Core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Network Graph Theory:** Concept of network graph terminology used in network graph, Relationship between twigs and links, planar and non planar graph, Tree, Property of a tree in a graph, Co-tree, Link, Basic loop and basic cut-set, Formation of incidence matrix, Cut-set matrix, Tie set matrix, Duality, Network Theorems: Reciprocity theorem, Millman's theorem, Compensation theorem, Tellegen's Theorem.	7
2	**Laplace Transformation:** Definition, Inverse LT, Properties of LT, Solution of linear differential equations, Transformed circuit components representation, Independent source, Resistance, inductance and capacitance parameters, Transfer functions.	8
3	**Transient Circuit Analysis**: Initial conditions, Natural response and forced response, Transient response and steady state response for arbitrary inputs, Transient response of RL, RC and RLC networks.	8
4	**Two Port Networks**: Transform impedances network functions of one port and two port networks, Concept of poles and zeros, Characterization of LTI two port networks; Z, Y, ABCD, g and h parameters, Reciprocity and symmetry, Inter-connections of two port networks, Analysis of ladder networks.	6
5	**Network Synthesis-** Causality and stability, Hurwitz polynomial, Positive real function, Frequency response of reactive one ports, Synthesis of LC, RC and RL driving point immittance functions using Foster's and Cauer's methods.	5
6	**Filters**- Passive and active filter fundamentals, Determination of pass and attenuation bands constant, Low pass filters, High pass filters, constant K-type filters, Band pass filters, Band stop filters, M-derived filters, lattice filters.	5

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	M. E. Van Valkenburg, "Network Analysis", Prentice Hall.	
2	C. K. Alexander and M. N. O. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill Education.	
3	A. Chakrabarti, "Circuit Theory", Dhanpat Rai & Co.	
Reference Books		
1	D. Roy Choudhary, "Networks and Systems", Wiley Eastern Ltd.	
2	W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education.	

Course Outcome

Sr	Course Outcome	CO
1	Understand the graph theory and its application in Electrical Network	CO1
2	Obtain the transient and steady-state response of electrical circuits.	CO2
3	Analyse two port circuit behavior.	CO3
4	Familiarization with network synthesis and stability of systems.	CO4
5	Understand the basics and analysis for filters.	CO5

Course Code : MEM SE 102
Course Title : Engineering Graphics with CAD
L-T-P/S=Credits : 2-0-2 = 3
Course Category : Skill Enhancement Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction of Engineering Graphics:** Drawing instruments and their uses, Orthographic Projections: Planes of projection–Projection of points in different quadrants. Orthographic Projection of Straight Line parallel to one plane and inclined to the other plane–Straight Line inclined to both the planes–True Length and inclination of lines with reference planes–Traces of line–Projection of Planes, Projection of Solids, Isometric Drawing: Types of Projection-Orthographic, Isometric, Oblique and Perspective Projections, exercises on Isometric drawings. Section of Solids: Classification of Solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to other plane. Development of Surfaces: Principle, Engineering applications and Methods of development.	
2	**Introduction:** Introduction to Computer Aided Drafting (CAD), Reasons for implementing CAD, Applications of CAD, Benefits/limitations of CAD, Hardware of CAD system, Types of CAD software. Introduction to other drafting software suchas Mechanical Desktop and Auto Cad Electrical	
3	**Introduction to Auto CAD:** Starting AutoCAD, AutoCAD screen components, creating a drawing on AutoCAD, invoking different commands, Dialog boxes, Coordinate Systems, Exercises on Drawing of Line, Circle, Arc, Ellipse, Polygon, etc. Drawing Aids and Ed	
4	**Drawing Aids and Editing Commands:** Layers, Drafting Settings, Object Snaps, Function and Control keys, various Editing Commands, Editing the Objects with Grips, Grip Types.	
5	**Creating Text, Dimensions and Tolerances in AutoCAD:** Creating Text, Editing Text, Styles of Dimensioning, Dimensioning System Variables, Editing/Updating Dimensions, Adding Tolerances.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint

Text Books		
1	Ellen Filkensten-AutoCAD 2006 & AutoCAD LT2006 Bible, Wiley, New York.	
2	Sham Tickoo -AutoCAD 2005,Tata McGraw Hill, New Delhi.	
3	George Omura - AutoCAD, Sybex Inc	
4	Bhat, N.D. and Panchal, V. M. - Engineering Drawing, Charotar Publishers, Anand.	
Reference Books		
1	Narayana, K.L. and Kannaiah, P.-Engineering Graphics, Tata McGrawHill, New Delhi.	
2	Gill, P.S-Engineering Drawing, S.K Kataria & Sons, New Delhi.	

Course Outcome

Sr	Course Outcome	CO
1	To learn basics of drawing, including dimensioning	CO1
2	To draw orthographic projections of points and lines, and traces of lines	CO2
3	To draw orthographic projections of planes.	CO3
4	To draw orthographic projections and sections of solids.	CO4

Course Code : BTL BS102
Course Title : Biology for Engineers
L-T-P/S=Credits : 3-0-0 =3
Course Category : Basic Science course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours

1	Introduction to Basic Biology Cell, Cell theory, Cell shapes, structure of a Cell, prokaryotic and eukaryotic Cell, Plant Cell and animal Cell, protoplasm, Plant Tissue and Animal Tissue. Cell cycle	16
2	Introduction to Bio-molecules Carbohydrates, proteins, Amino acid, nucleic acid (DNA and RNA) and their types. Enzymes and their application in Industry. Large scale production of enzymes by Fermentation 18	18
3	Gene structure and recombinant DNA technology Prokaryotic gene and Eukaryotic gene structure, gene replication, Transcription and Translation in Prokaryotes and Eukaryotes. Recombinant DNA technology and introduction to cloning. 18	18
4	Applications of Biology Brief introduction to Production of vaccines, Enzymes, antibodies, Cloning in microbes, plants and animals, Basics of biosensors, biochips, Bio fuels. Tissue engineering and its application, transgenic plants and animals, Stem cell and applications. Bio engineering (production of artificial limbs, joints and other parts of body).	20

Suggested Books:

Suggested Books: Sr. Name of Book, Author, Publisher Year of Publication / Reprint Text Books 1 2 3 Reference Books 1 2

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
	Text Books	
1	Essential Cell Biology Fifth edition by Bruce Alberts, Karen Hopkin, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter, WW Norton & Co	2019
2	Karp's Cell Biology Eighth edition by Gerald Karp, Janet Iwasa, Wallace Marshall; Wiley	2018
3	Biology for Engineers by T Johnson press	2011
	Reference Books	
1	The Cell: A Molecular Approach Fifth edition by Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, M.A.	2009
2	Lehninger: Principles of Biochemistry, 8th edition by David L. Nelson and Michael. M. Cox; W. H. Freeman and Company.	2021

Course Outcome

After successful completion of this course, students will be able to:

Sr	Course Outcome	CO
1	Understand the detailed structure of the cell and cell cycle.	CO1
2	Understand the structure and function of biomolecules and their importance	CO2
3	Illustrate about genes and genetic materials (DNA & RNA) present in living organisms and how they replicate, transfer & preserve vital information in living organisms	CO3
4	Demonstrate the concept of biology and its uses in combination with different technologies for the production of medicines and production of transgenic plants and animals.	CO4

Course Code : **ECL ES201**
Course Title : **Numerical Methods**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Engineering Science course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours L T P Cr 3 0 0
1	**Introduction & Approximations** Motivation and Applications, Accuracy and precision; Truncation and round-off errors; Binary Number System	4
2	**Non-Linear Equations**: Bisection, secant, fixed-point iteration, Regula Falsi Method, Newton method for simple and multiple roots, their convergence analysis and order of convergence.	10
3	**Linear Systems and Eigen-Values**: Introduction to Linear Systems, Overview of linear systems of equations. Representation of systems as matrices. Consistent, inconsistent, and dependent systems. Direct Methods for Solving Linear Systems: Gauss Elimination Method, Gauss Jordan Elimination Method, LU Decomposition(Crout's and Doolittle's method) Indirect Method: Jacobi's Method, Gauss-Seidel Method, Successive Over relaxation Method (SOR) Method.	8
4	**Interpolation and Approximations**: Newton's Forward Difference Interpolation Formula, Newton's Backward Difference Interpolation Formula, Spline Interpolation and Cubic Splines Approximation, Least squares approximation, uniform approximation and rational approximation. **Regression :** Linear regression in one variable ,Linear regression in multiple variables, other methods of multiple regression	8
5	**Numerical Integration**: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss-Legendre quadrature formulae.	6
6	**Differential Equations**: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.	6

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Gerald F. C. and Wheatley O. P., Applied Numerical Analysis, Pearson, (2003) 7thEdition,	2012
2	Steven C. Chappra, Numerical Methods for Engineers, McGraw-Hill Higher Education; 7th edition (1 March 2014)	2014
3	Jain K. M., Iyengar K. R. S. and Jain K. R., Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2012), 6^{th} edition.	
Reference Books		
1	Mathew H. J., Numerical Methods for Mathematics, Science and Engineering, Prentice Hall, (1992) 2nd edition.	1992
2	Burden L. R. and Faires D. J. Numerical Analysis, Brooks Cole (2011),9^{th} edition.	2011
3	Atkinson K. and Han H., Elementary Numerical Analysis, John Willey &Sons (2004), 3rd edition.	2004

Course Outcome

Sr	Course Outcome	CO
1	Learn about errors and approximation and how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.	CO1
2	Solve system of linear equations numerically using direct and iterative methods.	CO2
3	Understand how to approximate the functions using interpolating polynomials.	CO3
4	Learn how to solve definite integrals and initial value problems numerically.	CO4
5	To Learn about solutions of problems using differential equations.	CO5

Course Code : ECP ES201
Course Title : Numerical Methods Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category :
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to MATLAB and basic programs including function, matrices etc.	
2	Write a program to find the roots of equation using Bisection Method	
3	Write a program to find the roots of equation using Iteration Method	
4	Write a program to find the roots of equation using Secant Method	
5	Write a program to find the roots of equation using Newton Raphson Method	
6	Write a program for Gauss elimination method (Direct Methods)	
7	Write a program for Indirect Methods for Matrices.	
8	Write Programs related to interpolation and approximation.	
9	Write programs related to Differential equations.	
10	Write programs related to integration differential Methods.	

The programs may vary and this is just a broad guideline for the lab.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Gerald F. C. and Wheatley O. P., Applied Numerical Analysis, Pearson, (2003) 7th Edition,	
2	Steven C. Chappra, Numerical Methods for Engineers, McGraw-Hill Higher Education; 7th edition (1 March 2014)	
3	Jain K. M., Iyengar K. R. S. and Jain K. R., Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2012), 6th edition.	

Course Code : **ECL DC 203**
Course Title : **Electromagnetic Field Theory**
L-T-P/S=Credits : **3-1-0 = 4**
Course Category : **Department Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction:** Vector Analysis, Coordinate System, Gradient, Divergence, Curl, Laplaceian in rectilinear, Cylindrical, Spherical Coordinate System, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem	
2	**Time varying fields and Maxwell's equations:** Introduction, The Equation of Continuity For Time-Varying Fields, Inconsistency Of Ampere's Law, Maxwell's Equation in Integral and differential form, Physical Significance of Maxwell Equation, Boundary	
3	**ELECTROMAGNETIC WAVES:** Solution For Free-Space Conditions, Uniform Plane Waves & Propagation, The Wave Equations For A Conducting Medium, Sinusoidal Time Variations, Conductors And Dielectrics, Polarization, Reflection By A Perfect Conductor Normal Incidence & Oblique Incidence, Reflection By A Perfect Dielectric — Normal Incidence & Oblique Incidence, Reflection At The Surface Of A Conductive Medium.	
4	**RADIATION:** Potential Functions And Electromagnetic Field, Potential Functions For Sinusoidal Oscillations, Alternating Current Element, Power Radiated By Current Element, Application To Short Antennas, Radiation From A Monopole Or Dipole.	
5	**Transmission Line:** Circuit theory analysis of Transmission Line, Loss less and Lossy transmission lines, Reflection coefficient, Transmission Coefficient, VSWR, Input Impedance, Matching of Transmission Line, pulse excitation. Group Velocity and Phase velocity.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Fields & Wave Electromagnetics , DK Cheng	
2	Electromagnetic Waves and Radiating Systems, Jordan &Balmin	
3	Elements of Electromagnetics, Sadiku	
Reference Books		
1	Engineering Electromagnetics: W H Hayt & J A Buck	
2	Advanced Engineering Electromagnetics: C A Balanis	

Course Outcome

Sr	Course Outcome	CO
1	To learn about vector analysis and coordinate systems.	CO1
2	Able to learn time varying electromagnetic fields.	CO2
3	To learn how to obtain solutions of wave equations.	CO3
4	To study radiation & reflection in a time varying EM field.	CO4
5	To learn about the basics of transmission lines.	CO5

Course Code : ECL DC 205
Course Title: Electronic Devices and Circuits
L-T-P/S=Credits : 3-0-0 =3
Course Category : Department Core Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Transistor biasing and basic characteristics: operating point, bias stability, different biasing arrangements, stabilization, thermal runway and thermal stability, small signal low frequency amplifiers, analysis of generalized amplifier models, transistor hybrid models, determination and measurement of h-parameters, analysis of transistor amplifier circuits using h-parameters.	9
2	Low frequency response of amplifiers: Cascading transistor amplifiers, calculations for different amplifier configurations, Emitter follower, Miller's theorem, Cascode transistor configurations, few configurations of high frequency response, Basic overview on difference and power amplifiers.	7
3	Basic overview on difference and power amplifiers.Large Signal Amplifier a) Difference between voltage and power amplifiers b)Importance Of Impedance Matching In Amplifiers C)ClassA,ClassB,ClassAB,andClass C amplifiers d) Single ended power amplifiers, push-pull amplifier, and complementary symmetry push-pull amplifier	7
4	Feedback : Feedback concept, positive and negative feedback, different feedback configurations, Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short;	6
5	MOS Basics, MOS Amplifier Topologies Biasing , Realization of Current Sources , Common-Source Stage, CS Core, CS Stage with Current-Source Load, CS Stage with different conditions, Common Gate Stage and Source Follower under different biasing conditions.	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Electronic Devices and Circuits Christos C. Halkias, Jacob Millman, Satyabrata Jit Tata McGraw Hill Education Pvt Ltd.	Third Edition (2010)
2	Fundamentals of Microelectronics, 3rd Edition Behzad Razavi ISBN: 978-1-119-69514-1	April 2021
3	Microelectronic Circuits (The Oxford Series in Electrical and Computer Engineering) Sedra Smith	2009
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	To introduce and verify basic principles, operation and applications of the various analog electronic circuits and devices like: BJT and MOSFET for various functions.	CO1
2	To make students understand and analyze the design and working of amplifiers and their configurations.	CO2
3	To Learn about frequency response of the amplifier configurations.	CO3
4	To Learn about feedback its configurations and impact on designed amplifiers.	CO4
5	To learn MOSFET as amplifier and work under different conditions	CO5

Course Code : **ECP DC 205**
Course Title : **Electronic Devices and Circuits lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Design a transistor bias circuit.
2	Study of h-parameters of Transistor
3	Design a two stage RC coupled amplifier-using BJT.
4	Design a bias circuit of FET
5	Design a single stage amplifier using FET.
6	Design a power supply with a C filter.
7	Design a voltage regulator.
8	Design a push pull class B amplifier without input and output transformer.
9	Study of Feedback Amplifier
10	Input impedance output impedance of common emitter Amplifier and measurement of gain.
11	Exercises on circuit simulation using PSPICE

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Integrated Electronics, Millman Halkias,Tata McGraw Hill	
2	Microelectronics, Millman Grabel, Tata Mc Graw Hill	
3	Electronics Circuits, Schilling & Belove, McGraw Hill	
Reference Books		

1	Introduction to PSpice using OrCad for Circuits & Electronics, Rashid, Pearson Education	

Course Outcome

Sr	Course Outcome	CO
1	To learn basic concepts of Semiconductor Devices	CO1
2	Able to understand and use BJT and MOS Devices.	CO2
3	Learn and be able to apply small signal BJT and FET analysis.	CO3
4	To analyze and design rectifiers and amplifiers using SPICE.	CO4

Course Code : **ECL DC 207**
Course Title : **Digital Electronics**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Department core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Basic concepts of Boolean Algebra:** Review of number systems - Binary, Hexadecimal, conversion from one to another, complement arithmetic, Signed and unsigned numbers and their arithmetic operations. BCD, Excess-3, Gray and Alphanumeric codes. Review of Boolean algebra, De-Morgan's Theorems, Standard Forms of Boolean Expressions, MinimizationTechniques: K-MAPS, VEM Technique, Q-M (Tabulation) method.	
2	**CMOS Logic family :** Logic family features, noise margin, setup time, hold time, delay, fan in, fan out, CMOS based logic gates.	
3	**Combinational Logic Circuits:** Problem formulation and design of Basic Combinational Logic Circuits, Combinational Logic Using Universal Gates. Basic Adders, ALU, Parity-Checkers and Generators, Comparators, Decoders, Encoders, Code Converters, Multiplexer (Data Selector), De-multiplexers.	
4	**Sequential Circuits:** Latches, Flip-flops (SR, JK, T, D, Master/Slave FF,) Edge-Triggered Flip-Flops, Flip-Flop Operating Characteristics, Basic Flip-Flop Applications, Asynchronous Counter Operation, Synchronous Counter Operation, Up/Down Synchronous Counters.	
5	**Shift Registers & Memories:** Random-Access Memories (RAM), Read Only Memories (ROMs), Programmable ROM's (PROMs and EPROMs), PAL, PLA.FPGA introduction, CPLD.	
6	**A/D and D/A convertor:** Characteristics of ADC, Types of ADC- SAR, Dual Slope, Flash ADC. Characteristics of DAC, R-2R Ladder, Weighted Resistance Type.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	"Digital Fundamentals" by Thomas L. Floyd, Prentice Hall, Inc	
2	"Digital Systems - Principles and Applications" by Tocci, R. J. and Widner, Prentice Hall	
3	Switching and finite automata theory: Z V Kohavi.–TMH	
4	Digital Logic Circuit Analysis & Design, by Victor P. Nelson, H. Troy Nagle, Bill D. Carroll and J. David Irwin, Prentice Hall,	
5	Digital logic and computer design: M Morris Mano –PHI	
6	Modern digital electronics: R.P. Jain. TMH	
Reference Books		
1	Digital Design: Principles and Practices, by Wakerly J F, Prentice-Hall,	
2	"Digital Experiments Emphasizing Systems and Design," by David Buchla, Prentice Hall, Inc	

Course Outcome

Sr	Course Outcome	CO
1	To provide the skills to efficiently acquire knowledge on digital electronic circuit analysis and design.	CO1
2	To acquire Knowledge of various number systems and codes from a historic point of view.	CO2
3	To understand the logic families in digital circuits.	CO3
4	To obtain the ability to analyze various aspects of sequential circuit design.	CO4
5	To learn the design procedure for Sequential Circuits and data converters.	CO5

