B.Tech. ELECTRONICS AND COMMUNICATION ENGINEERING

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FOREWORD

In the present era, the field of Electronics and Communication plays an important role in every sphere of our life. It has penetrated in to all the fields of human existence. It has not only connected people but also provided viable solutions to various practical problems in the field of Communication through the utilization of Maths and Science. So, the greatest contributions to the society can be done by electronic advancements in the fields of Communications, Navigation, Medical Diagnosis, Control and Automation. These developments have revolutionised the way people live and the way people think. These emerging developments are exciting, inspiring and challenging for the students aspiring to be Electronics and Communication Engineer.

In the Department of Electronics and Communication Engineering, a wide range of professional courses are offered to train Electronics and Communication Engineers. The curriculum has been updated and enriched not only in its core area but made more versatile through incorporation of computer knowledge, elective courses of student's choice, and some basic courses of science that form the bridge to technology, industry internship and project works. The new curriculum of R22 accomplishes multidisciplinary holistic education, continuous assessment along with multiple honorable exit options if a student unable to complete the requirements to earn the degree within the stipulated period including the permissible spill over period.

R22 curriculum comprises of:

- *Revision in tune with National Education Policy 2020 [NEP 2020]*
- *Various exit options*
- *Regular Degree along with Honours / Minor Degree/ Certification*
- *Reduction in total credits to 161*
- *Module wise course syllabus*
- *More weightage to Continuous Assessment*
- *Advanced courses like Cognitive Radio Networks (CRN), Multirate Digital Signal Processing and RF Transceiver System Design*

The focus area of each unit in every course is clearly defined. Topics of contemporary relevance such as the Hardware, software tools related to IoT, RF and Microwave designs, Low Power VLSI, Embedded Systems are included. The Board of Studies consisting of eminent personalities along with experienced faculty members of the university have designed the curriculum to offer knowledge and skill of electronics engineering on the above-mentioned areas. The curriculum includes concepts with skill-based tasks through integrated transcations, laboratory and activities combined with theory. The department aims to make graduates ready for the industrial requirements.

External BoS Members:

1. Dr. Sreehari Rao Patri, Professor & HoD, Department of Electronics and Communication Engineering, National Institute of Technology, Warangal.
2. Dr. K. Krishna Naik, Department of Electronics and Communication Engineering, Indian Institute of Information Technology Design and Manufacturing (IIITDM) Kurnool, Ministry of Education, Government of India.
3. Vijaykumar R Tawker, Senior Architect, L&T Technology Service Limited, Bengaluru, Karnataka.

I thank all the BoS Members, Academic Council Members and University authorities for encouraging and supporting us in designing this innovative curriculum for our students.

Dr. T. Pitchaiah
HOD, ECE

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

VISION

To evolve into a Centre of Excellence in Science & Technology through creative and innovative practices in teaching – learning, towards promoting academic achievement and research excellence to produce internationally accepted, competitive and world class professionals who are psychologically strong & emotionally balanced, imbued with social consciousness & ethical values.

MISSION

To provide high quality academic programmes, training activities, research facilities and opportunities supported by continuous industry - institute interaction aimed at promoting employability, entrepreneurship, leadership and research aptitude among students and contribute to the economic and technological development of the region, state and nation.

Department of ELECTRONICS AND COMMUNICATION ENGINEERING

VISION of the department

To emerge as a Centre of Academic Excellence in Electronics and Communication Engineering that imparts quality technical education, research impetus, professional and ethical values to meet global needs of Industry and society.

MISSION of the department

M1: Offering state of the art curriculum with innovative practices in teaching learning to pursue career in electronics and related fields.

M2: Providing advanced laboratory facilities and conducive research environment to make them industry ready and equip to carryout higher education towards research and consultancy.

M3: Transforming into responsible professionals with leadership qualities, managerial ability, team spirit, social consciousness, human values and ethics.

B.Tech in Electronics and Communication Engineering

Program Educational Objectives (PEOs)

PEO1: Apply the concepts of electronics, communication and computation to pursue career in core and allied industries to solve industrial and societal problems.

PEO2: Pursue higher education to progress professionally in contemporary Technologies and multidisciplinary fields with an inclination towards continuous learning.

PEO3: Exhibit professional skills, ethical values, interpersonal skills, leadership abilities, team spirit and lifelong learning.

Program Specific Outcomes (PSOs)

PSO1: Analyse and design electronic systems for signal processing, communications and other applications.

PSO2: Develop Solutions for various problems using Embedded Systems and Internet of Things.

PSO3: Apply domain specific knowledge to design, analyse, synthesize and validate the VLSI systems.

Program Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

R22 B.Tech.

4 YEAR

DEGREE PROGRAMME

COURSE STRUCTURE - R22

I Year I Semester

Course Code	Course Title	L	T	P	C
22MT102	Linear Algebra	3	2	0	4
22PY104	Physics for Electronic Engineers	2	0	2	3
22EE101	Basics of Electrical and Electronics Engineering	2	0	2	3
22CS103	IT Workshop and Tools	0	2	4	3
22TP103	Programming in C	2	0	4	4
22EN102	English Proficiency and Communication Skills	0	0	2	1
22SA101	Physical Fitness, Sports and Games – I	0	0	3	1
22TP101	Constitution of India	0	2	0	1
Total		**9**	**6**	**17**	**20**
		32 Hrs			

I Year II Semester

Course Code	Course Title	L	T	P	C
22MT111	Multivariate Calculus	3	2	0	4
22EC104	Semiconductor Physics and Devices	2	0	2	3
22ME101	Engineering Graphics	2	0	2	3
22TP104	Basic Coding Competency	0	1	3	2
22EN104	Technical English Communication	2	0	2	3
22EC102	Network Theory	3	2	0	4
22SA103	Physical Fitness, Sports and Games – II	0	0	3	1
22SA102	Orientation Session	0	0	6	3
Total		**12**	**5**	**18**	**23**
		35 Hrs			