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Course Code : **ECP DC 207**
Course Title : **Digital Electronics Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Introduction to Digital Electronics Lab- Nomenclature of Digital ICs, Specifications, Study of the Data Sheet, Concept of V-CC and Ground, Verification of the Truth Tables of Logic Gates using TTL ICs.
2	To Study and Verify NAND and NOR as a Universal Gate.
3	To Design & Verify Operation of Half Adder & amp; Full Adder.
4	To Study & Verify Half Subtractor and Full Subtractor.
5	Implementation of 4x1 Multiplexer using IC 74153.
6	Implementation of 4-Bit Parallel Adder Using 7483 IC.
7	Implementation and Verification of Decoder/Demultiplexer using IC74139.
8	Verification of State Tables of Rs, J-k, T and D Flip-Flops using NAND & NOR Gates
9	To Design & Verify the Operation of Magnitude Comparator
10	Design, and Verify the 4-Bit Asynchronous Counter.
11	To design and implement a binary to gray and gray to binary converter.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	"Digital Fundamentals" by Thomas L. Floyd, Prentice Hall, Inc	
2	"Digital Systems - Principles and Applications" by Tocci, R. J. and Widner, Prentice Hall	
3	Switching and finite automata theory: Z V Kohavi.–TMH	
4	Digital Logic Circuit Analysis & Design, by Victor P. Nelson, H. Troy Nagle, Bill D. Carroll and J. David Irwin, Prentice Hall,	
5	Digital logic and computer design: M Morris Mano –PHI	
6	Modern digital electronics: R.P. Jain. TMH	

Reference Books		
1	Digital Design: Principles and Practices, by Wakerly J F, Prentice-Hall,	
2	"Digital Experiments Emphasizing Systems and Design," by David Buchla, Prentice Hall, Inc	

Course Outcome

Sr	Course Outcome	CO
1	To provide the skills to efficiently acquire knowledge on digital electronic circuit analysis and design.	CO1
2	To acquire Knowledge of various number systems and codes from a historic point of view.	CO2
3	To understand the logic families in digital circuits.	CO3
4	To obtain the ability to analyze various aspects of sequential circuit design.	CO4
5	To learn the design procedure for Sequential Circuits and data converters.	CO5

FOURTH SEMESTER

Course Code : **ECL DC 201**
Course Title : **Signals Systems**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Department Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS** Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Classification of signals — Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals — Classification of systems- CT systems and DT systems- — Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.	
2	**UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS** Fourier series for periodic signals — Fourier Transform — properties- Laplace Transforms and properties	
3	**UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS** Impulse response — convolution integrals- Differential Equation-Fourier and Laplace transforms in Analysis of CT systems — Systems connected in series / parallel.	
4	**UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS** Baseband signal Sampling — Fourier Transform of discrete time signals (DTFT) — Properties of DTFT,DFT and its property — Z Transform & Properties	
5	**UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS** Impulse response — Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	S.Haykin and B. VanVeen "Signals and Systems, Wiley, 1998.	
2	M. Mandal and A. Asif, "Continuous and Discrete Time Signals and Systems, Cambridge, 2007.	
3	D.C. Lay, Linear Algebra and its Applications (2/e), Pearson, 200.	
4	K. Huffman & R. Kunz, Linear Algebra, Prentice- Hall, 1971.	
Reference Books		
1	D.C. Lay, Linear Algebra and its Applications (2/e), Pearson, 200.	
2	K. Huffman & R. Kunz, Linear Algebra, Prentice- Hall, 1971.	
	S.S. Soliman & M.D. Srinath, Continuous and Discrete Signals and Systems, Prentice- Hall, 1990.	

Course Outcome

Sr	Course Outcome	CO
1	To learn the basics of signals and systems.	CO1
2	Able to learn the convolution property of the LTI systems.	CO2
3	To learn the Laplace and Z transforms	CO3
4	To study the direct form I and II.	CO4
5	To learn the DTFT and DFT theories.	CO5

Course Code : **ECL DC 202**
Course Title : **Linear Integrated Circuits Application**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Department Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Differential Amplifiers:** Basics of Differential Amplifier, Transistorized Differential Amplifier, Configurations of Differential Amplifier, Analysis of Dual Input Balanced Output Differential Amplifier, Constant Current Bias, Current Mirror Circuit, Cascading of Differential Amplifiers.	
2	**Introduction to Operational Amplifiers:** The Ideal Op-Amp, Block diagram Representation of Op-Amp, Voltage Transfer Curve of Op-Amp, Integrated Circuit: Package Types, Pin Identification and Temperature-Ranges, Interpretation of Data sheets and Characteristics of an Op-Amp, Inverting and Non-Inverting Configuration, Ideal Open-Loop and Closed-Loop Operation of Op-Amp, Block diagram Representation of Feedback Configurations, Voltage-Series Feedback Amplifier, Voltage-Shunt Feedback Amplifier, Differential Amplifiers with One & Two Op-Amps.	
3	**Frequency Response of an Op-Amp:** Introduction, Frequency Response, Compensating Networks, Frequency Response of Internally Compensated Op-Amp, Frequency response of Non-compensated Op-Amp, Closed-Loop Frequency Response, Circuit Stability, Slew Rate.	
4	**General Linear Applications:** DC & AC Amplifiers, Peaking Amplifier, Summing, Scaling and Averaging amplifier, Instrumentation Amplifier, Voltage-to-Current Converter, Current-to-Voltage Converter, The Integrator, The Differentiator, Log and Antilog Amplifier, Peak Detector, Precision Rectifiers, Comparator, Zero Crossing Detector, Schmitt Trigger, Sample and Hold Circuit, Clippers and Clampers, A/D and D/A Converters.	

5	**Active Filters and Oscillators:** Active Filters:- Butterworth Filters, Band-Pass Filters, Band Reject Filters, All-Pass Filters. Oscillators and Wave Generators:- Phase Shift Oscillator, Wien Bridge Oscillator, Voltage-Controlled Oscillator(VCO), Square Wave Generator, Triangular Wave Generator, Saw-tooth Wave Generator.	
6	**Specialized IC Applications:** Introduction, Universal Active Filter, The 555 Timer, Monostable and Astable Multivibrator using IC 555, Phase-Locked Loop(PLL), Voltage Regulators.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	OP-AMP and Linear IC's By Ramakant A. Gayakwad, Prentice Hall	
2	Digital Integrated Electronics, By Taub and Schilling, McGraw Hill	
3	Integrated Electronics, By Millman J. and Halkias C.C., McGraw Hill.	
Reference Books		
1	Op-Amp and Linear IC's, By Caughlier and Driscoll, PHI	

Course Outcome

Sr	Course Outcome	CO
1	To understand the concept of differential amplifiers	CO1
2	To understand the basics of Operational amplifiers and its applications	CO2
3	To be able to perform the Frequency response analysis of Op-amp	CO3
4	To be able to design active filters and oscillators using Op-amp	CO4
5	To be introduced about some specialized IC applications of OP-amp	CO5

Course Code : **ECP DC 202**
Course Title : **Linear Integrated Circuits Application Lab.**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	To study and verify the op-amp parameters including Offset voltage, CMRR & Slew-Rate
2	To study and verify the Op-amp as an Inverting & Non-Inverting amplifier.
3	To study and verify the application of an Op-amp as a Differentiator & Integrator.
4	To study and verify the application of an Op-amp as a Comparator, Schmitt Trigger, Peak Detector, Zero crossing detector.
5	To study and verify the application of an Op-amp as a Clipper & Clamper.
6	To study and verify the application of an Op-amp as a Precision Rectifier.
7	To study and verify the application of an Op-amp as a Voltage-to-Current / Current-to-Voltage Converter.
8	To study and verify the application of an Op-amp as an Astable Multivibrator / Monostable Multivibrator using an IC 555 timer.
9	To study and verify Phased Lock Loop(PLL)
10	To study the performance of a 3 pin fixed voltage regulator and a 3 pin variable Voltage regulator.
11	To study the working of Op-amp based filters.
12	To study and verify the application of op-amp as Wave-form generator
13	To study and verify the application of op-amp as log / anti-log amplifier.
14	To study and verify the application of op-amp as A/D & D/A convertor

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	OP-AMP and Linear IC's By Ramakant A. Gayakwad, Prentice Hall	
2	Digital Integrated Electronics, By Taub and Schilling, McGraw Hill	
3	Integrated Electronics, By Millman J. and Halkias C.C., McGraw Hill.	
Reference Books		
1	Op-Amp and Linear IC's, By Caughlier and Driscoll, PHI	

Course Outcome

Sr	Course Outcome	CO
1	To understand the concept of differential amplifiers	CO1
2	To understand the basics of Operational amplifiers and its applications	CO2
3	To be able to perform the Frequency response analysis of Op-amp	CO3
4	To be able to design active filters and oscillators using Op-amp	CO4
5	To be introduced about some specialized IC applications of OP-amp	CO5

Course Code : **ECL DC 204**
Course Title : **Analog Communication**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Department Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction:** Historical Review, Elements of an Electronic Communication System, Communication Channel and their Characteristics, Mathematical Models for Communication Channels.	
2	**Frequency Domain Analysis of Signals and Systems:** The Fourier Transform, Properties of the Fourier Transform, Rayleigh's Energy Theorem, the inverse relationship between time and frequency, Dirac Delta Function, Fourier transform of Periodic signals, transformation of signals through Linear systems, Paley-Wiener Criterion, Hilbert transform, Band Pass signals, Transmission of Band Pass signals, Phase and group delay.	
3	**Analog Signals Transmission and Reception:** Introduction, Amplitude Modulation, Double side Band Suppressed carrier Amplitude Modulation, Single side band Amplitude Modulation, Vestigial sideband Modulation, Implementation of AM Modulators and Demodulators, Frequency division Multiplexing, Analog Modulation, representation of FM and PM signals, Spectral Characteristic of Analog Modulated Signals, Implementation of Angle Modulators and Demodulators, AM Radio Broadcasting, FM Radio Broadcasting	
4	**Effect of Noise on Analog communication System:** White noise, shot noise, thermal noise, noise equivalent bandwidth, Effect of Noise on AM , Effect of Noise on DSB-SCAM, Effect of Noise on SSBAM, Carrier Phase Estimation with Phase Locked loop , Effect of Noise on Angle Modulation, Threshold Effect in Angle Modulation, Pre-emphasis and De-emphasis in FM.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Communication Systems, Simon Haykin, John Willey & Sons	
2	Communication Systems Engineering, Proakis Salehi, Pearson Education	
3	Radio Engineering, G.K. Mithal	
Reference Books		
1	Electronic Communication, Roddy Coolen	
2	Electronic Communication, Kennedy	

Course Outcome

Sr	Course Outcome	CO
1	Able to understand basic concepts of signals and Fourier transform.	CO1
2	Able to learn amplitude modulation and angle modulation.	CO2
3	Able to learn the basic design concept of communication transmitters and receivers.	CO3
4	Acquire knowledge of random signal theory.	CO4
5	Able to learn noise analysis in communication systems.	CO5

Course Code : **ECP DC 204**
Course Title : **Analog Communication Lab.**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	To study and calculate the modulation index of AM wave
2	To study the demodulation of AM wave and find out modulation frequency
3	To study and observe frequency modulation
4	Study of various FM receivers
5	Study of modulation and detection of single side band modulation.
6	To find the selectivity & sensitivity of the AM receiver
7	To find and plot the fidelity of the AM receiver.
8	Study of various AM receivers
9	To study the sample and hold process.
10	To study PAM and its demodulation
11	To study PWM and its demodulation
12	Study of 3 –band superheterodyne receiver.
13	Noise power spectral density measurement

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Communication Systems, Simon Haykin, John Willey & Sons	
2	Communication Systems Engineering, Proakis&Salehi, Pearson Education	
3	Radio Engineering, G.K. Mithal	
Reference Books		
1	Electronic Communication, Roody & Coolen	
2	Electronic Communication, Kennedy	

Course Outcome

Sr	Course Outcome	CO
1	Able to understand basic concepts of signals and Fourier transform.	CO1
2	Able to learn amplitude modulation and angle modulation.	CO2
3	Able to learn the basic design concept of communication transmitters and receivers.	CO3
4	Acquire knowledge of random signal theory.	CO4
5	Able to learn noise analysis in communication systems.	CO5

Course Code : **ECL DC 206**
Course Title : **Microprocessor & Interfacing**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Department Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction to 8085 Microprocessor:** Functional block diagram – Registers, ALU, Bus systems, Memory & Instruction cycles Timing diagrams, Address Decoding techniques, Addressing modes, Instruction Set, Assembly Language Programming, Interrupts-Types & handling, ISR, Stack architecture	
2	**Memory and Peripheral interfacing:** Basic interfacing concepts - Memory space partitioning - Buffering of buses – Timing constraints - Memory control signals - Read and write cycles, Interfacing RAM, ROM, 8255PPI, Interfacing applications using 8255. Need for direct memory access - DMA transfer types	
3	**Intel 16 bit Microprocessor:** Register organization of 8086 – Architecture - Physical Memory organization - I/O addressing capability, Addressing modes of 8086 - Instruction set of 8086 - Assembler directives and operators, Assembly language programming, Interrupt Architecture	
4	**Freescale 32 bit ColdFire Processor:-**Introduction to ColdFire Core, Comparison with 8085 & 8086 Architecture, Introduction to MCF5223X Microprocessor Architecture & Functional Blocks	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		

1	Gaonkar R. S, “Microprocessor Architecture: Programming and Applications with the 8085/8086A”, New Age International (P) Ltd.,	
2	K. Ray, K. M. Bhurchandi – Advanced Microprocessors and Peripherals – Architecture, Programming and Interface – Tata McGraw Hill	
3	“ColdFire Microprocessors & Microcontrollers” – Munir Bannoura, Rudan Bettelheim and Richard Soja, AMT Publishing.	
4	Douglas V. Hall, “Microprocessors and Interfacing Programming and Hardware”, Tata McGraw Hill,	
Reference Books		
1	Daniel Tabak, ”Advanced Microprocessors”, McGraw Hill,	
2	David A. Patterson, John.L. Hennessy – Computer organization and design-the hardware/software Interface- Elsevier-Morgan Kaufmann Publishers-	

Course Outcome

Sr	Course Outcome	CO
1	The student will be able to analyze, specify, design, write and test assembly language programs of moderate complexity.	CO1
2	The student will be able to select an appropriate ‘architecture’ or program design to apply to a particular situation; e.g. an interrupt-driven I/O handler for a responsive real-time machine.	CO2
3	The student will be able to calculate the worst-case execution time of programs or parts of programs, and to design and build, or to modify, software to maximize its run time memory or execution-time behavior.	CO3
4	Write programs to run on 8086 microprocessor based systems.	CO4
5	Design system using memory chips and peripheral chips for 16 bit 8086 microprocessors.	CO5

Course Code : **ECP DC 206**
Course Title : **Microprocessor & Interfacing Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Write a program to add two 8-bit numbers stored in the memory location 2300H & 2301H and store the result in memory location 2302H and the carry in location 2303H.
2	Write a program to transfer 16 bytes of data stored at memory location 2300H to 2400H.
3	Write a program to add two two digit BCD numbers stored in memory location 2100H & 2101H, the 3 digit BCD result should be stored from memory location 2102H onwards.
4	Write a program to add two 16 bit numbers stored in memory location 2100H & 2102H and store the sum at memory location 2104H onwards.
5	Write a program to subtract two 8-bit numbers.
6	Write a program to subtract two 16-bit numbers
7	Write a program to subtract two digit BCD numbers stored at memory location 2100H & 2101H and store the result in memory location 2102H.
8	Write a program to unpack two digit BCD number stored at memory location 2100H and store the unpacked BCD numbers at memory locations 2101H & 2102H.
9	Write a program to read a two digit BCD number stored at memory location 2100H and switch the digits of the BCD number and store the result at memory location 2101H.
10	Write a program to sort 16 numbers stored at memory location 2100H to 210FH in ascending order.
11	Write a program to convert an 8-bit binary number to ASCII Hex Code.
12	Write a program to convert a two digit BCD number, stored at location 2100H, into its binary equivalent number and store the result in memory location 2200H.

13	Write a program to convert a Binary number to its equivalent BCD number.
14	Write a Program to generate a ramp waveform.
15	Write a Program to generate staircase waveform
16	Write a Program to display the character “V” in 8x8 LED Matrix.
17	Write a Program to rotate a Stepper Motor in Anticlockwise Direction
18	Write a Program to Control Traffic.
19	Write a program to interface ADC 0808 with the 8085 microprocessor and store the A/D result in memory location 3200H.
20	Write a program to convert an 8-bit binary number to ASCII.
21	Write a program to blink Port C bit 0 of the 8255. Assume address of control word register of 8255 as 0BH. Use Bit Set/Reset mode.
22	Calculate the sum of series of even numbers from the list of numbers. The length of the list is in memory location 2200H and the series itself begins from memory location 2201H. Assume the sum to be 8 bit number so you can ignore carries and store the sum at memory location 2210H.
23	Design a system (both Software and Hardware) that will cause 4 LEDs to flash 10 times when a push button switch is pressed. Use 8255.

Suggested Books:

Sr.	**Name of Book, Author, Publisher**	**Year of Publication / Reprint**
Text Books		
1	Gaonkar R. S, “Microprocessor Architecture: Programming and Applications with the 8085/8086A”, New Age International (P) Ltd.,	
2	K. Ray, K. M. Bhurchandi – Advanced Microprocessors and Peripherals – Architecture, Programming and Interface – Tata McGraw Hill	
3	“ColdFire Microprocessors & Microcontrollers” – MunirBannoura, Rudan Bettelheim and Richard Soja, AMT Publishing.	

4	Douglas V. Hall, “Microprocessors and Interfacing Programming and Hardware”, Tata McGraw Hill,	
Reference Books		
1	Daniel Tabak, ”Advanced Microprocessors”, McGraw Hill,	
2	David A. Patterson, John.L.Hennessy – Computer organization and design-the hardware/software Interface- Elsevier-Morgan Kaufmann Publishers-	

Course Outcome

Sr	Course Outcome	CO
1	The student will be able to analyze, specify, design, write and test assembly language programs of moderate complexity.	CO1
2	The student will be able to select an appropriate ‘architecture’ or program design to apply to a particular situation; e.g. an interrupt-driven I/O handler for a responsive real-time machine.	CO2
3	The student will be able to calculate the worst-case execution time of programs or parts of programs, and to design and build, or to modify, software to maximize its run time memory or execution-time behavior.	CO3
4	Write programs to run on 8086 microprocessor based systems.	CO4
5	Design system using memory chips and peripheral chips for 16 bit 8086 microprocessors.	CO5

Course Code : ECL DC 208
Course Title : Control Systems
L-T-P/S=Credits : 3-1-0 = 4
Course Category : Department Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction to Feedback Control System**: Mathematical models of physical system , Open loop and closed loop systems, regenerative feedback, Transfer function, Block diagrams and reduction techniques including signal flow graphics, deriving transfer function of physical system, one mechanical system and field controlled and armature controlled DC servo motors.	
2	**Time Response Analysis:** Standard test signals, time response of second order system, steady state errors and error constants, design specifications of second order system.	
3	**Stability Analysis:** Concept of stability, condition of stability, characteristic equation, relative stability, Routh-Hurwitz criterion, special cases for determining relative stability, Nyquist stability criterion, Nyquist plots	
4	**Root Locus Techniques: B**asic concept, rules of root locus, application of root locus technique for control systems.	
5	**Frequency Response Analysis:** Bode plots, gain margin, phase margin, effect of addition of poles and zeros on bode-plots.	
6	**Compensators:** Preliminary design considerations, need of compensation, lead compensations, lag-compensation, lag-lead compensation.	
7	**Analysis of Control Systems in State – Space:** Basic concepts of state, state variable and state models, transfer matrix, Controllability, absorbability, obtaining state space equations in canonical form.	

8	**Discrete control system**: Z Transform and its properties, Basic structure of Digital Control systems, Description and analysis of Sampled-Data system, Stability analysis of Discrete-time systems	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Control System Engineering -- I.J. Nagrath, M.Gopal (Wiley Eastern)	
2	Feedback Control Systems -- (Schaum's Series book)	
3	Modern Control System – Dorf ,Bishop (addison – Wesley Publication)	
Reference Books		
1	Modern Control Engg.(II edition) – Katsuhiko Ogata	
2	Automatic Control Engg.(II edition)-Kuo	

Course Outcome

Sr.No.	Course Outcome	CO
1	Apply sufficient Knowledge of control system concepts including basics, time response analysis and stability of systems.	CO1
2	Apply control theory concepts for solving control system engineering problems for root locus, stability analysis and compensators.	CO2
3	Able to understand the concept of digital control system and state space analysis.	CO3

Course Code : **XXLM**
Course Title : **Environmental Studies (Expect Civil Engineering)**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction of Environmental Studies Definition of Environmental studies and its importance. Natural resources and their conservation. Forest resources, water resources and land resources. Environmental Pollution: Definition, Causes, effects and control measures of Air pollution, Water pollution.	12
2	Types of ecosystem Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Energy flow in the ecosystem, Ecological succession Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem.	12
3	Energy sources and sustainable development Energy resources: conventional and nonconventional sources of energy .Renewable and non-renewable resources Social Issues and the Environment: From Unsustainable to Sustainable development, Water conservation.	12
4	Impact of population growth on environment Human Population and the Environment: Population growth, Environment and human health, Human Rights, Value Education, Women and Child Welfare. Role of information Technology in Environment and human health.	12
5	Visit to sites to assess the impact of human activities 1. Visit to a local area to document environmental assets-river/forest/grassland/ hill/mountain. 2. Field visit for study of simple ecosystems-pond, river, hill slopes, etc., Study of common plants, insects, birds. 3. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural	12

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Principles of Environmental Science 8th Edition by William Cunningham (Author), Mary Cunningham (Author) ISBN-13: 978-0078036071, ISBN-10: 0078036070 二 Ecology and Environment by PD Sharma	
2	Barron's AP Environmental Science, 6th Edition 6th Edition Gary S. Thorpe MS ISBN-13: 978- 1438005522 , ISBN-10: 1438005520	
3	Climate Change: What Everyone Needs to Know® 1st Edition by Joseph Romm, ISBN-13: 978-0190250171, ISBN-10: 0190250178	
4	The Wood for the Trees: One Man's Long View of Nature by Richard Fortey, ISBN-13: 978-1101875759, ISBN-10: 1101875755	
5	Principles of Environmental Science 8th Edition by William Cunningham (Author), Mary Cunningham (Author) ISBN-13: 978-0078036071, ISBN-10: 0078036070 二 Ecology and Environment by PD Sharma	

Course Outcome

Sr	Course Outcome	CO
1	Give a brief account on interactions within the living and non living entities	CO1
2	Explain role of human activities in destroying a balance in an ecosystem	CO2
3	Define the conservation strategies adopted for protecting flora and fauna in terrestrial and aquatic ecosystem	CO3
4	Define lithosphere, biosphere and atmosphere and role of dwindling resources in degradation of environment.	CO4
5	Causes of pollution and remedies	CO5

FIFTH SEMESTER

Course Code : ECL DC 301
Course Title : Digital Communication Engineering
L-T-P/S=Credits : 3-0-0 =3
Course Category : Department Core Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Digital Communications, Nyquist Sampling Theorem for LPS and BPS, Information Sources,	4
2	Introduction of Probability and Random process,	4
3	Quantization, Pulse Code Modulation, Delta Modulation, Signal Space Representation: Orthogonal expansion of signals, Gram-Schmidt Procedure, Representation of digitally modulated signals;	4
4	Digital Transmission over the AWGN Channel, Matched Filters, ML and MAP Receivers, Power Density Spectra and Probability of Bit Error; Modulation for BandwidthLimited Channels: Intersymbol interference, Equalization, error performance; Passband Digital Transmission via Carrier Modulation: BPSK, QPSK, MPSK, ABFSK, MFSK, CPFSK, OQPSK, MSK, GMSK and Continuous phase modulation, , Communication over fading channels	12
5	Spread spectrum systems: direct sequence modulation and frequency hopping Case study — code division multiple access (CDMA); Multichannel and multicarrier systems: OFDM; Introduction to information theory: Entropy, Channel Capacity in AWGN;	12

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint

Text Books		
1	Digital communication, Simon Hykins, John Willey & Sons	
2	J. G. Proakis and M. Salehi, "Fundamentals of Communication Systems," Prentice Hall, 2004. 2. S. Haykin, "Communication Systems," John Wiley & Sons, 5th Ed., 2009.	2009
3	Fundamental of Telecommunications, R G Freeman , John Wiley	
4	Telecommunications Systems Engineering , R G Freeman, John Wiley	
Reference Books		
1	Telecommunication Transmissions Systems, R G Winch, McGraw-Hill	
2	Electronic Communication Systems, W Tomasi, PHI	

Course Outcome

Sr	Course Outcome	CO
1	Understand the theoretical aspects of digital communication system, useful for today's multidisciplinary applications.	CO1
2	Learn the elements of digital communications systems, fundamental concepts of sampling theorem, quantization and coding.	CO2
3	Understand the different types of digital pulse and band pass modulation techniques.	CO3
4	Able to calculate probability of error for method filter Receiver and various Digital	CO4
5	Modulation techniques to analyze the performance of Digital Communications Systems in the pressure of noise.	CO5
6	Able to do the source coding problems and understand the compact description of sources.	CO6
7	Able to solve the various channel coding problems and analyze the performance of vicarious coding techniques.	CO7

Course Code : **ECP DC 301**
Course Title : **Digital Communication Engineering Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Study of Sample and hold circuit
2	Generation & detection of PAM
3	Generation & detection of PWM
4	Generation & detection of PPM
5	Generation & detection of ASK / FSK / PSK
6	Generation & detection OF APSK
7	Generation & detection of PCM, ADPCM, DM
8	Power spectrum analysis of various modulation techniques
9	Study of framing & marker with voice coding kit
10	Data conditioning & Carrier modulation kit
11	Data Re-conditioning & carrier demodulation

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Digital communication, Simon Hykins, John Willey & Sons	
2	Digital communication, John G Proakis, McGraw Hill	
3	Fundamental of Telecommunications, R G Freeman , John Wiley	

4	Telecommunications Systems Engineering , R G Freeman, John Wiley	
Reference Books		
1	Telecommunication Transmissions Systems, R G Winch, McGraw-Hill	
2	Electronic Communication Systems, W Tomasi, PHI	

Course Outcome

Sr	Course Outcome	CO
1	Understand the theoretical aspects of digital communication system, useful for today's multidisciplinary applications.	CO1
2	Learn the elements of digital communications systems, fundamental concepts of sampling theorem, quantization and coding.	CO2
3	Understand the different types of digital pulse and band pass modulation techniques.	CO3
4	Able to calculate probability of error for method filter Receiver and various Digital	CO4
5	Modulation techniques to analyze the performance of Digital Communications Systems in the pressure of noise.	CO5
6	Able to do the source coding problems and understand the compact description of sources.	CO6
7	Able to solve the various channel coding problems and analyze the performance of vicarious coding techniques.	CO7

Course Code : **ECL DC 305**
Course Title : **Digital Signal Processing**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Department Core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**DISCRETE FOURIER TRANSFORM :** Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms – Decimation in time Algorithms, Decimation in frequency Algorithms – Use of FFT in Linear Filtering.	
2	**FILTER DESIGN :** Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.	
3	**FIR FILTER DESIGN :** Structures of FIR – Linear phase FIR filter – Fourier series - Filter design using windowing techniques (Rectangular Window, Hamming Window, and Hanning Window), Frequency sampling techniques – Finite word length effects in digital Filters: Errors, Limit Cycle, and Noise Power Spectrum.	
4	**FINITE WORDLENGTH EFFECTS :** Fixed point and floating point number representations – ADC –Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Round off noise power – limit cycle oscillations due to product round off and overflow errors – Principle of scaling	
5	**DSP APPLICATIONS :** Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Linear Systems And Signals, B. P. Lathi, Oxford University Press	
2	Signals and Systems, A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, Prentice-Hall	
3	Probability, Statistics And Random Processes, T Veerarajan, Mcgraw-Hill	
Reference Books		
1	Fundamentals of Signals and Systems using MATLAB, E. W. Kamen and B. S. Heck, Prentice-Hall	
2	Signals And Systems, M. J. Roberts, McGraw-Hill	

Course Outcome

Sr	Course Outcome	CO
1	To learn discrete Fourier transform and its properties	CO1
2	To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals.	CO2
3	To understand Finite word length effects.	CO3
4	To study the concept of Multirate and adaptive filters	CO4

Course Code : **ECP DC 305**
Course Title : **Digital Signal Processing Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Representation of time-series; computation of convolution
2	Response of a difference equation to initial conditions; stability
3	DFT computation
4	Computational experiments with digital filtering
5	Sampling & Waveform generation
6	FIR & IIR Filters Implementation
7	Fast Fourier transforms
8	Quantization Noise
9	Adaptive Filters
10	Multirate Signal Processing

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Linear Systems And Signals, B. P. Lathi, Oxford University Press	
2	Signals and Systems, A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, Prentice-Hall	
3	Probability, Statistics And Random Processes, T Veerarajan, Mcgraw-Hill	

Reference Books		
1	Fundamentals of Signals and Systems using MATLAB, E. W. Kamen and B. S. Heck, Prentice-Hall	
2	Signals And Systems, M. J. Roberts, McGraw-Hill	

Course Outcome

Sr	Course Outcome	CO
1	To learn discrete Fourier transform and its properties	CO1
2	To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals.	CO2
3	To understand Finite word length effects.	CO3
4	To study the concept of Multirate and adaptive filters	C4

Course Code : **ECL DC 304**
Course Title : **AI & ML**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Department Core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :
Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	• **Introduction to Artificial Intelligence** o Definition, history, and different branches of artificial intelligence. o Problem-solving techniques in AI and their relevance to ECE. o Applications of AI in various engineering domains.	6
2	• **Fundamentals of Machine Learning** o Data preprocessing and feature engineering o Model evaluation and validation techniques o Over fitting, under fitting, and model selection o Unsupervised learning algorithms (clustering, dimensionality reduction) for data analysis in ECE projects. o Reinforcement learning concepts and potential applications in control systems.	10
3	• **Linear Regression and Classification** o Linear regression for prediction and modeling o Logistic regression for binary classification o Regularization techniques: L1 and L2 regularization o Support Vector Machines (SVM) for classification	8
4	• **Neural Networks and Deep Learning** o Introduction to artificial neurons and neural networks o Feedforward neural networks and backpropagation algorithm o Convolutional Neural Networks (CNN) for image processing o Recurrent Neural Networks (RNN) for sequential data	6

5	• **Machine Learning Libraries** o Introduction to chosen deep learning library (TensorFlow or PyTorch) for building neural networks. o Implementing basic neural network architectures (perceptrons, multi-layer perceptrons) in Python. o Training and evaluating neural network models for image/signal classification, regression tasks.	6
6	• **AI for Electronics and Communication Engineering** o Application of AI and ML in signal processing: noise reduction, anomaly detection, channel prediction. o Machine learning for image and video analysis: object detection, image segmentation, and video content analysis for communication systems. o AI-powered control systems: adaptive control, predictive maintenance using machine learning models. o **IoT and sensor data analytics**	4
7	• **Ethical Considerations and Challenges in AI (1 week):** o Bias in AI algorithms and datasets, potential for misuse in engineering applications. o Explainability and interpretability of AI models for trust and transparency. o Responsible development and deployment of AI solutions in ECE projects.	2

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	**"Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow" by Aurélien Géron**	
2	**"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville**	
Reference Books		
1	“Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper	

Course Outcome

Sr	Course Outcome	CO
1	Understand the core principles of artificial intelligence and machine learning.	CO1
2	Explore various types of machine learning algorithms (supervised, unsupervised, reinforcement learning) and their suitability for ECE applications.	CO2
3	Gain hands-on experience with Python programming for AI and ML implementations.	CO3
4	Utilize popular machine learning libraries (Tensor Flow, PyTorch) to build and train AI models relevant to ECE projects.	CO4
5	Apply AI and ML techniques to solve real-world problems in signal processing, image/video analysis, communication systems, and control engineering.	CO5
6	Develop an understanding of the ethical considerations and limitations of AI in engineering applications.	CO6

Course Code : **ECP DC 303**
Course Title : **AI & ML**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :
Detailed Syllabus

Course Description:

This lab manual complements the "AI & ML" course by providing hands-on experience with Python programming, popular machine learning libraries, and applying AI/ML techniques to solve ECE-related problems.

Software Requirements:

- Python 3.x (download from https://www.python.org/downloads/)
- Jupyter Notebook (installation instructions within Python environment)
- Chosen Deep Learning Library (TensorFlow or PyTorch - installation instructions provided in specific labs)
- Additional libraries as needed (e.g., NumPy, Pandas, Matplotlib)

Lab Schedule:

Lab 1: Introduction to Python for AI & ML

- Objectives:
  - Set up a Python development environment with Jupyter Notebook.
  - Explore basic Python syntax and data structures (lists, tuples, dictionaries).
  - Utilize NumPy and Pandas libraries for numerical computations and data manipulation.
- Exercises:
  - Write Python code to perform basic arithmetic operations, string manipulation, and conditional statements.
  - Create NumPy arrays and perform element-wise operations, data type conversions.
  - Load and work with datasets using Pandas DataFrames, perform data cleaning and exploration.

Lab 2: Data Visualization with Matplotlib and Seaborn

- Objectives:
  - Understand the importance of data visualization in AI and ML.

    - Learn to create informative plots and charts using Matplotlib and Seaborn libraries.
    - Visualize data distributions, relationships between variables, and model performance.
- Exercises:
    - Create various plots (scatter plots, bar charts, histograms) to visualize sample datasets.
    - Explore advanced visualization techniques (box plots, heatmaps) for analyzing relationships within data.
    - Visualize the performance metrics (e.g., accuracy, loss) of a simple machine learning model.

Lab 3: Introduction to Machine Learning with Scikit-learn

- Objectives:
    - Get familiar with the Scikit-learn library for implementing machine learning algorithms.
    - Explore supervised learning algorithms (linear regression, k-Nearest Neighbors) and their applications.
    - Evaluate model performance using metrics like accuracy, precision, recall.
- Exercises:
    - Load and pre-process a sample dataset suitable for supervised learning (e.g., Iris flower classification).
    - Implement linear regression and k-Nearest Neighbors algorithms using Scikit-learn for classification tasks.
    - Train and evaluate the models, interpret the results using confusion matrix and other metrics.

Lab 4: Introduction to Deep Learning Library (TensorFlow or PyTorch)

- Objectives:
    - Set up and explore the chosen deep learning library (Tensor Flow or PyTorch) for building neural networks.
    - Understand the fundamental concepts of neural networks (neurons, layers, activation functions).
    - Build and train simple neural network architectures (perceptrons, multi-layer perceptrons) for classification tasks.
- Exercises:
    - Install and set up the chosen deep learning library (TensorFlow or PyTorch) following official instructions.
    - Implement a basic perceptron model for binary classification using the chosen library.

- Train the model on a sample dataset, evaluate its performance, and visualize the learning process.

Lab 5: AI for Signal Processing (Noise Reduction)

- Objectives:
  - Apply machine learning techniques for noise reduction in signal processing tasks relevant to ECE.
  - Utilize autoencoders or denoising algorithms for data reconstruction and noise removal.
  - Evaluate the effectiveness of AI-based noise reduction methods on simulated or real-world signals.
- Exercises:
  - Simulate a noisy signal (e.g., sinusoidal wave with added noise).
  - Implement an autoencoder or denoising algorithm using the chosen deep learning library.
  - Train the model on the noisy signal data, compare the reconstructed signal with the original, and analyze noise reduction effectiveness.

Lab 6: AI for Image/Video Analysis (Object Detection)

- Objectives:
  - Explore convolutional neural networks (CNNs) for image recognition and object detection tasks.
  - Utilize pre-trained models like MobileNet or VGG for image classification and feature extraction.
  - Apply object detection techniques (e.g., YOLO) to identify and localize objects within images or video frames.
- Exercises:
  - Load a pre-trained CNN model for image classification (e.g., using TensorFlow Hub or PyTorch Torchvision).
  - Use the model to classify objects in a set of images, analyze the results.
  - Explore object detection frameworks like YOLO, implement basic object detection on video frames.

Lab 7: AI for Control Systems (Predictive Maintenance)

- Objectives:
  - Apply machine learning for predictive maintenance in control systems relevant to ECE.
  - Utilize regression models to predict equipment failures or performance degradation.

    - Analyze sensor data from simulated or real-world systems to identify potential maintenance needs.
- Exercises:
    - Simulate sensor data from a control system component (e.g., temperature readings from a motor).
    - Implement a regression model (e.g., linear regression, random forest) to predict future sensor readings based on historical data.
    - Analyze the model's predictions to identify potential anomalies or trends suggesting equipment degradation.

Lab 8: Responsible AI Development (Bias and Fairness)

- Objectives:
    - Understand the concept of bias in AI algorithms and datasets.
    - Explore techniques for mitigating bias and promoting fairness in AI models used in ECE applications.
    - Evaluate the potential impact of bias in AI models on decision-making and engineering systems.
- Exercises:
    - Analyze a sample dataset for potential biases (e.g., racial or gender bias).
    - Explore techniques for data cleaning and pre-processing to mitigate bias in the training data.
    - Discuss the importance of fairness metrics (e.g., F1 score) and responsible development practices for AI in ECE projects.