Department Subject is extension of Basic sciences

COURSE STRUCTURE - R22

II Year I Semester

Course Code	Course Title	L	T	P	C
22EC202	Probability Theory and Stochastic Processes	3	2	0	4
22CT201	Environmental Studies	1	1	0	1
22TP201	Data Structures	2	2	2	4
22EC201	Analog Circuits	3	0	2	4
22EC203	Digital Electronics	2	2	2	4
22EC205	Signals and Systems	2	2	2	4
22EC209	Printed Circuit Board Design	0	0	2	1
22SA201	Life Skills	0	0	2	1
	Total	13	9	12	23
	NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication with good impact factor (Only 2 students can claim 1 paper /patent). These credits maybe earned on or before the end of IV semester	0	0	0	1
	Total	**13**	**9**	**12**	**24**
		34 Hrs			

II Year II Semester

Course Code	Course Title	L	T	P	C
22TP203	Advanced Coding Competency	0	0	2	1
22MS201	Management Science	2	2	0	3
22EC206	Communication Systems	3	0	2	4
22EC207	Computer Architecture and Organization	2	2	0	3
22EC208	Control Systems	2	2	0	3
	Department Elective – 1	2	0	2	3
	Open Elective – 1	3	0	0	3
22SA202	Life Skills	0	0	2	1
	Total	**14**	**6**	**8**	**21**
	Minor / Honours - 1	3	0	2	4
		17	**6**	**10**	**25**
	Total	**33 Hrs**			

R22 B.Tech.

4 YEAR DEGREE PROGRAMME

COURSE STRUCTURE - R22

III Year I Semester

Course Code	Course Title	L	T	P	C
22TP301	Soft Skills Laboratory	0	0	2	1
22EC301	Microcontrollers	2	2	2	4
22EC303	VLSI Design	3	0	2	4
22EC305	Electromagnetic waves and Transmission Lines	2	0	2	3
	Department Elective – 2	2	0	2	3
	Open Elective – 2	2	0	2	3
22EC306	Industry interface course	1	0	0	1
22EC305	Inter-Departmental Project – Phase I	0	0	2	0
	Total	**12**	**2**	**14**	**19**
	NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication with good impact factor (Only 2 students can claim 1 paper /patent). These credits maybe earned on or before the end of VI semester	0	0	0	1
	Minor / Honours - 2	3	0	2	4
	Total	**15**	**2**	**16**	**24**
		33 Hrs			

III Year II Semester

Course Code	Course Title	L	T	P	C
22TP204	Professional Communication	0	0	2	1
22TP302	Quantitative Aptitude and Logical Reasoning	1	2	0	2
22EC308	Digital Signal Processing	2	2	2	4
22EC309	Antenna Theory : Analysis and Design	2	0	2	3
	Department Elective – 3	2	0	2	3
	Department Elective – 4	2	0	2	3
	Open Elective – 3	3	0	0	3
22EC309	Inter-Departmental Project – Phase II	0	0	2	2
	Total	**12**	**4**	**12**	**21**
	Minor / Honours - 3	3	0	2	4
	Total	**15**	**4**	**14**	**25**
		33 Hrs			

COURSE STRUCTURE - R22

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DEGREE PROGRAMME

IV Year I Semester

Course Code	Course Title	L	T	P	C
22EC401	Data Communications and Computer Networks	3	0	2	4
22EC402	Microwave Engineering	3	0	2	4
	Department Elective – 5	2	2	0	3
	Department Elective – 6	2	2	0	3
	Department Elective – 7	2	2	0	3
	Department Elective – 8	2	2	0	3
	Total	**14**	**8**	**4**	**20**
	Minor / Honours – 4	3	0	2	4
	Total	**17**	**8**	**6**	**24**
		31 Hrs			

IV Year II Semester

Course Code	Course Title	L	T	P	C
22EE403 / 22EE404	Project Work / Internship	0	2#	22	12
	Total	**24**			**12**
	Minor / Honours – 5 (for project)	3	0	2	**4**
	Total	**32**			**16**

for interaction between Guide and students

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME

COURSE STRUCTURE - R22

Department Electives

Course Code	Course Title	L	T	P	C
STREAM-1 VLSI					
22EC834	C-Based VLSI Design	2	2	0	3
22EC835	FPGA Based System Design	2	0	2	3
22EC836	Hardware Verification Techniques	2	2	0	3
22EC837	PERL & TCL Programming	2	2	0	3
22EC838	Python for Software/Hardware Co-Design	2	2	0	3
22EC839	System on Chip Design	2	2	0	3
22EC840	Testing of VLSI Circuits	2	2	0	3
22EC841	Verification Using System Verilog	2	2	0	3
STREAM-2 ES & IoT					
22EC815	Android OS and Application Development	2	0	2	3
22EC816	Cognitive Radio Networks	2	0	2	3
22EC817	Embedded System Design Using FPGA	2	0	2	3
22EC818	Introduction to Embedded Systems	2	0	2	3
22EC819	Introduction to Industry 4.0 and Industrial Internet of Things	2	0	2	3
22EC820	Multi-Core Architectures and Programming	2	0	2	3
22EC821	Smart & Virtual Instrumentation	2	0	2	3
22EC823	Wireless Sensor Networks	2	0	2	3

STREAM-3 AI & ML

Course Code	Course Title	L	T	P	C
22EC801	Deep Learning and ANN	2	2	0	3
22EC802	Digital Image Processing	2	0	2	3
22EC803	Human Machine Interaction	2	0	2	3
22EC804	Introduction to Artificial Intelligence	2	2	0	3
22EC805	Machine Learning and Data Science	2	2	0	3
22EC806	Programming With Python	2	0	2	3
22EC807	Statistical Analysis & Data Analytics	2	2	0	3
22EC808	Time Series Data Analysis Using Python	2	0	2	3