Course Code : **ECL DC 305**
Course Title : **VLSI Design**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Department Core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to VLSI and MOS Transistor Theory: - VLSI Design Flow - Moore's Law, ASICs/FPGAs - CAD Tools Introduction - MOSFET Structure, Operation, I-V Characteristics - Threshold Voltage, CMOS Basics	9
2	CMOS Logic Design and Performance Parameters: - CMOS Inverter Characteristics - Static/Dynamic Behavior - Noise Margins, Delay, Power - CMOS Logic Gates - Logical Effort, Sizing Basics	10
3	Combinational and Sequential Circuit Design: - Multiplexers, Decoders, Adders - Latches and Flip-Flops - Timing, Clocking, FSM Design - Intro to Low Power Design	10
4	Layout, Fabrication and CAD Tools: - Stick Diagrams, Layout Rules - Layout of Inverter, NAND, NOR - CMOS Fabrication Overview - EDA Tools Introduction (Microwind/Cadence) - Design Flow Demonstration	10

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	J. M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective Second Edition, Pearson/PH,	2003
2	J. P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2001.	2001.

3	Kang, S.M. and Leblebici, Y., 2003. *CMOS digital integrated circuits* (pp. 116-117). New York: MacGraw-Hill.	2003
4	Weste, Neil HE, and David Harris. CMOS VLSI design: a circuits and systems perspective. Pearson Education India, 2015.	2015
Reference Books		
1	R. L. Geiger, P. E. Allen and N. R. Strader, VLSI Design Techniques for Analog and Digital Circuits, McGraw-Hill,	2003

Course Outcome

Sr	**Course Outcome**	**CO**
1	Understand the fundamentals of MOS transistors and their I-V characteristics.	CO1
2	Analyze and design CMOS-based combinational and sequential logic circuits.	CO2
3	Interpret design rules and draw stick/layout diagrams for CMOS circuits.	CO3
4	Explain the basic fabrication process and steps involved in CMOS IC manufacturing.	CO4
5	Use EDA tools to simulate basic CMOS circuits and understand the design flow.	

Course Code : **ECP DC 305**
Course Title : **VLSI Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department Core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Introduction to Microwind/Cadence/DSCH/Other CAD tools and their features.
2	Design and simulation of CMOS inverter – transient and DC analysis.
3	Design of basic logic gates (NAND, NOR, XOR) using CMOS – schematic and layout.
4	Design and layout of combinational circuits (Multiplexer, Full Adder).
5	Design and simulation of flip-flops (SR, D, JK) and timing analysis.
6	Schematic and layout of a 4-bit shift register.
7	Analysis of propagation delay, power, and area using tool reports.
8	Design and layout of a finite state machine (FSM).
9	Stick diagram and layout rule checking (DRC and LVS).
10	Mini-project: Layout and simulation of a simple digital system (optional for evaluation).

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		

1	May G S and Sze S M, “Fundamentals of Semiconductor Fabrication”, John Wiley & Sons, India.	
2	Ghandhi S K, “VLSI fabrication Principles”, John Wiley Inc., New York	
3	Streetman BG, “Solid State Electronics Devices”, Prentice Hall of India, New Delhi,	
4	Chang C Y and Sze S (Ed),“ULSI Technology”, McGraw-Hill Companies Inc.	
5	Allen, Phillip E. &Holberg, Douglas R. “CMOS Analog Circuit Design” Oxford University Press	
6	J. Baker “CMOS: Circuit Design, Layout, and Simulation” Wiley IEEE Press	

Reference Books		
1	Neil H. E. Weste, Kamran Eshraghian “ Principles of CMOS VLSI Design ”, Pearson Education India	
2	Kang S.M, Leblebici Y,"CMOS Digital Integrated Circuits : Analysis and Design" Tata McGraw	

Course Outcome

Sr	Course Outcome	CO
1	Design and simulate basic CMOS gates and circuits using EDA tools.	CO1
2	Draw layout diagrams and perform design rule checks (DRC).	CO2
3	Simulate combinational and sequential logic circuits using CMOS logic.	CO3
4	Analyze delay, power, and area parameters using simulation results.	CO4
5	Understand the basic design flow in VLSI CAD tools.	CO5

SIXTH SEMESTER

Course Code : ECL DC 302
Course Title : Microwave Engineering
L-T-P/S=Credits : 3-0-0 =3
Course Category : Department Core Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction:** Importance of RF Design, RF Behavior of Passive Components: High Frequency Resistors, High-Frequency Capacitors, High-Frequency Inductors. Chip Components and Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface-Mounted Inductors.	
2	**An Overview of RF Filter Design I:** Basic Resonator and Filter Configurations: Filter Type and Parameters, Low-Pass Filter, High Pass Filter, Bandpass and Bandstop Filters, Insertion Loss, Special Filter Realizations: Butterworth –Type, Chebyshev and Denormalization of Standard Low-Pass Design.	
3	**An Overview of RF Filter Design II:** Filter Implementations: Unit Elements, Kuroda's Identities and Examples of Microstrip Filter Design. Coupled Filter: Odd and Even Mode Excitation, Bandpass Filter Section,Cascading Bandpass Filter Elements, Design Examples.	
4	**Matching and Biasing Network:** Impedance Matching using Discrete Components: Two Component Matching Networks, Forbidden regions, Frequency Response and Quality Factor, Microstrip Line Matching Networks: From Discrete Components to Microstrip Lines, Single-Stub Matching Networks, Double-Stub Matching Networks, Amplifier Classes of Operation and Biasing Network: Classes of Operation and Efficiency of Amplifiers, Bipolar Transistor Biasing Networks, Field Effect Transistor Biasing Networks.	

5	**RF Transistor Amplifier Design I:** Characteristics of Amplifiers, Amplifier Power Relations: RF source, Transducer Power Gain, Additional Power Relations, Stability Considerations: Stability Circles, Unconditional Stability, Stabilization Methods.	
6	**RF Transistor Amplifier Design II:** Constant Gain: Unilateral Design, Unilateral Figure of Merit, Bilateral Design, Operating and Available Power Gain Circles. Noise Figure Circles, Constant VSWR Circles. Broadband, High Power and Multistage Amplifiers.	
7	**RF Oscillators and Mixers:** Basic Oscillator Model: Negative Resistance Oscillator, Feedback Oscillator Design, Design Steps, Quartz Oscillators. High Frequency Oscillator Configuration: Fixed Frequency Oscillators, Dielectric Resonator Oscillators, YIG-Tuned Oscillators, Voltage Controlled Oscillators, Gunn Element Oscillator. Basic Characteristics of Mixers: Basic Concepts, Frequency Domain Considerations, Single-Balanced Mixer Double-Balanced Mixer.	

Suggested Books:

Sr.	**Name of Book, Author, Publisher**	**Year of Publication / Reprint**
Text Books		
1	RF Circuit Design Theory and Application, Reinhold Ludwig and Pavel Bretchko, Ed. 2004, Pearson Education	
Reference Books		
1	Radio Frequency & Microwave Electronics Illustrated, Radmanesh, Pearson	

Course Outcome

Sr	**Course Outcome**	**CO**
1	Understanding the design concept of various RF/Microwave devices.	CO1
2	Knowledge of Microwave Circuit Analysis and Impedance matching.	CO2
3	Understanding the behavior of nonlinear RF/Microwave Devices.	CO3
4	Ability to design discrete RF/ Microwave Devices	CO4

Course Code : **ECP DC 302**
Course Title : **Microwave Engineering Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Department Core Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Introduction to CAD Tool & its features
2	Simulation of Microwave Passive Components – Filters, Antennas, Couplers, Power dividers
3	Introduction to Measurement Techniques: Measurement of Passive Components using VNA & Spectrum Analyzer

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	RF Circuit Design Theory and Application, Reinhold Ludwig and Pavel Bretchko, Ed. 2004, Pearson Education	

Reference Books		
1	Radio Frequency & Microwave Electronics Illustrated, Radmanesh, Pearson	

Course Outcome

Sr	Course Outcome	CO
1	Understanding the design concept of various RF/Microwave devices.	CO1
2	Knowledge of Microwave Circuit Analysis and Impedance matching.	CO2
3	Understanding the behavior of nonlinear RF/Microwave Devices.	CO3
4	Ability to design discrete RF/ Microwave Devices	C4

Course Code : ECL DC 401
Course Title : Mobile Communication
L-T-P/S=Credits : 3-0-0 =3
Course Category : Department Core Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Modeling requirements and scenarios, Channel model requirements, Propagation scenarios, Relaying multi-hop and cooperative communications: Principles of relaying and fundamentals.	
2	Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems. Diversity, exploiting multipath diversity, transmit diversity, Space-time codes, Delay Diversity, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing.	
3	Introduction, NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfill 5G Requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment.	
4	D2D: from 4G to 5G, D2D standardization: 4G LTE D2D, D2D in 5G: research challenges, Radio resource management for mobile broadband D2D	
5	Access design principles for multi-user communications, Orthogonal multiple-access systems, Spread spectrum multiple access systems, Capacity limits of multiple-access methods, Sparse code multiple access (SCMA), Interleave division multiple access (IDMA), Radio access for dense deployments, OFDM numerology for small-cell deployments	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint

Text Books		
1	T1. K. Feher, Wireless Digital Communication, Prentice Hall of India, New Delhi, 1995. References:	
2	R1. T.S. Rappaport, Wireless Communication; Principles and Practice, Prentice Hall, NJ, 1996.	
3	R2. W.C.Y. Lee, Mobile Communication Engineering; Theory and Application, Second Edition, McGraw-Hill International, 1998	
Reference Books /Materials		
1	Latest Research Paper and materials	
2		

Course Outcome

Sr	Course Outcome	CO
1	Understand and explain the channel models of 5G and the use cases for 5G.	CO1
2	Analyze use of MIMO in 5G and its techniques.	CO2
3	Draw and explain 5G architecture, its components and functional criteria.	CO3
4	Understand device to device (D2D) communication and standardization.	CO4
5	Study the in-depth functioning of 5G radio access technologies.	CO5

Course Code : **ECL VA102**
Course Title : **Introduction to Digital Technology**
L-T-P/S=Credits : **2-0-0 =2**
Course Category : **Value Added Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction & Evolution of Digital Systems:** Role & Significance of Digital Technology. Information & Communication Technology & Tools. Computer System & its working, Software and its types. Operating Systems: Types and Functions. Problem Solving: Algorithms and Flowcharts.	
2	**Communication Systems:** Principles, Model & Transmission Media. Computer Networks & Internet: Concepts & Applications, WWW, Web Browsers, Search Engines, Messaging, Email, Social Networking.	
3	**Computer Based Information System:** Significance Types. E-commerce & Digital Marketing: Basic Concepts, Benefits & Challenges.	
4	**Digital India & e-Governance:** Initiatives, Infrastructure, Services and Empowerment. Digital Financial Tools: Unified Payment Interface, Aadhar Enabled Payment System, USSD, Credit / Debit Cards, e-Wallets.	
5	**Introduction to emerging technologies :** Cloud, Big Data, Artificial Intelligence , 3 D printing.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Introduction to Computers by Peter Norton, Tata McGraw Hill.	

2	Artificial intelligence- modern approach by Stuart Russell and Peter NorvigBrewka, Prentice Hall, series in Artificial Intelligence, Englewood Cliffs, NJ. The Knowledge Engineering Review, 1(1), 78-79. doi: 10.1017/S0269888900007724.	
3	E-commerce, by K. C. Laudon, and C.G. Traver, MA: Pearson, 2013.	
Reference Books		
1	Big data for dummies, Hurwitz, Judith, A. Nugent, F. Halper, and M. Kaufman, Hoboken, NJ John Wiley & Sons, 2013.Wiley, 2011.	
2	Blockchain Basics: A Non-Technical Introduction in 25 Steps, by Danicl Drescher, Ist Edition.	

Course Outcome

Sr	Course Outcome	CO
1	To gain familiarity with digital paradigms.	CO1
2	To sensitize about the role & significance of digital technology.	CO2
3	To provide know how of communications & networks.	CO3
4	To bring awareness about the e-governance and Digital India initiatives.	CO4
5	To provide a flavor of emerging technologies - Cloud, Big Data, and 3D printing.	CO5

Course Code : **ECM SE102**
Course Title : **Electronics Workshop**
L-T-P/S=Credits : **1-0-2 =2**
Course Category : **Skill Enhancement Course**
Pre-requisite Courses (if any) : **Physics, Chemistry at 10+2 level.**
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to electrical components, familiarity with CRO and other instruments such as voltmeter, ammeter etc. , introduction to power supplies, breadboard, PCB fabrication process , familiarity with PCB design software, demonstration of various machines used in PCB designing, demonstration of various components including Diodes, Transistors, LEDs, FETs etc, demonstration of electronic chips, Instructor will introduce new development in the field of electronic fabrication to ignite curiosity among students.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Relevant material from Software Manuals and e-content.	

Course Outcome

Sr	Course Outcome	CO
1	Familiarity with electrical and electronic components	CO1
2	Introduction to PCB design and fabrication	CO2
3	Familiarity with commonly used electronic devices	CO3
4	Familiarity with commonly used electrical equipment available in the department	CO4
5	Brief introduction to CAD tools	CO5

Course Code : **ECM SE201**
Course Title : **MATLAB Programming**
L-T-P/S=Credits : **1-0-2 =2**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) : **Computer programing**
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	INTRODUCTION:- Why MATLAB, What Are Tool boxes, MATLAB Interface, Introduction To Arrays And Matrices, MATLAB File Types, Basics Of MATLAB Programming	4
2	Handling Data And Data Flow In MATLAB :- Data Types ,Creating Variables, Scalars, Vectors And Matrix Operations & Operators, Importing & Exporting Of Data, File Input-Output	4
3	File Editing And Debugging In MATLAB:- Writing Script Files, Writing Function Files, Inserting Breakpoints And Debugging, Error Correction	5
4	MATLAB Graphics :- Simple Graphics & Types, Plotting Functions, Creating And Editing Plots (2D & 3D),Handling Graphics	5
5	MATLAB Programming:- Conditional Statements, Iterative Statements, Flow Control, Efficient Coding Practices, Linear Algebra, Polynomials,Curve Fitting, Differentiation & Integration, Introduction To Symbolic Math, Symbolic Operations	6
6	Introduction To MATLAB Toolboxes:-Data Acquisition Toolbox In MATLAB, Signal Processing Toolbox In MATLAB, Image Acquisition Toolbox In MATLAB, Image Processing Toolbox In MATLAB	6

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	**MATLAB Programming for Engineers 5th Edition by Stephen J. chapman Pearson Publication**	
2	**Essential MATLAB for Engineers and Scientists, Brian Hahn and Daniel Valentine AP publication**	
3		

Reference Books/Sources		
1	MATHWORKS	
2		

Course Outcome

Sr	Course Outcome	CO
1	Understand Basics of MATLAB coding.	CO1
2	Write the program for a given problem in MATLAB coding.	CO2
3	Simulate various Engineering Problems in MATLAB	CO3

Course Code : ECM SE202
Course Title : Fundamentals of Machine Learning for Predictive Data Analytics
L-T-P/S=Credits: 1-0-2
Course Category : Engineering Science Course
Pre-requisite Courses (if any) : Computer programing
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction: Fundamentals of Machine Learning for Predictive Data Analytics, The Predictive Data Analytics Project Lifecycle: CRISP-DM, Data to Insights to Decisions Converting Business Problems into Analytics Solutions case studies	4
2	Data Exploration: The Data Quality Report, Identifying Data Quality Issues and its handling, Advanced Data Exploration case studies,	4
3	Information-based Learning Decision Trees ,Shannon's Entropy Model, Information Gain, Standard Approach: The ID3 Algorithm, Case studies	5
4	Similarity-based Learning fundamentals, nearest neighbour algorithm, extenions and variations with case studies and example	5
5	Probability-based and error based Learning: Bayes Theroem, naïve bayes model, extensions and variations	6
6	Case studies for different methodologies	6

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Machine Learning For Absolute Beginners: A Plain English Introduction (Second Edition) (AI, Data Science, Python & Statistics for Beginners) 2021 edition	
2	Machine Learning For Dummies by by Judith Hurwitz and Daniel Kirsch,IBM Limited edition	
3	"Data Mining: Practical Machine Learning Tools and Techniques" by Ian H. Witten, Eibe Frank, and Mark A. Hall	
Reference Books/Sources		
1	MATLAB official website and e-content.	
2		

Course Outcome

Sr	Course Outcome	CO
1	Acquire Data Analysis skills	CO1
2	Apply data analysis for predictions	CO2
3	Apply AI/ML methods, techniques and tools immediate	CO3

Course Code : **ECM SE203**
Course Title : **EDA Tools**
L-T-P/S=Credits : **1-0-2 =2**
Course Category : **Skill Enhancement Course**
Pre-requisite Courses (if any) : **For M.Sc Physics, B.Sc Physics B.Tech ECE, EE, Design and CSE students.**
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Linux Operating system.	4Theory+8 Lab
2	Licensing in EDA Tools . Installation of EDA Tools.	4Theory+8 Lab
3	Design flow of EDA Tools : Cadence, Mentor Graphics and other relevant	4Theory+8 Lab
4	Project using EDA Tools	4Theory+8 Lab

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Study Material		
1	Linux documentation available online.	
2	Cadence Material available online.	
3	Mentor Graphics Material	

Course Outcome

Sr	Course Outcome	CO
1	To learn Linux Operating system Basics	CO1
2	To Learn basics of Licensing.	CO2
3	To obtain knowledge related to design flow using EDA Tools.	CO3
4	Practical implementation of project using EDA Tools	CO4

SPECIALIZATION BASKET:

Course Code : **ECM DE 360**
Course Title : **Embedded Systems and Microcontrollers**
L-T-P/S=Credits : **4-0-0 =4**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	• **Introduction to Embedded Systems** o Definition, characteristics, and applications of embedded systems. o Hardware components: microcontrollers, memories, I/O interfaces. o Embedded system design methodologies and challenges.	4
2	• **Microcontroller Architecture** o 8-bit, 16-bit, and 32-bit microcontroller architectures (e.g., ARM Cortex-M). o Instruction Set Architecture (ISA), addressing modes, and instruction cycles. o General Purpose Registers (GPRs), Special Function Registers (SFRs), and memory organization. o Interrupt handling mechanisms and prioritization.	8
3	• **Interfacing Techniques** o Analog-to-Digital Converters (ADCs) and Digital-to-Analog Converters (DACs) interfacing. o Sensor interfacing: temperature sensors, pressure sensors, etc. o Communication protocols: I2C, SPI, UART for data transfer.	8

4	• **Embedded System Programming with C** o C language fundamentals for embedded systems: data types, operators, control flow. o Bit manipulation techniques and memory access. o Input/Output programming: ports, pins, and configuration registers. o Timer/counter programming for precise timing and delays. o Interfacing with Liquid Crystal Displays (LCDs) and LEDs.	10
5	• **Real-Time Operating Systems (RTOS)** o Introduction to Real-Time Operating Systems (RTOS) concepts. o Task scheduling, synchronization primitives (semaphores, mutexes). o Device drivers for peripherals in RTOS environment.	6
6	• **Embedded System Design Methodologies** o Requirements analysis and specification o Hardware-software co-design o Design optimization techniques o Testing and validation strategies	6