COURSE STRUCTURE - R22

Department Electives

Course Code	Course Title	L	T	P	C
STREAM-4 CSP					
22EC809	Advanced Digital Signal Processing	2	2	0	3
22EC810	Cellular and Mobile Communications	2	2	0	3
22EC811	Fundamentals of Radar Signal Processing	2	0	2	3
22EC812	Multirate Digital Signal Processing	2	2	0	3
22EC813	Optical Fiber Communications	2	2	0	3
22EC814	Satellite Communications	2	2	0	3
STREAM-5 RF & MICROWAVE					
22EC824	Advanced Antenna Arrays	2	0	2	3
22EC825	Advanced Antennas for Modern Wireless Communication	2	0	2	3
22EC826	Computational Electromagnetics	2	2	0	3
22EC827	Microwave Measurements	2	2	0	3
22EC828	MIMO Antennas for Wireless Communication-Theory and Design	2	0	2	3
22EC829	Radar System Design	2	0	2	3
22EC830	RF Devices and Active Circuits	2	0	2	3
22EC831	RF Passive Circuits	2	0	2	3
22EC832	RFIC and Microwave MEMS	2	0	2	3
22EC833	Smart Antenna	2	2	0	3

R22 B.Tech.
4 YEAR
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COURSE STRUCTURE - R22

Honours Streams and Courses

STREAM-1 VLSI					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
22EC975	Analog IC Design	3	2	0	4
22EC976	ASIC Design	3	2	0	4
22EC977	Digital IC Design	3	2	0	4
22EC978	Low Power VLSI Design	3	2	0	4

STREAM-2 EMBEDDED SYSTEMS AND IOT					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
22EC961	ADHOC Sensor Networks	3	0	2	4
22EC962	Cloud Computing for IoT Systems	3	0	2	4
22EC963	Embedded System Design Using FPGA	3	0	2	4
22EC964	Embedded Systems	3	0	2	4
22EC965	Introduction to Internet Of Things	3	0	2	4
22EC966	IoT Architecture	3	0	2	4
22EC967	IoT Design	3	0	2	4
22EC968	IoT Security	3	0	2	4
22EC969	Sensors and Actuators for IoT	3	0	2	4

STREAM-3 AI & ML					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
22EC951	Advanced Deep Learning and Computer Vision	2	0	4	4
22EC952	Applied Data Science With Python	3	0	2	4
22EC954	Reinforcement Learning in Python	3	2	0	4

COURSE STRUCTURE - R22

Honours Streams and Courses

STREAM-4 CSP					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
22EC955	Array Signal Processing	3	2	0	4
22EC956	Free Space Optics	2	2	2	4
22EC957	Fundamentals of Massive MIMO	3	2	0	4
22EC958	Information Theory and Coding	3	2	0	4
22EC959	SDR for Future Communication Systems	3	2	0	4
22EC960	Wavelet Theory and Applications	3	2	0	4

STREAM-5 RF & MICROWAVE					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
22EC970	Applied RF Engineering I - Circuits and Transmission Line	3	2	0	4
22EC971	Microstrip and Printed Antenna Design	3	2	0	4
22EC973	Modeling and Simulation of Phased-Array Antennas	3	2	0	4
22EC974	RF Transceiver System Design	3	2	0	4

MINORS ES & IOT					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
22EC901	ADHOC Sensor Networks	3	0	2	4
22EC902	Design Priciples of IoT	3	0	2	4
22EC903	Introduction to Internet of Things	3	0	2	4
22EC904	Introduction to IoT Architecture	3	0	2	4
22EC906	Security Aspects of IoT	3	0	2	4
22EC907	Sensors and Actuators for IoT	3	0	2	4
22EC905	Machine Learning for IoT Systems	3	0	2	4

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4 YEAR
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COURSE STRUCTURE - R22

Honours Streams and Courses

OPEN ELECTIVES					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
22EC855	Android OS and Application Development	2	0	2	3
22EC856	Internet of Things	2	0	2	3
22EC857	Introduction to Embedded Systems	2	0	2	3
22EC858	Microprocessors and Microcontrollers	2	0	2	3
22EC859	Smart & Virtual Instrumentation	2	0	2	3
22EC860	Wireless Sensor Networks	2	0	2	3

I

YEAR

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech.

COURSE CONTENTS

I SEM & II SEM

I SEMESTER

22MT102	-	Linear Algebra
22PY104	-	Physics for Electronic Engineers
22EE101	-	Basics of Electrical and Electronics Engineering
22CS103	-	IT Workshop and Tools
22TP103	-	Programming in C
22EN102	-	English Proficiency and Communication Skills
22SA101	-	Physical Fitness, Sports & Games-I
22TP101	-	Constitution of India

II SEMESTER

22MT111	-	Multivariate Calculus
22EC104	-	Semiconductor Physics and Devices
22ME101	-	Engineering Graphics
22TP104	-	Basic Coding Competency
22EN104	-	Technical English Communication
22EC102	-	Network Theory
22SA103	-	Physical Fitness, Sports & Games – II
22SA102	-	Orientation Session

22MT102 LINEAR ALGEBRA

Image Source: https://thumbs.dreamstime.com/z/linear-algebra-complex-like-puzzle-pictured-as-word-linear-algebra-puzzle-pieces-to-show-linear-algebra-can-be-164220956.jpg

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of matrices, Determinant, relations and functions.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to build a grasp of the fundamental concepts of matrices and rank of a matrix using Echelon form, Normal forms. The methods for solving the system of linear equations using Cramer's rule, Gauss Elimination method and Gauss-Jordan method. To find the Eigen values and Eigen vectors of a square matrices and applications on it. To discuss vector space and its properties, Basis and Dimension and their applications.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

MATRICES:

Rank of a Matrix: Algebra of matrices, Types of matrices, Invertible matrices, Rank of a matrix, Echelon from, Normal form.

Solutions of Linear Equations: Consistency of System of linear equations, Cramer's Rule, Gauss Elimination method, Gauss-Jordan method.

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF MATRICES:

Eigen values and Eigen vectors: Introduction to Eigen values and Eigen vectors, Eigen values of diagonal matrix, Eigen values of triangular matrices, Properties of an Eigen values and Eigen vectors (without proofs).

Applications of Eigen Values and Eigen Vectors: Cayley-Hamilton theorem (without proof), Verification of Cayley-Hamilton theorem, Power of a square matrix, Spectral matrix, Diagonalization of a matrix.

PRACTICES:

- Determine the Rank of a matrix using the definition.
- Determine the rank of a matrix using Echelon form and Normal form.
- To find the solution of system of linear equations using Cramer's rule and Gauss Elimination method.
- To find the solution of system of linear equations (Homogeneous and Non-homogeneous) using Gauss-Jordan method.
- Determine the Eigen values and Eigen vectors of a square matrix which are either diagonal matrix or triangular matrix.
- Verification of Cayley-Hamilton theorem for square matrices.
- Examine the given square matrix is diagonalizable or not.
- Using Cayley-Hamilton theorem find the powers of a matrix.

SKILLS:

- ✓ *To discuss the solution of system of linear equations using other methods.*
- ✓ *Find Eigen Values and Eigen Vectors.*
- ✓ *Apply transformation to real world problems involving linear transformations.*
- ✓ *Analyze Quadratic forms and its applications.*

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

VECTOR SPACES:

Vector Spaces, Bases and Dimension: Vector space, Subspace, Linear independence and dependence of vectors, Bases and Dimension.

Linear Transformation: Linear transformations, Representation of linear transformations by matrices, Null space, Rank-nullity theorem.

UNIT-2 **12L+8T+0P=20 Hours**

INNER PRODUCT SPACES:

Inner Product Space: Inner product spaces, Cauchy-Schwarz's inequality, Orthogonal basis, Gram-Schmidt orthogonalization process.

Quadratic Forms: Introduction to Quadratic forms, Reduction of Quadratic form to symmetric matrix form and vice-versa, Positive, negative and semi definite matrices.

PRACTICES:

- Verify the given set of vectors is linearly dependent or not.
- Verify the given set of vectors is a basis or not.
- Examine the given transformation is a linear transformation or not.
- Verify Rank-Nullity theorem for given set problems.
- To discuss the applications of Orthogonal vectors and linearly independent.
- Find the Orthonormal basis to the given set of vectors using Gram-Schmidt Orthogonalization process.
- Discuss the Quadratic forms.
- Determine the nature of the Quadratic form.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of matrices and the methods to solve the system of equations.	Apply	1	1, 2, 4, 9, 10, 12
2	Apply the concepts of vector spaces, subspaces, bases, dimension.	Apply	2	1, 2, 4, 9, 10, 12
3	Evaluate inverse and power of a matrix by Caley Hamilton theorem.	Evaluate	1	1, 2, 4, 9, 10, 12
4	Determine orthogonality in inner product spaces.	Evaluate	2	1, 2, 4, 9, 10, 12

TEXT BOOKS:

1. Gilbert Strang, "Linear Algebra", 5th edition, Wellesley-Cambridge Press, 2016
2. V. Krishnamurthy, V. P. Mainra ,J.l. Arora, "An introduction to linear algebra", Chaukhamba Auriyantaliya, 2018.

REFERENCE BOOKS:

1. N. P. Bali, K. L. Sai Prasad, "A Textbook of Engineering Mathematics I, II, III", Universal Science Press, New Delhi, 2018, 2nd Edition.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44 Edition, 2018.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, Inc, 2015.
4. H. K. Dass and Er. Rajanish Verma, "Higher Engineering Mathematics", S. Chand and Co., Third revised edition, 2015.

22PY104 PHYSICS FOR ELECTRONIC ENGINEERS

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of bonding in solids, electrostatics and magnetostatics.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of this course is to have insight into crystal Physics, principles of quantum mechanics and electron dynamics of solids from the perspective of optoelectronic devices. This provides seamless consolidation of electromagnetics towards establishment Maxwell's equations and their applications.

MODULE-1

UNIT-1 **8L+0T+8P = 16 Hours**

INTRODUCTION TO CRYSTAL PHYSICS:

Lattice points and Space lattice; Basis and crystal structure; Unit Cell – Primitive cell and Lattice parameters; Crystal Systems and Bravais lattices; Packing factor for SC, BCC, and FCC; Miller Indices – Distance of separation between successive (hkl) planes; X- ray diffraction – Bragg's law- Powder Crystal Method; Classification of defects – Point defects.

UNIT-2 **8L+0T+ 8P = 16 Hours**

QUANTUM THEORY OF SOILDS AND FREE ELECTRON THEORY OF METALS:

Introduction to Quantum mechanics; Concepts of wave and particle duality of radiation; de Broglie's concepts of matter waves- Schrödinger's time-independent wave equation- Particle confined in a one-dimensional infinite Potential square well; Classical and Quantum free electron theory of metals Fermi- Dirac distribution; Density of states – derivation -Bloch's Theorem (Qualitative); Classification of solids based on energy bands.

PRACTICES:

- Laser - Determination of wavelength.
- Determination of Planck's constant.
- Melde's Experiment - determination of the frequency of tuning fork.
- Determination of Energy Band gap of p-n junction diode.

MODULE-2

UNIT-1 **8L+0T+ 8P = 16 Hours**

ELECTROMAGNETICS:

Electrostatics: Computation of electric field and potential due to Point charge, linear charge density, surface charge density, bulk charge density. Coulomb's law, Electric field due to line of charges. Gauss law, Differential Form of Gauss law, Applications. Electric field due to a charged sphere – inside, on the surface, and outside. Electric field due to a spherical shell- inside and outside.

Magnetostatics: Introduction to magnetic force – Lorentz force, Biot-Savart's law, Magnetic field due to a linear conductor – magnetic field due to a circular loop – Ampere's law, Faraday's law in integral form; Lenz's law, Maxwell's equations – correction to Ampere's law.