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	"Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers" by Jonathan W. Valvano	
2	"Embedded Systems: Real-Time Interfacing to Arm® Cortex™-M Microcontrollers" by Jonathan W. Valvano	
3	"Embedded Systems Design" by Steve Heath	
Reference Books		
1	"Embedded Systems: Architecture, Programming, and Design" by Raj Kamal	

Course Outcome

Sr	Course Outcome	CO

1	Understand the principles of embedded systems design and development.	CO1
2	Learn various microcontroller architectures and their applications.	CO2
3	Develop embedded systems programs using C programming language.	CO3
4	Interface various peripherals (sensors, actuators, displays) with microcontrollers.	CO4
5	Apply real-time operating systems (RTOS) concepts in embedded systems design.	CO5
6	Design and implement simple embedded system projects.	CO6

Course Code : ECM DE 361
Course Title : Computer and Data Networks
L-T-P/S=Credits : 4-0-0 =3
Course Category : Department Elective Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :
Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction to Data Communication and Networks** Network evolution and applications. Data communication fundamentals: signals, transmission media, bandwidth Protocol architecture: layered model (OSI and TCP/IP).	4
2	**Physical Layer** Transmission media: guided (coaxial cable, twisted pair) and unguided (wireless).Signal encoding techniques (NRZ, Manchester). Error detection and correction techniques (parity checking, checksum).	6
3	**Data Link Layer** Media Access Control (MAC) protocols: CSMA/CD, Ethernet. Error detection and correction (CRC).Address Resolution Protocol (ARP).	6
4	**Network Layer** IP addressing (IPv4, IPv6). Subnetting and VLSM. Routing principles and algorithms (static, dynamic).Internet Protocol (IP) and routing protocols (RIP, OSPF).	9
5	**Transport Layer** Port addressing and transport protocols (TCP, UDP). Connection-oriented vs. connectionless communication. Flow control and congestion control mechanisms.	6
6	**Application Layer** Application layer protocols (HTTP, DNS, FTP, SMTP). Network services and applications (web browsing, email, file transfer).	6
7	**Emerging Network Technologies** Wireless Local Area Networks (WLANs): IEEE 802.11 standards. Mobile communication networks: cellular systems (GSM, LTE). Cloud computing and network virtualization concepts.	4

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	"Computer Networking: A Top-Down Approach" by James F. Kurose and Keith W. Ross	
2	"Computer Networks" by Andrew S. Tanenbaum and David J. Wetherall	
3	"Data Communications and Networking" by Behrouz A. Forouzan	
Reference Books		
1	"The Internet Book: Everything You Need to Know about Computer Networking" by Douglas E Comer	

Course Outcome

Sr	Course Outcome	CO
1	Understand the fundamental concepts and principles of data communication and networks.	CO1
2	Analyze the layered network architecture and the functionalities of each layer.	CO2
3	Apply knowledge of network protocols (TCP/IP, UDP, DNS) for data transmission.	CO3
4	Understand the working of basic network devices (hubs, switches, routers).	CO4
5	Evaluate different routing algorithms and their performance characteristics.	CO5

Course Code : ECL DE 362
Course Title : **Programming Server-Side Applications**
L-T-P/S=Credits : **4-0-0 =4**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction to Server-Side Programming** Client-server architecture and web application development process. Common server-side programming languages (Python, Java, Node.js). Introduction to web frameworks (Django, Spring, Express.js).	4
2	**Web Application Development** In-depth exploration of the chosen framework (e.g., Express.js, Flask, Python, Django syntax, Spring MVC architecture). Building dynamic web pages with templates and routing. User authentication and authorization mechanisms. Form handling and data validation techniques.	10
3	**Authentication and Authorization** User authentication mechanisms: JWT, OAuth Role-based access control (RBAC) Implementing authentication and authorization in server-side applications	2
4	**Data Management with Databases** Introduction to relational databases (SQL) and database management systems (DBMS). Database design principles for server-side applications (normalization, relationships). Interaction with databases using ORM (Object-Relational Mapping) tools.	8
5	**APIs and Web Services** Design principles for RESTful APIs and JSON data format. Building and consuming APIs in server-side applications. Security considerations for API access and data transmission.	6
6	**Server Administration** Introduction to server operating systems (Linux basics). Server setup, configuration, and deployment of web applications. Security best practices for server management.	6

7	**Advanced Topics** Introduction to asynchronous programming and frameworks (e.g., Node.js with Express). Micro services architecture for building large-scale applications. Deployment of applications on cloud platforms (e.g., AWS, Google Cloud).	6

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	“Node.js in Action” by Marc Garcia and Eduardo Garcia	
2	“Head First JavaScript Programming” by Eric Freeman and Elisabeth Robson	
3	“Django for Beginners” by William Vincent	
4	“Spring in Action” by Craig Walls	
Reference Books		
1	Official Node.js documentation: https://nodejs.org/en	
2	"Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack" by Brad Dayley, Brendan Dayley, and Caleb Dayley	

Course Outcome

Sr	Course Outcome	CO
1	Understand the fundamental principles of server-side programming and web architectures.	CO1
2	Analyze the functionalities and choose appropriate programming languages and frameworks for server-side development.	CO2
3	Develop and deploy server-side applications using a chosen language and framework	CO3
4	Design and implement APIs (Application Programming Interfaces) for interaction with client applications.	CO4

5	Utilize databases for data storage and retrieval in server-side applications.	CO5
6	Gain experience with server administration tasks, including configuration and security.	CO6

Course Code : **ECM DE 363**
Course Title : **Internet of Things**
L-T-P/S=Credits : **3-0-2 =4**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction to IoT** Definition, characteristics, and potential of IoT technology. Applications of IoT in various domains (smart homes, wearables, industrial automation). Architectural models for IoT systems (3-layer, 5-layer models).	4
2	**IoT Building Blocks** Sensors and actuators: types, characteristics, interfacing with microcontrollers. Microcontrollers for IoT applications (e.g., Arduino, ESP32). Communication protocols: wired (SPI, I2C) and wireless (Wi-Fi, Bluetooth, LoRaWAN).	8
3	**IoT Communication Technologies** Wireless communication technologies: Wi-Fi, Bluetooth, Zigbee, LoRaWAN Cellular IoT: 2G/3G/4G/5G networks Near Field Communication (NFC) and RFID	6
4	**Data Management and Analytics** Data acquisition and processing in IoT systems. Cloud platforms for IoT data storage and analytics (e.g., AWS IoT, Azure IoT). Data visualization techniques for IoT applications.	6
5	**IoT Security** Security threats and vulnerabilities in IoT systems. Authentication, authorization, and encryption techniques for secure communication. Secure coding practices for IoT development.	6
6	**IoT System Design** Design methodologies for building robust and scalable IoT systems. User interface design for IoT applications (mobile apps, web dashboards). Project planning, prototyping, and testing of IoT systems.	8

7	**Emerging Trends in IoT** Introduction to artificial intelligence and machine learning for IoT applications. Blockchain technology and its potential role in secure IoT ecosystems. Future directions in IoT: edge computing, low-power networking, etc.	4

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	“Internet of Things: Architecture and Design Principles” by Michael Friedewald and Omar Elkhatib	
2	"Internet of Things: Principles and Paradigms" by Rajkumar Buyya, Amir Vahid Dastjerdi, and Sriram Illikkal	
Reference Books		
1	"Building Arduino Projects for the Internet of Things" by Adeel Javed	
2	"IoT Solutions in Microsoft's Azure IoT Suite: Data Acquisition and Analysis in the Real World" by Scott Klein and Manfred Kuttler	

Course Outcome

Sr	Course Outcome	CO
1	Understand the key concepts and driving forces behind the Internet of Things (IoT).	CO1
2	Analyze various sensor technologies and their applications in IoT systems.	CO2
3	Apply knowledge of communication protocols for data exchange in IoT environments.	CO3
4	Design and develop basic IoT systems using microcontrollers and development platforms.	CO4
5	Integrate IoT systems with cloud platforms for data storage, analysis, and visualization.	CO5
6	Gain an understanding of emerging trends and future directions in the field of IoT.	CO6

Course Code : **ECM DE460/ECE 3101**
Course Title : **Wireless Networks**
L-T-P/S=Credits : **3-0-2 =4**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Unit 1:** Review of Computer Networks & Data Communication, Wireless LANs: IEEE 802.11 WLANs - protocol architecture, Physical layer, MAC layer, analysis, deployment of 802.11 infrastructures.	
2	**Unit 2:** WPANs: IEEE 802.15.4, Bluetooth, ZigBee. Protocol architecture, Physical layer, MAC layer, analysis, deployment of 802.15.4 infrastructure.	
3	**Unit 3:** Introduction to MANETS; MAC Protocols, Routing Protocols, performance comparison; Quality of Service.	
4	**Unit 4:** Wireless Sensor Networks (WSNs): Overview/Architectures; Data Dissemination/Data Gathering; Routing Protocol, Security, Power control; Cross layer design; Localization.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Rappaport, "Wireless Communications – Principles & Practices", PHI, Latest Edition	
2	C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Pearson Education, Inc.,	
3	Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons,	
4	Charles E Perkins, "Ad Hoc Networking", Addison Wesley,	
5	Jochen Schiller, "Mobile Communications", Addison Wesley,	

6	Ramjee Prasad and Luis Munoz, “WLANs and WPANs towards 4G wireless”, Artech House,	
Reference Books		
1	Selected papers from IEEE & ACM to be provided by Faculty	
2		

Course Outcome

Sr	Course Outcome	CO
1	To basic understanding of concept of data communication and computer networks that will further help to understand the different kinds of wireless technologies.	CO1
2	To provide ability to understand the concept of various multiple access techniques, channel diversity, and fading.	CO2
3	To acquire knowledge about Wi-Fi, and WPANs technology.	CO3
4	To develop an interest among student to do research in emerging research area as MANETs & WSN	CO4

Course Code : **ECM DE 461/ ECE 4082**
Course Title : **Advanced Embedded systems**
L-T-P/S=Credits : **3-0-2 =4**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents
1	**Embedded Architecture:** Embedded systems Overview, Design Challenge – Optimizing design metrics, Processor Technology, Embedded system design process- Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration.
2	**Embedded Processor and Computing Platform:** Power PC processor- Power architecture and Programming model, Memory management, Interrupts and Exceptions and debugging, Communication Processor module, Interrupt controller, SCC, SMC, FEC, TSEC, UCC, MCC, QMC and Code Warrior Tools.
3	**Networks:** Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, TDM, ATM , Ethernet, HDLC, Wirelees Protocols – IrDA, Bluetooth, WI FI, WIMAX, Network-Based design- Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design .
4	**Real-Time Characteristics:** Introduction to RTOS- Special considerations in an RTOS, Clock driven Approach, weighted round robin Approach, Priority driven Approach, Dynamic Versus Static systems, effective release times and deadlines, Optimality of the Earliest deadline first (EDF) algorithm, challenges in validating timing constraints in priority driven systems, Off-line Versus On-line scheduling.
5	**System Design Techniques:** Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance, Design Example: VOIP phone, Network based Appliance control- Hardware Design and Software Design

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
	Text Books	
1	Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2001.	2001
2	Jane. W. S. Liu "Real-Time systems", Pearson Education Asia,	
3	C. M. Krishna and K. G. Shin , "Real-Time Systems" ,McGraw-Hill,	
4	Frank Vahid and Tony Givargi, "Embedded System Design: A Unified Hardware/Software Introduction", John Wiley	
5	MPC885 Power QUICC Family Reference by Freescale Semiconductor	
6	MPC8323E Power QUICC II Pro Integrated Communications Processor Reference Manual by Freescale Semiconductor	

Course Outcome

Sr	Course Outcome	CO
1	Understand the architecture, ISA, programming, and interface requirements of a commercially 32-bit microprocessor (ARM Cortex-M4F).	CO1
2	Analyze and design to interface a microprocessor to displays, memories, ports, serial ports (USART, SPI, I2C), etc.	CO2
3	Apply 32-microprocessor systems (ARM) to solve real-time problems like timers, counters, A2D, Motors, etc.	CO3
4	Learn to use assemblers, compilers, simulators and emulators to help with design and verification for ARM processors.	CO4
5	Develop closed and open embedded/Linux based systems for ARM processors	CO5

Course Code : **ECL DE462/ ECE 4083**
Course Title : **Industry 5.0 & IOT**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction: Sensing & actuation, Fundamentals of Communication and Networks Industry 40 to 5.0: Globalization, The Fourth Revolution, LEAN Production Systems, Cyber-Physical Systems and Next Generation Sensors, Collaborative Platform, and Product Lifecycle Management	
2	Cybersecurity in Industry 4.0, Basics of Industrial IoT, Transition to Industry 5.0, Human-Robot Interaction, likely impact on human workforce, improvement in industrial manufacturing processes,	
3	IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture, Layers- Sensing, Processing & Communication, Networking Big Data Analytics and Software Defined Networks, Introduction to Machine Learning and Data Science Security and Fog Computing in IIoT	
	Industrial IoT- Application Domains - Healthcare, Power Plants, Inventory Management & Quality Control, Oil, chemical, and pharmaceutical industry	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
	Text Books	
1	Raj Kamal *The internet of things*. John Wiley & Sons, 2017.	2017

2	Misra, Sudip, Chandana Roy, and Anandarup Mukherjee. *Introduction to industrial internet of things and industry 4.0*. CRC Press, 2021.		2021
3	Introduction to IoT. Authors, Sudip Misra, Anandarup Mukherjee, Arijit Roy. Edition, illustrated. Publisher, Cambridge University Press, 2021.		2021
4	Gilchrist, A., 2016. *Industry 4.0: the industrial internet of things*. Apress.		2016

Course Outcome

Sr	Course Outcome	CO
1	Understand the concept of industrial revolution from industry 1.0 to 5.0	CO1
2	CO2: Be able to define the various layers of Industrial IoT and the allied technologies	CO2
3	Analyse possible use case and applications for IIoT	CO3

Course Code : **ECL DE 463**
Course Title : **Advance Computer Networks**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Department Elective Course**

Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**High-Performance Networking** Traffic shaping, congestion control, and Quality of Service (QoS) mechanisms. Routing algorithms for high-performance networks (MPLS, OSPF-LS). High-speed network technologies (Ethernet variants, SONET/SDH). Network performance analysis and optimization techniques.	6
2	**Data Center Networking** Introduction to data centers and their networking requirements. Network virtualization technologies (VXLAN, VLANs). Data center fabric architectures (Leaf-Spine, Clos networks). Storage Area Networks (SAN) and Network Attached Storage (NAS).	6
3	**Information-Centric Networking (ICN)** ICN architecture and content naming paradigms. In-network caching and content retrieval mechanisms in ICN. Security considerations and routing strategies in ICN. Comparison of ICN with traditional client-server architecture.	4
4	**Advanced Network Security** Denial-of-Service (DoS) and Distributed DoS (DDoS) attacks and mitigation techniques. Intrusion detection and prevention systems (IDS/IPS). Network security protocols (IPsec, SSL/TLS). Advanced cryptographic techniques for secure communication.	8
5	**Software-Defined Networking (SDN)** SDN architecture and separation of control and data planes. OpenFlow protocol and SDN controllers. Programming SDN applications for network automation. Benefits and challenges of SDN adoption in real-world networks.	8

6	**Network Performance Evaluation** **S**imulation tools for network performance evaluation (e.g., NS-3, OPNET) Performance metrics and analysis techniques Case studies and performance evaluation of real-world networks	6
7	**Emerging Technologies** Internet of Things (IoT) and sensor networks 5G and beyond: next-generation mobile networks Edge computing and fog computing Blockchain for secure and decentralized networking	4

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	“Computer Networking: A Top-Down Approach Featuring the Internet” by James Kurose and Keith Ross	
2	"Computer Networking: Principles, Protocols, and Practice" by Olivier Bonaventure	
3	"Computer Networks: A Systems Approach" by Larry L. Peterson and Bruce S. Davie	
Reference Books		
1	"Network Security Essentials: Applications and Standards" by William Stallings	

Course Outcome

Sr	Course Outcome	CO
1	Analyze and evaluate advanced routing and switching algorithms for high-performance networks.	CO1
2	Understand the design and operation of data center networks, including virtualization technologies.	CO2
3	Explore the principles and applications of information-centric networking (ICN).	CO3
4	Gain in-depth knowledge of advanced network security threats and mitigation strategies.	CO4

5	Comprehend the concepts of software-defined networking (SDN) and its impact on network management.	CO5
6	Develop the ability to critically evaluate and propose solutions for complex network challenges.	CO6

Course Code : **ECL DE 464**
Course Title : **Cloud Computing**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction to Cloud Computing** Definition, characteristics, and evolution of cloud computing. Benefits and limitations of cloud computing for ECE applications. Cloud computing deployment models (public, private, hybrid) and their suitability for ECE projects.	6
2	**Cloud Service Models** Infrastructure as a Service (IaaS): Virtualization concepts, resource provisioning, and management in the cloud. Platform as a Service (PaaS): Building and deploying applications on cloud platforms with minimal infrastructure management. Software as a Service (SaaS): Utilizing pre-built cloud applications for specific functionalities in ECE projects.	10
3	**Leading Cloud Providers** Introduction to Amazon Web Services (AWS) for ECE applications: EC2, S3, Lambda, IoT services. Exploring Microsoft Azure services for ECE needs: Virtual Machines, Azure Functions, Cognitive Services. Google Cloud Platform (GCP) for ECE projects: Compute Engine, Cloud Storage, Cloud Functions, AI/ML tools.	10
4	**Cloud Setup** Setting up cloud accounts with major providers (AWS, Azure, GCP). Provisioning and managing virtual machines in the cloud. Cloud storage services (S3, Azure Blob Storage, GCP Cloud Storage) for efficient data management. Building and deploying ECE-relevant applications on cloud platforms (e.g., data processing pipelines, sensor data analysis). Utilizing cloud-based tools and services for visualization and monitoring of ECE projects.	10

5	**Security in Cloud Computing** Security considerations for data storage, access control, and application deployment in the cloud. Best practices for securing cloud deployments in ECE projects (IAM, encryption, network security). Compliance considerations for sensitive data hosted in cloud environments.	6

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	“Cloud Computing for Dummies” by Bernard Golden, Timothy Fairfax Prickett, Richard L. Sherman	
2	“Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood	
3	"Cloud Computing: Principles and Paradigms" by Rajkumar Buyya, James Broberg, and Andrzej M. Goscinski	
4	"Architecting the Cloud: Design Decisions for Cloud Computing Service Models" by Michael J. Kavis	
Reference Books		
1	Official Node.js documentation: https://nodejs.org/en	
2	"Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack" by Brad Dayley, Brendan Dayley, and Caleb Dayley	

Course Outcome

Sr	Course Outcome	CO
1	Understand the fundamental principles, benefits, and limitations of cloud computing.	CO1
2	Analyze the different cloud service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid) for optimal application in ECE projects.	CO2
3	Explore the offerings and services of major cloud providers (AWS, Microsoft Azure, Google Cloud Platform) relevant to ECE needs.	CO3

4	Gain experience with cloud platforms for infrastructure provisioning, resource management, and application deployment.	CO4
5	Design and implement cloud-based solutions for data acquisition, processing, and visualization in ECE projects.	CO5
6	Evaluate security considerations and best practices for cloud deployments in ECE applications.	CO6

Course Code : **ECL DE320**
Course Title : **Millimeter Wave Technology**
L-T-P/S=Credits : **4-0-0 =0**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Millimeter Wave Technology Introduction: Millimeter wave characteristics, implementation challenges, Radio wave propagation for mm wave,Emerging applications of millimetre wave communications, Large scale propagation channel effects, small scale channel effects.	
2	Guiding Structures at Millimeter Wave Frequencies Wave Guiding Structures at millimetre Wave, Waveguide, Microstrip line, CPW Line, Different modes in guides, Surface Modes, Effect of surface roughness on millimetre wave propagation, MicrostripTransmission lines and its variants	
3	Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC‟s and DAC‟s.	
4	Millimeter Wave Antennas: Antenna beam width, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.	

5	MillimeterWave Systems Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, March .	2011
2	Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall.	2014
3	Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications: Springer.	2016
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	To understand the fundamentals of Millimeter wave devices and circuits.	CO1
2	To understand the various components of Millimeter wave Communications system.	CO2
3	To know the antenna design at Millimeter wave frequencies	CO3

Course Code : **ECL DE321**
Course Title : **Microwave Integrated Circuits**
L-T-P/S=Credits : **4-0-0 =0**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Fundamental Concepts: Elements of microwave/millimeter wave integrated circuits; Classification of transmission lines: Planar, quasi-planar and 3-D structures, their basic properties, field distribution and range of applications; Substrate materials and technology used for fabrication	
2	Analysis of Planar Transmission Lines: Variational approach for the determination of capacitance of planar structures; Transverse transmission line techniques for multi-dielectric planar structures; Rigorous analysis of dielectric integrated guides; Use of effective dielectric constant in the approximate analysis of dielectric guide.	
3	Metamaterials: Theory of Composite Right/Left Handed (CRLH) transmission line metamaterials; Representation of CRLH metamaterial by an equivalent homogeneous CRLH TL; L-C network implementation and its physical realization.	
4	Discontinuities: Analysis of discontinuities in planar and non-planar transmission lines and their equivalent circuit representation.	
5	Passive Circuits: Design and circuit realization of filters, couplers, phase shifters, and switches using planar and non-planar transmission lines.	
6	Active Circuits: Design and circuit realization of amplifiers and oscillators using planar and non-planar transmission lines.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint

Text Books		
1	Leo Young and H. Sobol, Ed. Advances in Microwaves, Vol.2, Academic Press Inc., 1974.	1974
2	B.Bhat and S. Koul, Stripline-like transmission lines for MICs, John Wiley, 1989.	1989
3	T.K. Ishii, Handbook of Microwave Technology, vol. I, Academic Press, 1995	1995
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	To develop the fundamental concept of Millimeter wave integrated circuits.	CO1
2	To be able to analysis various planar transmission lines	CO2
3	To understand the concept of metamaterial and its applications	CO3
4	TO analyse the effect of discontinuities in the active and passive circuits	CO4

Course Code : **ECL DE420**
Course Title : **Signal Processing for mm wave communication for 5G and beyond**
L-T-P/S=Credits : **4-0-0 =0**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Module I:mmWave channel model Tx- Rx Structure, Rx –Structure, Fundamental of Ray-Tracing model, General channel model, mm wave channel model	
2	Module II: Channel Estimation and Equalizer Wireless channel-A ray tracing model, RMS Delay, spread & Doppler Effect on channel, Basic ISI channel, Channel estimation and Equalizer, precoder and MIMO, Doppler Impact on coherence BW, Introduction to time series, AR,ARMA,MA process, Doppler with AR process model, Coherence time and parameter summary	
3	Module mm Wave Spectrum Angle of arrival and angle of departure, 3D concepts, AoA, AoD, mmWave channel model with RX beaming, Concept of Beam Forming, SISO and MIMO Beamforming	
4	Concept of OFDM OFDM Data Model, General OFDM, OFDM spectrum, MIMO OFDM structure, MIMO OFDM decode and beamforming	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	IEEE Explorer papers	
2	3GPP document 38.211/212	

3	Fundamental of Wireless Communication By David Tse, PramodViswanathan	
4	Millimeter Wave communication Systems By Kao-Cheng Huang, Zhaocheng Wang	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	To be able to understand the basic of Ray Tracing Model	CO1
2	To know the effect of various process models on the millimetre wave communication	CO2
3	To develop understanding of the need of beamforming techniques	CO3
4	To know basic concepts of OFDM in context of millimetre wave communication	CO4

Course Code : **ECL DE421**
Course Title : **Microwave and Millimetre Wave Measurement Technique**
L-T-P/S=Credits : **4-0-0 =0**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Microwave And Millimetre Wave Measurements: Introduction: Radio Frequency Band, microwave and millimetre wave. Power Measurement-High Power Measurement, calorimeter technique, Low power Measurement, bolometer technique, Very Low Power Measurement.	
2	Frequency Measurement : Different Technique to measure frequency, Slotted Line Technique, maxima & minima, wavelength & frequency measurement. Impedance Measurement- Measurement of unknown load impedance of transmission line, Slotted Line Technique to measure unknown impedance. Distortion & Frequency Translation Measurement- Different types of distortion occurred at microwave frequencies, Procedures for frequency translation	
3	Detectors Or Sensors: Definition of Detectors; Different types of microwave detectors functions and applications, Sensors Definition & working principle, applications, measurement of scattering parameters.	
4	Vector Network Analyzer (VNA): Concept of vector network analyzer, Basic block diagram of vector network Analyzer (VNA), Application of vector network Analyzers. Scalar Network Analyzer (SNA): Definition of network Analyzer, Difference between SNA VNA, Basic block diagram Scalar Network Analyzer.	
5	Spectrum Analyzer: Basic block diagram of a spectrum analyzer, functions applications of a spectrum analyser, Time Domain Electrometer (TDR) & IC Technology: Introduction to Electrometer, Measurement of reflection coefficient using electrometer technique, Basic block diagram of a time domain electrometer.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	G.H. Bryant,"Principles of Microwave Measurements"-,Peter PeregrinusLtd.IEE,19932.	
2	D.Pozar," Microwave Engineering", John Wiley.	
3	T.S. Laverghetta-"Hand book on Microwave Testing",Artech House,19814.	
4	S.F.Adam-" Microwave Theory & Application"- Prentice Hall, Inc A.E. Bailey, Ed." Microwave Measurements"- Peter Peregrinus Ltd,IEE.	1985
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	To understand the concept of microwave and millimeter wave measurement techniques	CO1
2	To be able to use different techniques in the frequency measurement	CO2
3	To learn the use of the Vector Network Analyzer	CO3
4	To be able to use the Spectrum analyser in measurement	CO4

Course Code : **ECL DE422**
Course Title : **Remote Sensing**
L-T-P/S=Credits : **4-0-0 =0**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Remote Sensing and Physical Fundamentals: Electromagnetic spectrum and penetration capabilities of electromagnetic wave through vegetation, soil, moisture etc., energy and power of wave, Introduction to remote sensing, remote sensing from space, radios, death rays, principle of radar, phase as distance measure, passive remote sensing , active remote sensing	
2	Polarimetry: Polarized wave and partially polarized wave, scattering matrix, passive polarimetry, Radar Polarimetry, polarimetric ratio, coherent parameters, and polarimetric decomposition.	
3	Microwave and Remote Sensing: Brightness Temperature, interaction with discrete objects, radar cross-section, scattering and emission from ocean, lakes, ice, snow, glacier, soil, vegetarian, rocks, desserts etc., radiometer, antenna properties for remote sensing, dielectric properties of earth materials , atmospheric sounding.	
4	Passive and Active Imaging: Principles of passive imaging, practical radiometers, measurement of parameters related to ocean, sea, ice, land, principle of active imaging using Radar, altimeter measurement, scanning altimeters, echo shape analysis, synthetic aperture altimeters, rain Radar, wind scatterometers, imagining Radar, principles of synthetic aperture radar (SAR), SAR focusing, scan SAR operation, spotlight mode, SAR images, speckle statistics, and speckle filtering.	
5	Interferometry: Principles of interferometry, phase measurement, interferometry for resolving directions, passive imaging, interferometry, Radar Interferometry, interferometric altimetry, interferometric SAR, vegetation height estimation.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Introduction to Microwave Remote Sensing: I.H. Woodhouse, CRC Press/Tayler and Francis,.	2006
2	Remote sensing of Snow and Ice: G. Rees, CRC Press, Taylor and Francis.	2006
3	Fundamental of Remote Sensing and Airphoto Interpretation: G. L.L. Belin and T.E. Avery, Prentice Hall, NJ, USA.	2003
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Define physical parameters of remote sensing	CO1
2	Classify passive and active polarimetry	CO2
3	Analyse passive and active imaging	CO3
4	Design and analyse interferometer	CO4

Course Code : ECL DE423
Course Title : Millimetre Wave Personal Communication System
L-T-P/S=Credits : 4-0-0 =0
Course Category : Department Elective Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Indoor propagation modelling: Introduction – Interference – Indoor propagation effects – ITU indoor path loss model – Long distance path loss model – link budget. Millimetre Wave (MMW) characteristics: MMW characteristics – 60 GHz MMW radio: Principle and technology – Channel performance at 60 GHz – Gigabit wireless communications – Development of MMW standards – Coexistence with wireless backhaul.	
2	Review of modulations for MMW communications: PSK – OFDM. MMW transceivers: Transceiver architecture. MMW antennas: Path loss and antenna directivity – Antenna beam width – Beam steering antenna.	
3	MMW MIMO: Spatial diversity of antenna arrays – Multiple antennas – Multiple transceivers – Noise coupling in a MIMO system. Potential benefits of advanced diversity for MMW: Spatial and temporal diversity – Spatial and frequency diversity – Dynamic spatial, Frequency and modulation allocation. Advanced beam steering and beam forming: The need for beam steering / beamforming. MMW applications.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Kao-Cheng Huang, Zhoacheng Wang, "Millimeter Wave Communication Systems", Wiley IEEE press, 2011.	2011
2	John S. Seybold "Introduction to RF propagation,"John Wiley and Sons, 2005.	2005
3	Chia-Chin Chong, Kiyoshi Hamaguchi, Peter F. M. Smulders and Su-Khiong, "Millimeter – Wave Wireless Communication Systems: Theory and Applications," Hindawi Publishing Corporation, 2007.	2007
	Theodore S. Rappaport, Robert W. Heath, Robert C. Daniels, James N. Murdock, " Millimeter Wave Wireless Communications," Pearson, 2021.	2021
Reference Books		

1		
2		

Course Outcome

Sr	Course Outcome	CO
1	To understand the Indoor propagation behaviour of the electromagnetic wave	CO1
2	To review the various millimetre wave communication modulation schemes	CO2
3	To comprehend the concept of MIMO technique and its use in the millimetre wave communication.	CO3
4	To underhand the design concept of antennas for millimetre wave communications	CO4

Course Code : **ECL DE424**
Course Title : **Radar and Navigational Engineering**
L-T-P/S=Credits : **4-0-0 =0**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Radar: Radar Principle, Radar System losses & propagation losses, antennas, radar cross section, Rayleigh region, Mie region, Optical region, Scanning and Tracking radars, Radar Clutter, SONAR, LIDAR, Synthetic Aperture Radar (SAR)	
2	RADAR Transmitters and Receivers: Principle of microwave power sources, Radar modulators and transmitters, Types of radar Receivers, receiver noise and noise figure, receiver protectors	
3	Types of RADAR: Basic principles of CW Radar, FMCW and Gated Radars, Pulse Doppler Radar, MTI Radar	
4	Navigation Engineering : Method of navigation (celestial navigation pilotage and dead reckoning radio navigation) Classes of radio direction finders, direction finding using loop antennas and errors in this method, Adcock direction finders, Goniometer, automatic direction finders Radar Beacons, Hyperbolic navigation systems (Decca, Omega& LORAN systems), principles of distance measuring equipments (DME) and tactical air navigation (TACAN)	
5	Aircraft Homing Systems and landing System: Switched cardioid homing system,four course radio range, omnidirectional range, VHF Omni range (VOR), electrical pattern rotation, recovery of reference phase and measurement of bearing, Doppler VOR, Instrument landing system, elevation and azimuth guidance, localizer, ground control approach, radar altimeter, principle of precision approach radar, (PAR) landing system, Jamming and anti-jamming techniques.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Introduction to Radar System M.I. Skolnik TMH, 2003	2003
2	Radar systems and Radio Aids to Navigation, A. K. Sen and A. B. Bhattacharya, Khanna Publication Microwave and Radar Engineering" by GottapuSasiBhushanaRao, ISBN –978813179944 Pearson Education Chennai 2013.	2013
3	Radar Engineering and Fundamentals of Navigational Aids, G S N Raju, IK International Publishers, 2008	2008
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Define Basics of RADAR	CO1
2	Describe Radar transmitter and receiver	CO2
3	Demonstrate different types of Radar	CO3
4	Distinguish and classify methods of Navigation	CO4

Basket 3 : Multimedia

Course Code : ECL DE340
Course Title : Multimedia Communication Networks
L-T-P/S=Credits : 4-0-0 = 4
Course Category : Departmental Elective Course
Pre-requisite Courses (if any) : Programming and Digital communication Engineering exposure
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**UNIT I MULTIMEDIA COMMUNICATION MODELS** Common Multimedia applications - VoIP- Video Conferencing- Military Surveillance- Interactive TV- Video on Demand- Smartphone - Requirements and Design challenges of multimedia communications-Architecture of Internet Multimedia Communication- Protocol Stack-H.323.	8
2	**UNIT II BEST EFFORT AND GUARANTEED SERVICE MODEL** Best effort service model and its limitations-Resource allocation-Metrics-Max and Min fair sharing-Queuing-FIFO-Priority queue-Fair queue- Weighted fair queue-Traffic policing-Token bucket-leaky bucket-Admission control-Packet classification and scheduling.	7
3	**UNIT III MULTIMEDIA ON IP NETWORKS** QoS aware routing-RSVP-Integrated and Differentiated services-MPLS-Multicasting-IGMP-PIM-DVMRP	7
4	**UNIT IV TRANSPORT LAYER SUPPORT FOR MULTIMEDIA** Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video Streaming-Interactive and non Interactive Multimedia-RTP/RTCP-SIP-RTSP	7
5	**UNIT V MULTIMEDIA QOS ON WIRELESS NETWORKS** IEEE 802.11e, IEEE 802.16, 3G networks-UMTS, 3GPP, 4G networks-LTE-IMS. TOTAL: 45 PERIODS	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	James F. Kurose and Keith W. Ross, "Computer Networking-A Top-Down Approach Featuring the Internet", Pearson, 2012	

2	Larry L. Peterson and Bruce S. Davie, “Computer Networks- A Systems Approach”, Morgan Kaufmann Publishers, 2007	
3	Mario Marques da Silva, “Multimedia Communications and Networking”, CRC Press, 2012.	
4	Mark Wuthnow, Jerry Shih, Matthew Stafford, “IMS: A New Model for Blending Applications”, Auerbach Publications, 2009	
Reference Books		
1		

Course Outcome

Sr	**Course Outcome**	**CO**
1	To understand the multimedia communication models	CO1
2	To analyse the guaranteed service model	CO2
3	To study the multimedia transport in wireless networks	CO3
4	To explore real-time multimedia network applications	CO4

Course Code : **ECL DE341**
Course Title : **Digital Image Processing and Pattern Recognition**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) : **Programming and Digital communication Engineering**
Exposure
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**UNIT I FUNDAMENTALS OF IMAGE PROCESSING** Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.	8
2	**UNIT II IMAGE ENHANCEMENT AND RESTORATION** Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.	7
3	**UNIT III IMAGE SEGMENTATION AND MORPHOLOGY** Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations- Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.	7
4	**UNIT IV INTRODUCTION TO PATTERN RECOGNITION** Component Labeling - Image Features - Textures - Boundary representations and descriptions - Regional descriptors - Feature selection and Feature dimensionality reduction. Image Classification and Recognition- Statistical Classifiers _ Clustering Algorithms - Hierarchical and Partitional clustering	7
5	**UNIT V IMAGE PATTERN RECOGNITION CASE STUDIES** Image Understanding – Case Studies in Biometrics, Video Processing, Image Fusion - Image Security - Steganography and Watermarking - Stereo vision - Visual Effects - Image compositing	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Alasdair McAndrew, "Introduction to Digital Image Processing with Matlab", Cengage Learning 2011,India.	
2	Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", Third Edition, Pearson Education, 2008, New Delhi.	
3	S.Sridhar, "Digital Image Processing", Oxford University Press, 2011, New Delhi.	
4	Wilhelm Burger, Mark J Berge, " Digital Image Processing: An algorithmic Introduction using Java", Springer International Edition,2008.	
Reference Books		
1	Anil J Jain, "Fundamentals of Digital Image Processing", PHI, 2011.	