SKILLS:

- ✓ *To distinguish various crystals and the orientation of crystal planes*
- ✓ *To apply the principles of quantum mechanics to understand electron dynamics of solids*
- ✓ *To interpret the knowledge of electric and magnetic fields in view of electronic devices*
- ✓ *To appraise the utilization of optoelectronic devices*

UNIT-2 **8L+0T+ 8P = 16 Hours**

OPTOELECTRONICS:

Introduction to optoelectronics; Photovoltaic effect – construction and working of solar cell – Electroluminescence -construction and working of Light emitting diode – Stimulated emission - construction and working of diode laser, Photodiodes – classification of Photodiodes PIN-Avalanche types and applications.

PRACTICES:

- Hall Effect - Determination of Hall coefficient.
- Stewart & Gee's Experiment- Study of magnetic field along the axis of a current carrying coil.
- Solar cell – Determination of Fill factor & efficiency.
- LED - Study of V-I characteristics.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of crystal geometry to distinguish solids	Apply	1	1, 2, 3, 12
2	Interpret the electromagnetic laws to demonstrate the functioning of electric and electronic devices	Apply	2	1, 3, 4, 5, 12
3	Analyse the performance of optoelectronic devices based on their construction	Analyse	2	1, 2, 3, 4, 10, 12
4	Evaluate electron dynamics based on quantum principles	Evaluate	1	1, 2, 3, 10, 12

TEXT BOOKS:

1. S.O. Pillai, "Solid State Physics", New age International publishers, 8th edition, 2018.
2. H.P. Myers, "Introduction to Solid State Physics", Taylor & Francis, 2009.

REFERENCEBOOKS:

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", 6th edition, John Wiley and Sons, New York, 2001.
2. Charles Kittel, "Introduction to solid state physics", 7th edition, Wiley, Delhi, 2007.
3. Donald A. Neamen, "Semiconductor Physics and Devices: Basic principle", 4th edition, McGraw-Hill, New York, 2012.
4. David J. Griffiths, "Introduction to Electrodynamics", 3rd edition, Prentice Hall of India, New Delhi, 2012.
5. N.W. Ashcroft and N.D. Mermin, "Solid State Physics", International student edition, Brooks Cole, 2018.

22EE101 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Source : https://vita.vision.org.in/emerging-technologies-in-electrical-engineering/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Electrostatics and Electromagnetism.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an insight into the functioning of basic electrical components like resistor, inductor and capacitor. It deals with the constructional and operational details of AC machines. It also deals with the basic electronic components like P-N junction diode, Zener diode, Transistor and their characteristics.

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

FUNDAMENTALS OF ELECTRIC CIRCUITS:

DC Circuits: Concept of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Ohm's Law, Kirchhoff's Laws, Application to simple series, Parallel circuits, Mesh and nodal analysis of resistive circuits with DC source.

AC circuits: Generation of AC voltage, Frequency, Average value, R.M.S. value, Form factor, Peak factor for sinusoidal only.

UNIT-2 **8L+0T+8P=16 Hours**

SEMICONDUCTOR DEVICES:

Classification of semiconductors, P-N junction diode -operation and its characteristics, Half wave rectifier - operation, efficiency; Full wave rectifiers -types, operation, efficiency; Zener diode and its characteristics, Zener diode as Voltage regulator.

Bi polar junction transistor- operation, types (NPN & PNP).

PRACTICES:

- Verification of Ohm's law.
- Verification of Kirchhoff's current law.
- Verification of Kirchhoff's voltage law.
- Determination of R.M.S. Values of sinusoidal waveform.
- Verification of PN junction diode characteristics under both forward and reverse bias.
- Verification of Zener diode characteristics under reverse bias.

MODULE–2

UNIT-1 **8L+0T+8P=16 Hours**

ANALYSIS OF AC CIRCUITS:

Analysis of single- phase ac circuits consisting of R, L, C, RL, RC (series and parallel) (simple numerical problems). Introduction to three phase system, Relation between phase and line quantities of voltages and currents in star and delta connected systems (Elementary treatment only).

SKILLS:

- ✓ *Distinguish between linear and nonlinear elements by looking at VI characteristics.*
- ✓ *Develop a simple loop generator.*
- ✓ *Design a voltage regulator using Zener diode.*
- ✓ *Design a half wave rectifier using PN junction diode.*
- ✓ *Design a full wave rectifier using PN junction diodes.*

UNIT-2 **8L+0T+8P=16 Hours**

AC MACHINES:

Electromagnetism: Concepts of Magneto motive force, Reluctance, Flux and flux density, Concept of self-inductance and mutual inductance, Coefficient of coupling.

Static & Rotating AC Machine: Principle of operation of single phase transformer, Constructional features, EMF equation (simple numerical problems).

Rotating AC Machine Principle of operation of three phase induction motor, Slip ring and squirrel cage motors, Torque equation; Constructional details of synchronous machine.

PRACTICES:

- Transformation ratio of a single phase transformer at different loads.
- Measurement of Energy in single phase resistive load circuit.
- Measurement of Power in single phase resistive load circuit
- Determination of impedance in complex AC circuits.
- Verification of line and phase quantities in a balanced three phase system.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Solve the AC (single and three phase) and DC circuits using different methods.	Apply	1,2	1,2,9,12
2	Apply the concepts of electromagnetism for its applications.	Apply	2	1,2,3,9,12
3	Analyze the resistive circuits with independent sources and find its solution.	Analyze	1,2	1,2,6,9
4	Examine the different electrical equipment.	Evaluate	2	1,2,9,12
5	Acquire the knowledge of semiconductor devices to create circuits.	Create	1	1,2,3,9,12

TEXT BOOKS:

1. V. K. Mehta, “Principles of Electrical Engineering and Electronics”, S.Chand& Co., Publications, New Delhi, 2019.
2. D.P. Kothari, “Basic Electrical and Electronics Engineering”, TMH, New Delhi, 2017.