Course Outcome

Sr	Course Outcome	CO
1	To understand the basic concepts and algorithms of digital processing	CO1
2	To familiarize the student with the image processing environments like Matlab and its equivalent open source Image processing environments	CO2
3	To expose the students to a broad range of image processing techniques and issues and their applications, and to provide the student with practical experiences using them	CO3
4	To appreciate the use of image processing in current technologies and to expose the students to real-world applications of the image processing	CO4

Course Code : **ECL DE342**
Course Title : **MULTIMEDIA COMPRESSION TECHNIQUES**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) : **Programming and Digital communication Engineering**
Exposure
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**UNIT I FUNDAMENTALS OF COMPRESSION** Introduction To multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Taxonomy of compression Algorithms - Elements of Information Theory – Error Free Compression – Lossy Compression.	8
2	**UNIT II TEXT COMPRESSION** Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.	7
3	**UNIT III IMAGE COMPRESSION** Image Compression: Fundamentals — Compression Standards – JPEG Standard – Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards.	7
4	**UNIT IV AUDIO COMPRESSION** Audio compression Techniques – law, A-Law companding – Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – MPEG audio – progressive encoding – Silence compression, Speech compression – Formant and CELP vocoders.	7
5	**UNIT V VIDEO COMPRESSION** Video compression techniques and Standards – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – DVI real time compression – Current Trends in Compression standards.	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		

1	Darrel Hankerson, Greg A Harris, Peter D Johnson, „Introduction to Information Theory and Data Compression‟ Second Edition, Chapman and Hall ,CRC press, 2003	
2	David Solomon, “Data Compression – The Complete Reference”, Fourth Edition, Springer Verlog, New York, 2006	
3	Mark S. Drew, Ze-Nian Li, “Fundamentals of Multimedia”, PHI, 2009.	
4	Yun Q.Shi, Huifang Sun, “Image and Video Compression for Multimedia Engineering, Algorithms and Fundamentals”, CRC Press, 2003.	
Reference Books		
1	David Solomon, “Data Compression – The Complete Reference”, Fourth Edition, Springer Verlog, New York, 2006	

Course Outcome

Sr	**Course Outcome**	**CO**
1	Implement basic compression algorithms with MATLAB and its equivalent open source environments	CO1
2	Design and implement some basic compression standards.	CO2
3	Critically analyze different approaches of compression algorithms in multimedia related mini projects	CO3

Course Code **:ECL DE343**
Course Title **: Media Security**
L-T-P/S=Credits **: 4-0-0 = 4**
Course Category **: Departmental Elective Course**
Pre-requisite Courses (if any) **: Programming and Digital communication Engineering**
Exposure
Equivalent Course Code (if any) **:**

Sr	Contents	Approx. Contact Hours
1	**UNIT I BASICS OF CRYPTOGRAPHY** Classical Cryptography-The Shift Cipher, The Substitution Cipher, The Affine Cipher Cryptanalysis Techniques - Encryption Evaluation metrics - Histogram Deviation - orthogonal Frequency Division Multiplexing - OFDM model - OFDM Limitations.	6
2	**UNIT II DIGITAL WATERMARKING** Digital Watermarking - Digital Steganography - Differences between Watermarking and Steganography - A Brief History of Watermarking – Classification in Digital Watermarking – Least Significant-Bit Substitution - Discrete Fourier Transform (DFT) - Discrete Cosine Transform - Discrete Wavelet Transform - Random Sequence Generation - The Chaotic Map - Error Correction Code - Set Partitioning in Hierarchical Tree	7
3	**UNIT III DIGITAL WATERMARKING TECHNIQUES** Spatial-Domain Watermarking - Frequency-Domain Watermarking - The Fragile Watermark - The Robust Watermark - Watermarking Attacks and Tools - Image Processing Attacks - Geometric Transformation -Cryptographic Attack Protocol Attacks - Watermarking Tools	7
4	**UNIT IV INTRODUCTION TO DIGITAL STEGANOGRAPHY** Types of Steganography - Applications of Steganography - Embedding Security and Imperceptibility - Examples of Steganographic Software	7
5	**UNIT V STEGANALYSIS** An Overview - The Statistical Properties of Images - The Visual Steganalytic System - IQM-Based Steganalytic System - Learning Strategies -The Frequency-Domain Steganalytic System - An Overview of the GA-Based Breaking Methodology -The GA-Based Breaking Algorithm - Complexity Analysis	9

Detailed Syllabus

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint

Text Books		
1	Digital Watermarking and Steganography: Fundamentals and Techniques, Frank Shih, CRC Press, 2014	
2	Douglas R. Stinson ,"CRYPTOGRAPHY THEORY AND PRACTICE ", Third Edition, Chapman & Hall/CRC, 2006	
3	Image Encryption: A Communication Perspective, Fathi E. Abd El-Samie, HossamEldin H. Ahmed, Ibrahim F. Elashry, Mai H. Shahieen, Osama S. Faragallah, El-Sayed M. El-Rabaie, Saleh A. Alshebeili, CRC Press, 2013	
4		
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	To understand the standard algorithms used to provide confidentiality, integrity and authenticity	CO1
2	To understand security issues that arise in communication systems and web services.	CO2
3		CO3
4		CO4

Course Code : **ECL DE344**
Course Title : **Cryptography And Multimedia Data Hiding**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) : **Programming and Digital communication Engineering**
Exposure
Equivalent Course Code (if any) :

Detailed Syllabus

Sr		Approx. Contact Hours
1	**UNIT I CLASSICAL TECHNIQUES AND ENCRYPTION STANDARDS** Classical Cryptography-The Shift Cipher, The Substitution Cipher, The Affine Cipher Cryptanalysis-Cryptanalysis of the Affine Cipher, Cryptanalysis of the Substitution Cipher, Cryptanalysis of the Vigenere Cipher, Shannon‟s Theory- Block Cipher and the Advanced Encryption Standard-Substitution –Permutation Networks, Linear Cryptanalysis, Differential Cryptanalysis, The Data Encryption Standard-The Advanced Encryption Standard.	8
2	**UNIT II AUTHENTICATION** The RSA Cryptosystem and Factoring Integer - Introduction to Public –key Cryptography, Number theory, The RSA Cryptosystem, Other Attacks on RSA, Signature Scheme – Digital Signature Algorithm	7
3	**UNIT III MULTIMEDIA DATA HIDING INTRODUCTION** Overview of Multimedia Data Hiding – Data hiding framework-Key elements -Basic embedding mechanisms-Techniques for Embedding multiple bits-Quantitative model for Uneven embedding Capacity-Constant and Variable embedding Rate(VER).	7
4	**UNIT IV DATA HIDING FOR IMAGE AND VIDEO** Data Hiding in Binary Image: understanding Proposed Scheme – Applications-Robustness and Security considerations-Multilevel embedding- Multilevel image data hiding: Spectrum Partition-System Design-Refined Human visual model-Multilevel video data hiding: Embedding Domain-System Design.	7
5	**UNIT V AUTHENTICATION AND ATTACKS WITH COUNTERMEASURES** Data Hiding for Image Authentication- Data Hiding for Video Communication-Attacks on known Data Hiding Algorithms-Countermeasures against Geometric attacks- Attacks on unknown Data Hiding Algorithms.	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001	
2	Kaufman, R. Perlman, and M. Speciner, Network Security: Private communication in a Public World, 2nd ed., Prentice Hall, ISBN 0-13-0460192	
3	Wade Trappe and Lawrence C. Washington, "Introduction to Cryptography with Coding Theory" Second Edition, Pearson Education, 2007.	
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	The students would have understood the basic security algorithms required by any computing system.	CO1
2	The students may be now aware of the security challenges and issues that may arise in any system.	CO2
3	The students may have ideas about the data hiding for image and video with supporting algorithms.	CO3
4	Students may be now aware of developing data hiding algorithms for the specialized applications.	CO4

Course Code : **ECL DE345**
Course Title : **MULTIMEDIA INFORMATION STORAGE AND RETRIEVAL**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) : **Programming and Digital communication Engineering**
Exposure
Equivalent Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr		Approx. Contact Hours
1	**UNIT I FUNDAMENTAL MEDIA UNDERSTANDING** Introduction – Media Types – Media Understanding – Description of Audio, Visual spectral and Video - Storage networks, storage medium.	8
2	**UNIT II TEXT RETRIEVAL AND MUSIC** Text Information retrieval: Information retrieval system-catalog and indexing – automatic indexing – term clustering – User search Techniques- Information Visualization- Fundamentals - Instantaneous Features - Intensity - Tonal Analysis - Musical Genre, Similarity and Mood	7
3	**UNIT III IMAGE RETRIEVAL** content-based image retrieval; techniques; feature extraction; integration; similarity; feature in INDEXING; interactive retrieval; MPEG-7 standard	7
4	**UNIT IV VIDEO RETRIEVAL** Content Based Video Retrieval - Video Parsing – Video abstraction and Summarization– Video Content Representation, Indexing and retrieval –Video Browsing Schemes– Example of Video Retrieval Systems	7
5	**UNIT V RETRIEVAL METRICS AND MODERN IR** Average recall and average precision - Harmonic mean - Evaluation of a search engine – Relevance Issue – Kappa Measure – Quality versus Quantity, possible factors which influence outcome of a search – Grandfield Experimental Study. Introduction- parallel IR – Distributed IR – trends and research Issue.	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Brusilovsky, Peter et.al. The Adaptive Web: Methods and Strategies	

	of Web Personalization. Berlin: Springer, 2007	
2	Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze," Introduction to Information Retrieval" , Cambridge University Press, 2008	
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	Learn the basics of multimedia information storage technology, techniques for analysis, representation and retrieval that is commonly used in industry.	CO1
2	Compare and contrast information retrieval models and internal mechanisms such as Boolean, Probability, and Vector Space Models	CO2
3	Outline the structure of queries and media elements.	CO3
4	Critically evaluate Multimedia retrieval system effectiveness and improvement techniques	CO4

Course Code : **ECL DE346**
Course Title : **Social Networks**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) : **Programming and Digital communication Engineering**
Exposure
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction** Information Spread Puzzle, Introduction To Python-1, Introduction To Python-2, Introduction To Networkx-1, Introduction To Networkx-2, Social Networks: The Challenge, Google Page Rank, Searching In A Network, Link Prediction, The Contagions, Importance Of Acquaintances, Marketing On Social Networks	8
2	**Handling Real-World Network Datasets** Introduction To Datasets, Ingredients Network, Synonymy Network, Web Graph, Social Network Datasets, Datasets: Different Formats, Datasets : How To Download, Datasets, Analyzing Using Networkxm, Datasets: Analyzing Using Gephi, Introduction : Emergence Of Connectedness,	7
3	**Strength Of Weak Ties** Granovetter's Strength Of Weak Ties, Triads, Clustering Coefficient And Neighbourhood Overlap, Structure Of Weak Ties, Bridges, And Local Bridges, Validation Of Granovetter's Experiment Using Cell Phone Data, Embededness, Structural Holes, Social Capital, Tie Strength, Social Media And Passive Engagement, Betweenness Measures And Graph Partitioning, Finding Communities In A Graph (Brute Force Method) And Others	7
4	**Positive And Negative Relationships (Introduction),** Structural Balance, Enemy's Enemy Is A Friend, Characterizing The Structure Of Balanced Networks,Balance Theorem, Proof Of Balance Theorem, Introduction To Positive And Negative Edges, Outline Of Implementation, Creating Graph, Displaying It And Counting Unstable Triangles, Moving A Network From An Unstable To Stable State,	7
5	**Link Analysis and Power Law** The Web Graph, Collecting The Web Graph, Equal Coin Distribution, Random Coin Dropping, Google Page Ranking Using Web Graph, Implementing Pagerank Using Points Distribution Method-Degree Rank Versus Pagerank,	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010 (available for free download).	
2	Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010. (free chapter available)	
3		
4		
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	Work on the internals components of the social netw	CO1
2	Model and visualize the social network	CO2
3	Mine the behaviors of the users in the social network	CO3
4	Predict the possible next outcome of the social network	CO4

Course Code : **ECL DE440**
Course Title : **MULTIMEDIA CLOUD COMPUTING**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) : **Programming and Digital communication Engineering**
Exposure
Equivalent Course Code (if any) :

Detailed Syllabus

Sr		Approx. Contact Hours
1	**UNIT I INTRODUCTION** Multimedia Representation - Text, Audio, Image and Video Representation - Input and Output Transducers -Human Vision and Audio Systems and their Limitations - Sampling, Quantization, Coding, Companding.	8
2	**UNIT II BASIC CODING TECHNIQUES** Introduction to Data Compression - Information Theory -Statistical Coding - Dictionary Based Coding – Audio Coding	7
3	**UNIT III VIRTUALIZATION** Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation –Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization	7
4	**UNIT IV VIRTUALIZATION** INFRASTRUCTURE Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.	7
5	**UNIT V UNIT V CLOUD SECURITY** Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint

Text Books		
1	Charles Marsh, David W.Guth, B.PShort, “Strategic Writing: Multimedia writing for Public Relations, Advertising and More”, Pearson education, Second Edition, 2008.	
2	Yun Q. Shi, Huifang Sun, “Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards”, CRC Press, Second edition, 2008	
3	Danielle Ruest, Nelson Ruest, “Virtualization: A Beginner‟s Guide”, McGraw-Hill Osborne Media, 2009	
4	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.	
Reference Books		
1	Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O‟Reilly Media, Inc.,2009	

Course Outcome

Sr	**Course Outcome**	**CO**
1	Employ the concepts of storage virtualization, network virtualization and its management	CO1
2	Apply the concept of virtualization in the cloud computing	CO2
3	Apply the security models in the cloud environment	CO3

Course Code : **ECL DE441**
Course Title : **Machine Learning**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) : **Programming and Digital communication Engineering**
Exposure
Equivalent Course Code (if any) :

Detailed Syllabus

Sr		Approx. Contact Hours
1	**Unit I Machine Learning Foundations**: A Case Study Approach Identify potential applications of machine learning in practice. Describe the core differences in analyses enabled by regression, classification, and clustering. Select the appropriate machine learning task for a potential application. Represent and access your data as features to serve as input to machine learning models.	9
2	**Unit II Machine Learning: Regression** Describe the input and output of a regression model. Compare and contrast bias and variance when modeling data. Estimate model parameters using optimization algorithms. Tune parameters with cross validation analysis of it. Describe the notion of sparsity and how LASSO leads to sparse solutions. Build a regression model to predict prices using a housing dataset using phyton/MATLAB.	9
3	**Unit III Machine Learning: Classification** Describe the input and output of a classification model. Tackle both binary and multiclass classification problems. Implement a logistic regression model for large-scale classification.	9
4	**Unit IV** Bias & variance, artificial neural networks, decision trees, ensemble modeling, building a model in python model optimization	9

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Tom M. Mitchell, "Machine Learning", McGraw-Hill, 2010	
2		
3		
4		

Reference Books		
1	Ethem Alpaydin, (2004) “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press	

Course Outcome

Sr	Course Outcome	CO
1	Develop a deep understanding of key concepts of ML	CO1
2	Demonstrate the application of Regression and classification models	CO2
3	Able to optimise and recommend model based on requirement	CO3

Course Code : **ECL DE442**
Course Title : **Advanced Databases**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :**Python/MATLAB /related software and related Maths concept**
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr		Approx. Contact Hours
1	**UNIT I PARALLEL AND DISTRIBUTED DATABASES** Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies	8
2	**UNIT II INTELLIGENT DATABASES** Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases-Recursive Queries in SQL-Spatial Databases- Spatial Data Types - Spatial Relationships- Spatial Data Structures-Spatial Access Methods- Spatial DB Implementation.	7
3	**UNIT III XML DATABASES** XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.	7
4	**UNIT IV MOBILE DATABASES** Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models -Concurrency Control - Transaction Commit Protocols.	7
5	**UNIT V MULTIMEDIA DATABASES** Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication /

		Reprint
Text Books		
1	C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006	
2	Vijay Kumar, “Mobile Database Systems”, John Wiley & Sons, 2006.	
3	R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Sixth Edition, Pearson Education/Addison Wesley, 2010	
4	Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw Hill, 2011.	
Reference Books		
1	Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw Hill, 2011.	

Course Outcome

Sr	Course Outcome	CO
1	To develop skills on databases to optimize their performance in practice.	CO1
2	To acquire knowledge on parallel and distributed databases and its applications.	CO2
3	To study the usage and applications of Object Oriented and Intelligent databases.	CO3
4	To understand the emerging databases like Mobile, XML, Cloud and Big Data	CO4

Course Code : **ECL DE443**
Course Title : **Medical Image Processing**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category : **Department Elective Course**
Pre-requisite Courses (if any) :**Python/related software and related Mathematical concept**
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr		Approx. Contact Hours
1	**UNIT I FUNDAMENTALS OF IMAGE PROCESSING** Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.	8
2	**UNIT II BIO-MEDICAL IMAGE PREPROCESSING** Image Enhancement operations – Image noise and modeling, Image restoration – Image degradation model, Inverse and Weiner filtering, Geometric transformations and correction	7
3	**UNIT III MEDICAL IMAGE RECONSTRUCTION** Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultra sound imaging., 3D Ultra sound imaging Nuclear, Medical Imaging modalities – SPECT,PET, Molecular Imaging	7
4	**UNIT IV IMAGE ANALYSIS AND CLASSIFICATION** Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.	7
5	**UNIT V IMAGE REGISTRATIONS AND VISUALIZATION** Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.	7

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Implement basic medical image processing algorithms	

2	Design and implement image processing applications that incorporates different concepts of medical Image Processing	
3	Investigate the opportunity of applying Image processing concepts in hospitals and treatments	
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	Describe the concepts and techniques in digital image processing	CO1
2	Describe the characteristics and properties of different types of medical images	CO2
3	Describe the structure and components of PASCProfessional Skill	CO3
4	Design and implementation of algorithm(s) for a medical image processing application	CO4

Course Code : **ECL DE444**
Course Title : **Machine Learning in Image and Video Processing**
L-T-P/S=Credits : **4-0-0 = 4**
Course Category :
Pre-requisite Courses (if any) :**DIP,Python/related software and related Mathematical concept**
Equal Course Code (if any) :
Equivalent Course Code (if any) :
Detailed Syllabus

Sr		Approx. Contact Hours
1	**UNIT I FUNDAMENTALS OF IMAGE PROCESSING** Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.	6
2	**UNIT II BIO-MEDICAL IMAGE PREPROCESSING** Image Enhancement operations – Image noise and modeling, Image restoration – Image degradation model, Inverse and Weiner filtering, Geometric transformations and correction	7
3	**UNIT III MEDICAL IMAGE RECONSTRUCTION** Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultra sound imaging., 3D Ultra sound imaging Nuclear, Medical Imaging modalities – SPECT,PET, Molecular Imaging	7
4	**UNIT VI Acquisition** Generation of Bio-signals,Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes	7
5	**UNIT V Biomedical signal analysis and processing** by Fourier analysis, Biomedical signal processing by wavelet (time-frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant), Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals Coherent treatment of various biomedical signal processing methods and applications. Principle component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis ML model and analysis of data	9

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Practical Biomedical Signal Analysis Using MATLAB (Series in Medical Physics and Biomedical Engineering) 2011 by Katarzyn J. Blinowska (Author), JaroslawZygierewicz CRC Press; 1 edition	
2	Biomedical signal processing and signal modeling by Eugene N Bruce, John Wiley & Son's publication	
3	Biomedical signal processing by D C Reddy, McGraw Hill	
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	Understand different types of biomedical signal.	CO1
2	Identify and analyze different biomedical signals.	CO2
3	Apply biomedical signal processing concepts to relevant domain	CO3
4	Analysis of biomedical data for analysis and prediction	CO4

Basket Specialization : VLSI Design

Course Code : ECL DE 302
Course Title : IC Fabrication & MEMS
L-T-P/S=Credits : 4-0-0 = 4
Course Category : Departmental Elective Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction:** Overview of the VLSI technologies and ASIC Design Flow, VLSI Circuits and Analog IC Design Fundamentals. Detailed Design flow	6
2	**Fundamentals of Semiconductor Fabrication:** Cleanroom technology - Clean room concept – Growth of single crystal Si, surface contamination, cleaning & etching. Oxidation – Growth mechanism and kinetic oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, charactrisation of oxide films, Use of thermal oxide and CVD oxide; growth and properties of dry and wet oxide, dopant distribution, oxide quality. Solid State Diffusion – Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysilicon and silicon di-oxide diffusion systems. Ion implantation – Range theory, Equipments, annealing, shallow junction, high energy implementation. Lithography – Optical lithography, Some Advanced lithographic techniques. Physical Vapour Deposition – APCVD, Plasma CVD, MOCVD. Metallisation - Different types of metallisation, uses & desired properties.	15
3	**CMOS:** Introduction to CMOS, CMOS Capabilities and Limitations and CMOS Transistors and Logic . VLSI Circuits Design Theory. Process overview. Transistor device model, Circuit characterization. Technology libraries Overview. Pre-layout parasitics estimation. Post layout simulation techniques. VLSI Circuit Schematics and Simulation EDA Tool Flow	15