REFERENCE BOOKS:

1. Millman and Halkias, “Electronic Devices and Circuits”, Mc Graw Hill, 2006.
2. A.K. Thereja and B.L.Thereja, “Electrical Technology”, Vol.–II, S. Chand & Co., Publications, 2020.
3. U. Bakshi and A. Bakshi, “Basic Electrical Engineering”, 1st edition, Technical Publications, Pune, Nov 2020.

22CS103 IT WORKSHOP AND TOOLS

SOURCE : https://bright-industry.com/electrical-engineering

Hours Per Week :

L	T	P	C
0	2	4	3

PREREQUISITE KNOWLEDGE: Basics of Computer knowledge, Applications of Computers.

COURSE DESCRIPTION AND OBJECTIVES:

This course enables the students to learn various components of a computer system, assembly and dis-assembly of various components, troubleshooting, installation of OS and other applications. Also practicing of the usage of software tools such as word, excel, ppt and LaTex, text and image editors.

MODULE - 1

PRACTICES:

- Demo of various physical components of a computer system.
- Integration of various components of a computer system and dismantling.
- Installation of OS in a computer system through various storage devices.
- Installation of OS in a computer system through cloning.
- Detection of faulty components such as hard disk, RAM, SMPS, network interface in a computer system.
- Demonstration of program execution environment
- Demo of Windows/Linux file system.
- Demo of location OS files in the file system (Windows/Linux).
- Configuration of network interface in a computer system and troubleshooting of network connectivity issues.
- Demo of shell scripts for maintenance and administration of a computer system
- Usage of editor tools
- Installation of software tools such as C compiler / interpreter, Java IDE, Python IDLE, Pycharm etc.
- Installation of antivirus software, web browsers and application of servers such as Apache server etc.

MODULE - 2

PRACTICES:

- Prepare your resume using MS-word
- Design a “Birthday Invitation” card.
- Design a Timetable given to you at the beginning of the semester without grid lines.
- Using Draw Table feature, insert a 7-column, 6-row table to create a calendar for the current month.
- Enter the names of the days of the week in the first row of the table.
- Centre the day names horizontally and vertically.
- Change the font and font size as desired.
- Insert a row at the top of the table.
- Merge the cells in the row and enter the current month and year using a large font size.
- Shade the row.
- Enter and right-align the dates for the month in the appropriate cells of the table.
- Change the outside border to a more decorative border. Identify two important dates inthe calendar and shade them.

SKILLS:

- ✓ *Integration of various components of a computer system.*
- ✓ *Trouble shooting of components of a computer system.*
- ✓ *Installation of OS and its various tools/ applications.*
- ✓ *Usage of IT tools such as MS-Word, LaTex etc.*
- ✓ *Creating the documents using MS-Word and LaTex.*
- ✓ *Analysing and visualizing data with excel.*
- ✓ *Developing various power point presentations.*

- Prepare mark sheet using MS-Excel.
- Create a pivot table to analyse your worksheet data.
- Prepare a presentation on your university using MS-PowerPoint.
- Design a Magazine cover. Use the following:
  - (1) Select a theme for the page,
  - (2) Insert either a picture or clipart, and
  - (3) Use WordArt.
- Design a poster inviting all students of your university to the Computer Festival.
- Installation and demonstration of LaTeX.
- Prepare professional pdf documents using LaTeX.
- Prepare LaTex document containing mathematical equations

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Ability to assemble and disassemble the computer system components and trouble shooting.	Apply	1	1
2	Installing Operating Systems and understanding the system booting process.	Under-stand	1	1
3	Ability to develop system maintenance using shell scripts.	Apply	1	1
4	Create word documents, presentations and spread sheets by applying various tools.	Create	2	2,5

TEXT BOOKS:

1. Fundamentals of Computers by Reema Thareja, Oxford University Press 2nd edition 2019, India
2. Stefan Kottwitz, “LaTeX Beginner’s Guide: Create visually appealing texts, articles, and books for business and science using LaTeX”, 2nd Edition, Kindle, 2021.

REFERENCES:

1. 1. Priti Sinha and Pradeep K. Sinha, “Computer Fundamentals: Concepts, Systems and Applications”, 8th edition, BPB Publications, 2004.
2. John Walkenbach, Herb Tyson, Michael R.Groh and FaitheWempen, “Microsoft Office 2010 Bible”, Wiley.

E-RESOURCES:

1) https://explorersposts.grc.nasa.gov/post631/2006-2007/computer_basics/ComputerPorts.doc

Image source: https://www.facebook.com/TheITWorkshopWA

22TP103 PROGRAMMING IN C

Source: Techgig.com

Hours Per Week :

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Fundamentals of Problem Solving.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on basic concepts of C programming language and problem solving through programming. It covers basic structure of C program, data types, operators, decision making statements, loops, functions, strings, pointers, and also file manipulations. At the end of this course, students will be able to design, implement, test and debug complex problems using features of C.

MODULE- 1

UNIT-1 **8L+0T+16P=24 Hours**

INTRODUCTION TO ALGORITHMS AND PROGRAMMING LANGUAGES:

Introduction to Algorithms: Basics of algorithms; Flow charts; Generations of programming languages. Introduction to C: Structure of a C program - pre-processor statement, inline comments, variable declaration statements, executable statements; C Tokens - C character set, identifiers and keywords, type qualifiers, type modifiers, variables, constants, punctuations and operators.

Data Types and Operators: Basic data types; Storage classes; Scope of a variable; Formatted I/O; Reading and writing characters; Operators - assignment, arithmetic, relational, logical, bitwise, ternary, address, indirection, sizeof, dot, arrow, parentheses operators; Expressions - operator precedence, associative rules.

Control Statements: Introduction to category of control statements; Conditional branching statements - if, if– else, nested-if, if – else ladder, switch case; Iterative statements - for, while, do - while, nested loops; Jump statements - break, jump, goto and continue.

UNIT-2 **8L+0T+16P=24 Hours**

ARRAYS & STRINGS:

Arrays: Introduction; Types of arrays; Single dimensional array - declaration, initialization, usage, reading, writing, accessing, memory representation, operations; Multidimensional arrays.

Strings: Character array, Reading string from the standard input device, Displaying strings on the standard output device, Importance of terminating a string, Standard string library functions.

PRACTICES:

Questions on Data Handling – Level 1:

- Write a program to accept a character as input from the user and print it.
- Write a program to accept a number as input from the user and print it.
- Write a program to accept a float value from the user and print it.
- Write a program to accept a message as input from the user and print it.
- Write a program to accept a message from the user as input and print it in 3 different lines.
- Write a program to accept 2 numbers from the user as input and print their sum.
- Write a program to accept 2 numbers from the user as input and print their product.
- Write a program to accept a number as input from the user which denotes the temperature in Celsius, convert it to Fahrenheit reading and print it.

SKILLS:

- ✓ *Analysis of the problem to be solved.*
- ✓ *Select static or dynamic data structures for a given problem and manipulation of data items.*
- ✓ *Application of various file operations effectively in solving real world problems.*
- ✓ *Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

- Write a program to accept a number as input from the user which denotes the radius and print the area of the circle.
- Write a program to accept a character as input from the user and print it's corresponding ASCII value.

Questions on Control Statements - Looping – Level 1:

- Write a C program to print all the characters from a to z once.
- Write a C program to print all the characters from Z to A once.
- Write a C program to print all the characters from A to Z 3 times.
- Write a C program to print the first N natural numbers, where N is given as input by the user.
- Write a C program to print the first N natural numbers and their sum, where N is given as input by the user.
- Write a C program to print all the odd numbers between 1 and N where N is given as input by the user.
- Write a C program to print all the even numbers between I and N where N is given as input by the user.
- Write a C program to print the squares of the first N natural numbers between 1 and N, where N is given as input by the user.
- Write a C program to print the cubes of the first N natural numbers between 1 and N, where N is given as input by the user.
- Write a C program to print the squares of every 5th number starting from 1 to N, where N is given as input by the user.

Questions on Control Statements – Decision Making – Level 1:

- Write a program to accept two numbers as input check if they are equal.
- Write a program to accept two characters as input and check if they are equal.
- Write a program to accept two numbers as input and print the greater of the 2 numbers.
- Write a program to accept two numbers as input and print the lesser of the 2 numbers.
- Write a program to accept 3 numbers as input and print the maximum of the 3.
- Write a program to accept 3 numbers as input and print the minimum of the 3.
- Write a program to accept a number as input and print EVEN if it is an even number and ODD if it is an odd number.
- Write a program to accept a number as input and check if it is divisible by 3. If it is divisible by 3 print YES else print NO.
- Write a program to accept a number as input and check if it is divisible by both 3 & 5. If it is divisible print YES else print NO.
- Write a program to accept a number as input and check if it is positive, negative or zero.

Questions on Patterns – Level 1:

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

  *****

  *****

  *****

  *****

  *****

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

  *****

  * *

  * *

  * *

  *****

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
*
**
***
****
*****
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
    *
   **
  ***
 ****
*****
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
1
12
123
1234
12345
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
1
22
333
4444
55555
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
54321
4321
321
21
1
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
12345
2345
345
45
5
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
A
AB
ABC
ABCD
ABCDE
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

  A

  BC

  DEF

  GHIJ

  KLMNO

Questions on Number Crunching – Level 1:

- Write a program to accept a number as input and print the number of digits in the number.
- Write a program to accept a number as input print the sum of its digits.
- Write a program to accept a number as input, reverse the number and print it.
- Write a program to accept a number and digit as input and find the number of occurrences of the digit in the number.
- Write a program to accept a number as input and check if it is an Armstrong number.
- Write a program to accept a number as input and check if it is an Adam number.
- Write a program to accept a number as input and check if is a prime number.
- Write a program to accept 2 numbers as input and check if they are amicable or not.
- Write a program to accept a number as input and check if it is a power of 2.
- Write a program to accept 2 numbers as input and find their LCM.

Questions on Arrays – Level 1:

- Print the contents of an array from the left to the right.
- Print the contents of an array from the right to the left.
- Find the sum of the elements of an array.
- Find the maximum element in an unsorted array.
- Find the minimum element in an unsorted array.
- Find the average of the elements in an unsorted array.
- Count the number of 0s and 1s in an array having 0s and 1s in random order.
- Count the number of elements in an array whose elements are lesser than a key element in an unsorted array.
- Print all the elements in an array whose values are lesser than a key element in an unsorted array.
- Find the repeated elements in a sorted array.

Questions Number crunching – Level 2:

- Write a program to accept a number as input and print the product of its digits.
- Write a program to accept a number as input and check if it is a palindrome.
- Write a program to accept a number as input and print the frequency of occurrence of each digit.
- Write a program to accept a number as input and print its factors.
- Write a program to accept a number as input and print its prime factors.
- Write a program to accept a number as input and check if it is a perfect square of not.
- Write a program to accept 2 numbers as input and check if they are betrothed numbers or not.
- Write a program to accept 2 numbers as input and print their HCF.
- Write a program to accept a number as input and check if is a strong number.
- Write a program to generate prime numbers between two intervals given as input.

Questions on Arrays – Level 2:

- Find the sum of the maximum and minimum numbers of an unsorted array.
- Replace every element in an array with the sum of its every other element.
- Replace every element in an array with the sum of its right side elements.
- Replace every element in an array with the sum of its left side elements.
- Reverse the elements of an array (in place replacement).
- Reverse the first half of an array.

- Reverse the second half of an array.
- Write a program to find the second largest element in an unsorted array.
- Write a program to find the second smallest element in an unsorted array.
- Write a program to print the number of odd and even numbers in an unsorted array.