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	May G S and Sze S M, *"Fundamentals of Semiconductor Fabrication"*, John Wiley & Sons, India.	
2	Sze S M, "*VLSI Technology*", McGraw Hill International Edition	
3	Ghandhi S K, *"VLSI fabrication Principles"*, John Wiley Inc., New York	
4	Streetman BG, *"Solid State Electronics Devices"*, Prentice Hall of India, New Delhi,	
Reference Books		
1	Chang C Y and Sze S (Ed),*"ULSI Technology"*, McGraw-Hill Companies Inc.	
2	Allen, Phillip E. &Holberg, Douglas R. "CMOS Analog Circuit Design" Oxford University Press	
3	J. Baker "CMOS: Circuit Design, Layout, and Simulation" Wiley IEEE Press	
4	Neil H. E. Weste, Kamran Eshraghian " Principles of CMOS VLSI Design ", Pearson	

Course Outcome

Sr	Course Outcome	CO
1	· Understand the fabrication process of IC technology	CO1
2	· Analysis of the operation of MOS transistor	CO2
3	· Analysis of the physical design process of VLSI design flow	CO3
4	· Analysis of the design rules and layout diagram	CO4

Course Code : **ECM DE 303**
Course Title : **Digital Integrated Circuits**
L-T-P/S=Credits : **3-0-2 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**MOS Inverter:** Introduction to resistive - load inverter, inverter with n-type MOSFET load, CMOS inverter **Switching Characteristics and Interconnects Effects:** Introduction, Delay time definitions, Calculation of delay times, Inverter design with delay constraints, MOS Inverters: Switching Characteristics & Interconnect Effects. Estimation of interconnect parasitic.	8
2	**Sequential MOS Logic Circuits:** Introduction, SR latch circuits, Clocked latch and Flip-flop circuits, CMOS D-latch and edge -triggered flip-flop. Dynamic MOS Logic Circuit	8
3	**Semiconductor Memories:** Introduction, Dynamic random access memory (DRAM), Static random acces memory(SRAM),Non-volatile memory.	8
4	**Low Power CMOS Logic Circuits:** Introduction, Overview of power consumption, Switching power dissipation CMOS inverter, Estimation and optimization of switching activity.	8

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	1. Rabaey J.M, Chandrakasan A, Nikolic B , "Digital Integrated Circuits- A Design Perspective", Prentice Hall	
2	2. S M Kang and Y Lebici,"CMOS Digital Integrated Circuits-analysis and design", McGraw Hill.	
3	3. Pucknell D A and Eshraghian K, *"Basic VLSI Design"*, Prentice Hall India, New Delhi,	
4	4. Glaser L and Dobberpuhl D, *"The Design and Analysis of VLSI Circuits"*, Addison Wesley,	

Reference Books		
1	Weste N and Eshranghian K, *"Principles of CMOS VLSI Design"*, Pearson Education Asia	

Course Outcome

Sr	Course Outcome	CO
1	Analyze functionality of digital circuits including combinational, sequential, and memory.	CO1
2	Characterize speed, energy consumption, and robustness of combinational, sequential, and memory circuits.	CO2
3	Design combinational, sequential, and memory circuits to meet specified functionality, speed, energy, and robustness targets	CO3
4	Perform simulation of digital circuits, and write reports conforming to technical writing standards.	CO4

Course Code : **ECM DE 304**
Course Title : **CMOS Digital Design**
L-T-P/S=Credits : **3-0-0 = 3**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Designing Combinational Logic Gates in CMOS** Static CMOS Design. Dynamic CMOS Design. How to Choose a Logic Style? Perspective: Gate Design in the Ultra Deep-Submicron Era.	8
2	Dynamic Logic circuits. Bootstrap Logic , Domino Logic. Basic Principles of Pass Transistor Circuits, Synchronous Dynamic Circuit Techniques ,High-Performance Dynamic CMOS Circuits	8
3	**Sequential MOS Logic Circuits:** Introduction, SR latch circuits, Clocked latch and Flip-flop circuits, CMOS D-latch and edge -triggered flip-flop. Dynamic MOS Logic Circuit. Timing Metrics for Sequential Circuits. Classification of Memory Elements. Static Latches and Registers. Dynamic Latches and Registers. Pulse Registers. Sense-Amplifier Based Registers. Pipelining: An Approach to Optimize Sequential Circuits. Non-Bistable Sequential Circuits. Perspective: Choosing a Clocking Strategy.	8
4	**Semiconductor Memories:** Introduction, Dynamic random access memory (DRAM), Static Read-Write Memory (SRAM) Circuits ,Non-volatile memory. Read-Only Memory (ROM) Circuits and Dynamic Read-Write Memory (DRAM) Circuits	8
5	**Design for testability :** Introduction to fault types and Models, Built in Self Test (BIST).	8

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	1. Rabaey J.M, Chandrakasan A, Nikolic B , "Digital Integrated Circuits- A Design Perspective", Prentice Hall	
2	2. S M Kang and Y Lebici,"CMOS Digital Integrated Circuits-analysis and design", McGraw Hill.	

3	3. Pucknell D A and Eshraghian K, *"Basic VLSI Design"*, Prentice Hall India, New Delhi	
4	4. Glaser L and Dobberpuhl D, *"The Design and Analysis of VLSI Circuits"*, Addison Wesley	
Reference Books		
1	Weste N and Eshranghian K, *"Principles of CMOS VLSI Design"*, Pearson Education Asia	

Course Outcome

Sr	**Course Outcome**	**CO**
1	To analyse and implement various CMOS static logic circuits.	CO1
2	To learn the design of various CMOS dynamic logic circuits.	CO2
3	To learn the design techniques for CMOS Sequential Circuits.	CO3
4	To learn the different types of memory circuits design and testability.	CO4

Course Code : **ECM DE 304**
Course Title : **Low Power Devices and Systems**
L-T-P/S=Credits : **3-0-2 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Basics of MOS circuits: MOS Transistor structure MOS Inverters MOS Combinational Circuits - Different Logic Families	8
2	Sources of Power dissipation: Dynamic Power DissipationShort Circuit Power Switching Power Gliching Power Static Power Dissipation	8
3	Supply Voltage Scaling Approaches:Device feature size scaling Multi-Vdd CircuitsArchitectural level approaches: Parallelism, Pipelining Voltage scaling using high-level transformationsDynamic voltage scaling Power Management	8
4	Leakage Power minimization Approaches: Variable-threshold-voltage CMOS (VTCMOS) approach Multi-threshold-voltage CMOS (MTCMOS) approach Power gating Transistor stacking Dual-Vt assignment approach (DTCMOS)	8

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	1. Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata Mcgrag Hill.	
2	2. Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).	
3	3. A. Bellamour, and M. I. Elmasri, Low Power VLSI CMOS Circuit Design, Kluwer Academic Press, 1995.	
4	4. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.	
Reference Books		
1	Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-Interscience, 2000.	

Course Outcome

Sr	Course Outcome	CO
1	To implement MOS circuits.	CO1
2	To learn the design of various low power circuits.	CO2
3	To learn the scaling methods	CO3
4	To learn the different sources of power dissipation	CO4

Course Code : **ECM DE 401**
Course Title : **Analog VLSI Design**
L-T-P/S=Credits : **3-0-2= 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Operational amplifiers: Equivalent circuit, voltage transfer curve – Open loop Opamp configurations – Voltage series, Voltage shunt feedback amplifiers configurations, closed loop differential amplifiers for single and differential outputs. Output Off set voltage, offset null pins. Minimizing output offset voltage due to input bias current and input offset current, Factors affecting off set parameters. CMRR – Open loop and closed loop frequency response of op-amps, Circuit stability, Slew rate and its effects in applications.	12
2	Applications of Op Amp: DC & AC amplifiers – Summing, Scaling and Averaging amplifiers – Instrumentation Amplifier – voltage to current converter for floating and grounded loads – Current to voltage converter – Integrator, Differentiator. Voltage comparators – ZCD-Schmitt trigger with voltage limiter – Precision rectifier circuits – Peak detector – Sample and Hold circuit. Active Filters: Frequency response characteristics of major active filters, first and higher order low pass and high pass filters, all pass filters.	12
3	Oscillators and waveform generators: Requirements for oscillations, Op-amp RC oscillators, square wave generators, triangle and sawtooth waveform generators, astable and monostable operations, Voltage controlled oscillators – IC 555 timer, astable and monostable operation. Circuit board layout techniques: General considerations – PCB mechanical construction – Grounding – Decoupling – Input, output isolation.	12

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint

Text Books		
1	Ramakant A. Gayakwad, “Op-Amps and Linear integrated circuits”, Prentice Hall of India, 4th Edition, 2000.	
2	Donald E. Neaman, “Electronic Circuit, Analysis and Design”, Tata McGraw Hill Publishing Company Limited, Second Edition, 2002.	
Reference Books		
1	Sergio Franco,?Design with operational amplifiers and Analog Integrated circuits?, Tata McGraw Hill 3rd Edition 2002.	

Course Outcome

Sr	Course Outcome	CO
1	To implement MOS circuits.	CO1
2	To learn the design of various low power circuits.	CO2
3	To learn the scaling methods	CO3
4	To learn the different sources of power dissipation	CO4

Course Code : **ECL DE 401**
Course Title : **Analog and Mixed Signal Design**
L-T-P/S=Credits : **3-0-2 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Overview of MOFSET basics – Second order effects – Measurement of parameters for a given technology with a simulation tool – Passive and active current mirrors – Single stage amplifier – Differential voltage and current amplifiers – Noise performance of elementary transistor stages – Systematic design of operational amplifiers.	12
2	Mixed Signal Circuits: Non-linear analog circuits – Open loop comparators – static and dynamic comparators, effect of positive feedback and stability issues – Switched capacitor circuits. Nonlinearity and Mismatch – capacitor nonlinearity, effect of feedback on nonlinearity, linearization techniques – offset cancellation techniques – reduction of noise by offset cancellation.	12
3	Data convertors: Fundamental of data converters – static characteristics – INL, DNL – Dynamic characteristics – SNR, SFDR, SINAD – DAC architectures: Resistive – Capacitive – Current steering. ADC Architectures: Flash – SAR – Pipeline ADC.	12

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2003.	
2	Franco Maloberti, "Data Convertors", Springer, 2007.	
Reference Books		
1	Willy M. C Sansen, "Analog Design Essentials", Springer,2006.	

Course Outcome

Sr	Course Outcome	CO
1	Overview of MOSFET	CO1
2	To learn the mixed signal circuits	CO2
3	To learn the data converters	CO3
4	To learn the parameters of DC and DAC	CO4

Course Code : **ECL DE 501**
Course Title : **DSD using VHDL /Verilog**
L-T-P/S=Credits : **3-0-2 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Review: Review of concepts of combinational and Sequential logic circuit design, design of digital systems with help of state machine charts and their realization through Gates, Multiplexersandotherdiscrete digital ICs.	8
2	Basic language elements & behavioral modeling, Data flow modeling – structural, Generics and configurations - Subprogram and overloading – Packages and Libraries – Model simulation.	8
3	Design of Hardware using VHDL/Verilog as examples – code converters, multiplexer, de-multiplexer, binary adders and multipliers, counters. Design of sequential circuits using VHDL/verilog, counters, shift registers	8
4	Sequential Circuits: Synchronous sequential circuits and finite state machines (FSM); Mealy machine; Moore machine; State table; State diagram; Synchronous Sequential circuit analysis; System design; State minimization; State assignment; ROM implementation; Asynchronous sequential circuits	12

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Daniel Gajski: Principles of Digital Design	
2	Bhasker: A VHDL Primer	
Reference Books		
1	Pedroni: Circuit Design with VHDL	
2	Palnitkar: Verilog HDL	

Course Outcome

Sr	Course Outcome	CO

1	To understand and develop complex digital circuits and system functions based on algorithms.	CO1
2	To represent complex digital circuits in the form of the hierarchically organized VHDL/Verilogdesign/ simulation software tools.	CO2
3	To develop VHDL/Verilog architectural representations of systems and components using modelsrepresenting structure, behavior, or data flow concepts describing the internal structure orexternal behavior of the circuit.	CO3
4	To develop final technical documentation of a complex digital system using VHDL/verilog languagedescriptions.	CO4

Course Code : **ECL DE** 601
Course Title : **Advanced CMOS VLSI Design**
L-T-P/S=Credits : **3-0-2 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Design methodologies: VLSI Design flow, Design Hierarchy, Regularity, Modularity and Locality, VLSI design styles, Design quality, Packaging technology.MOS device design equations , Second order effects, the complementary CMOS Inverter DC characteristics.	12
2	Circuit Characterization and Performance Estimation: Parasitic effect in Integrated Circuits, Resistance estimation, capacitance estimation, Inductance. Switching characteristics, CMOS - Gate transistor sizing, Power dissipation, CMOS Logic Structures, Clocking Strategies.	12
3	CMOS Process Enhancement & Layout Considerations: Interconnect, circuit elements, Stick diagram, Layout design rules, Latchup, latchup triggering, latchup prevention, Technology related CAD issues	12

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	D.A. Pucknell, K. Eshraghian, Basic VLSI Design, PHI,.	
2	John P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & Sons.	
Reference Books		
1	Niel H.E. Weste, K. Eshraghian,, Principles of CMOS VLSI Design, Person,	
2	Mead and L. Conway, Introduction to VLSI Systems, Addison-Wesley.	

Course Outcome

Sr	Course Outcome	CO
1	To understand the CMOS logic and applications	CO1

2	To represent the parasitic effects	CO2
3	To develop layouts and designs	CO3
4	To develop the switching and static characteristics	CO4

Course Code : **ECM DE403**
Course Title (NPTEL) : **VLSI Physical Design with Timing Analysis**
L-T-P/S=Credits : **3-0-2 = 4**
Course Category : **Core**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to VLSI Design, VLSI Physical Design, Complexity Analysis for Algorithms, Graphs for Physical Design, Graph searching Algorithms, Spanning Tree and Shortest Path Algorithms, Overview of Timing Analysis, Timing Arcs and Unateness, Delay Parameters of Combinational Circuits, Delay Parameters of Sequential Circuit, Timing Analysis in Sequential Circuit, STA in Sequential Circuit with Clock Skew, STA in Sequential Circuit with Clock Jitter, STA considering OCV and CRPR (Setup check), STA considering OCV and CRPR (Hold check), STA for Combinational Circuits	9
2	Introduction to Partitioning, Partitioning Algorithms, Kernighan – Lin (KL) Algorithm, Fidduccia-Mattheyeses(FM) Algorithm, Introduction to Floor planning, Floor planning Representations, Floor planning Algorithms, Pin Assignment and Power - Ground Routing, Introduction to Placement, Wirelength estimation techniques, Min-cut placement, Placement Algorithms, Placement algorithms and legalization	9
3	Introduction to Clock Tree Synthesis, Clock Routing Algorithms, Introduction and Optimization Goals, Single net routing (Rectilinear routing), Global Routing in the connectivity graph, Finding Shortest Paths with Dijkstra's Algorithm, Full-Netlist Routing, Detailed Routing, Channel Routing Algorithms, Switchbox and Over the cell routing	9
4	Timing analysis in latches, Time borrowing in latches, Crosstalk Analysis, SSTA - Statistical Static Timing Analysis, Standard Cell Library, Low Power Cells in Standard Cell Library, Sub-threshold Standard Cell Library, Timing Library for Standard cells, PDK and Other files, Open-Source tool installation and Qflow, Open-Source tool-YOSYS, OpenSTA Static Timing Analyzer, OpenROAD Physical Synthesis Flow	9

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Kahng, A.B., Lienig, J., Markov, I.L., Hu, J., "VLSI Physical Design: From Graph Partitioning to Timing Closure", Springer.	
2	Sherwani, N.A., "Algorithm for VLSI Physical Design Automation", 2nd Ed., Kluwer.	
Reference Books		
1	J. Bhasker and Rakesh Chadha, "Static Timing Analysis for Nanometer Designs A Practical Approach" Springer 2009	
2	Bhatnagar, H. "Advanced ASIC Chip Synthesis: Using Synopsys Design Compiler Physical Compiler and Prime Time"; Kluwer Academic Publishers: New York, NY, USA, 2002	

Course Outcome

Sr	Course Outcome	CO
1	To understand the VLSI Physical design flow	CO1
2	To represent the steps of VLSI Physical design	CO2
3	To develop Static Timing Analysis	CO3
4	To study the Open-source tools	CO4

Course Code : **ECM DE404**
Course Title : **VLSI Interconnects (NPTEL)**
L-T-P/S=Credits : **3-0-2 = 4**
Course Category : **Departmental Elective Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to VLSI Interconnects. Distributed RC interconnect model, Elmore delay, Elmore delay in interconnects, Elmore delay in RC tree and branched interconnects, Equivalent circuit of RC interconnect, Scaling Effects, Delay mitigation in RC interconnects, RC interconnect simulation session, Inductive effects in interconnects	9
2	Distributed RLC Interconnect model (Frequency domain analysis), Transmission line equations. When to consider the inductive effects?, The transfer function of an interconnect, Time-domain response of a lumped model RLC circuit, Equivalent Elmore model for RLC interconnects (Distributed model), Two-pole model of RLC interconnects from ABCD parameters. Simulation of RLC interconnects. Origin of the skin effect, Effective resistance at high frequencies	9
3	Equivalent circuit to simulate skin effect, Power dissipation due to interconnects, Optimum interconnect width for minimizing total power dissipation. Heating effects and thermal modelling, Compact Thermal modeling with equivalent electrical circuit, Electromigration in interconnects, Mitigation of electromigration. Capacitive coupling in interconnects. Cross-talk and timing jitters in two identical interconnects. Effects of cross-talk and timing jitters.	9
4	Techniques for mitigation of cross-talk. ??Lecture-32: Matrix formulation of coupled interconnects. Coupled RLC interconnects, Decoupling of interconnects by diagonalization of matrix , Analysis of coupled interconnects: Examples, Analysis of coupled interconnects: Examples-2, Simulation of RC coupled interconnects, Extraction of capacitance ,Extraction of inductance, Estimation of interconnect parameters from S parameters	9

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	J. Davis and J. Meindl. Interconnect Technology and Design for Gigascale Integration. Springer Science+Business Media, LLC, 2003	
Reference Books		
1	Jens Lienig and Matthias Thiele. Fundamentals of Electromigration-Aware Integrated Circuit Design. Springer, 2018.	

Course Outcome

Sr	Course Outcome	CO
1	To understand the Interconnects	CO1
2	To study the interconnect effects	CO2
3	To develop techniques for electromagnetic and circuit modeling	CO3
4	To study the high frequency circuit design and signal integrity issues	CO4