Questions on Strings – Level 1:

- Write a program to accept a string as input and print it.
- Write a program to accept a string as input and count the number of vowels in it.
- Write a program to accept a string as input and count the number of consonants in it.
- Write a program to accept a string as input and print its length.
- Write a program to accept a string as input and print the reversed string.
- Write a program to accept 2 strings as input and check if they are the same.
- Write a program to accept a string as input and copy the contents into a second string and print the second string.
- Write a program to accept 2 strings as input and concatenate them into a third string and print the third string.
- Write a program to accept a string as input and check if it is a palindrome.
- Write a program to accept two strings as input and check if the second string is a substring of the first.

Questions on Strings – Level 2:

- Implement the string length function.
- Implement the string copy function.
- Implement the string concatenate function.
- Implement the string compare function.
- Implement the vowel count function.
- Implement the consonant count function.
- Implement the count words function.
- Implement the string reverse function.
- Implement the strstr function.
- Complete the code snippet to implement the is Palindrome function that checks if a given string is a palindrome. You will need to use the 3 functions string Copy, str Reverse and string Compare functions provided to accomplish this.

MODULE-2

UNIT-1 **8L+0T+16P=24 Hours**

FUNCTIONS & POINTERS:

User-defined functions: Function declaration - definition, header of a function, body of a function, function invocation; Call by value; Call by address; Passing arrays to functions; Command line arguments; Recursion; Library Functions.

Pointers: Declaration, Initialization, Multiple indirection, Pointer arithmetic, Relationship between arrays and pointers, Scaling up - array of arrays, array of pointers, pointer to a pointer and pointer to an array; Dynamic memory allocation functions.

UNIT- 2 **8L+0T+16P=24 Hours**

STRUCTURES, UNIONS & FILES:

Structures: Defining a structure, Declaring structure variable, Operations on structures, Pointers to structure - declaring pointer to a structure, accessing structure members using pointer; Array of structures, Nested structures, Passing structures to functions - passing each member of a structure as a separate argument, passing structure variable by value, passing structure variable by reference/ address; Typedef and structures.

Unions: Defining a union - declaring union variable, operations on union; Pointers to union - declaring pointer to a union, accessing union members using pointer; Array of union, Nested union, Typedef and union, Enumerations, Bit-fields.

Files: Introduction to files, Streams, I/O using streams – opening a stream, closing stream; Character input, Character output, File position indicator, End of file and errors, Line input and line output, Formatted I/O, Block input and output, File type, Files and command line arguments.

PRACTICES:

Questions on Strings – Level 3:

- Write a program to swap two given strings and print the swapped strings.
- Write a program to swap two given words of the given sentence and print the altered string.
- Return the maximum occurring character in the string.
- Write a program to print the character in the string with the count where count is the occurrence of the character.
- Write a program to print the duplicate characters in the given string.
- Write a program to remove the duplicate characters in the given string.
- Write a program to remove the vowels from a given string.
- Write a program to rotate a given string N number of times.
- Write a program to check if 2 strings are rotations of each other.
- Write a program to remove the characters from the first string that are present in the second string.

Questions on 2D Arrays – Level 1:

- Print the contents of a 2D array row-wise.
- Print the contents of a 2D array column-wise.
- Print the contents of a 2D array in a zig-zag order.
- Print the contents of a 2D array diagonal-wise.
- Print the contents of a 2D array right-diagonal order.
- Print the contents of a 2D array left-diagonal order.
- Print the contents of a 2D array in the upper triangular order – left top to right bottom.
- Print the contents of a 2D array in the lower triangular order.
- Find and print the maximum element along with its position in a matrix.
- Find and print the minimum element along with its position in a matrix.

Questions on 2D Arrays – Level 2:

- Find and print the maximum element of each row of a matrix.
- Find and print the minimum elements of each row of a matrix.
- Find and print the maximum element of each column of a matrix.
- Find and print the minimum element of each column of a matrix.
- Find the lowest value in the upper triangle area and the largest value in the lower triangular area of a matrix and print their product.
- Find the sum of the elements of each row and each column of a matrix and print the minimum row sum and maximum sum column.
- Write a program to find the row with the maximum number of 1’s in a matrix consisting of only 0’s and 1’s.
- Write a program to print the quotient and remainder on dividing sum of left-top to right-bottom diagonal by sum of right-top to left-bottom diagonal.
- Write a program to print the absolute difference of the sum of major diagonal elements and the sum of minor diagonals of the given matrix.
- Write a program to search a given element in a row-wise and column-wise sorted 2D array.

Questions on 2D Arrays – Level 3:

- Write a program to find the Kth smallest element in the given matrix.
- Write a program to find the Kth largest element in the given matrix.

- Write a program to check whether the given two two-dimensional array of same dimensions are equal or not.
- Write a program to add the given two two-dimensional array of same dimensions.
- Write a program to subtract the given two two-dimensional array of same dimensions.
- Write a program to multiply the given two two-dimensional array of same dimensions.
- Write a program to sort each row of a matrix.
- Write a program to find the sum of the elements in 'Z' sequence of the given 2D array.
- Write a program to print the unique rows of the given two-dimensional array consisting of only 0's and 1's.
- Write a program to print the unique columns of the given two-dimensional array consisting of only 0's and 1's.

Questions on Files, Structures & Unions:

- Write a C program to create a struct, named Student, representing the student's details as follows: first_name, last_name, Age and standard.

  Example

  Read student data

  john

  carmack

  15

  10

  Display the data in the following format

  First Name: john

  Last Name: carmack

  Age: 15

  Standard: 10

- Declare a structure POINT. Input the coordinates of point variable and write a C program to determine the quadrant in which it lies. The following table can be used to determine the quadrant.

Quadrant	X	Y
1	Positive	Positive
2	Negative	Positive
3	Negative	Negative
4	Positive	Negative

  Example

  Input the values for X and Y coordinate: 7 9

  The coordinate point (7,9) lies in the First quadrant.

- Bob and Alice both are friends. Bob asked Alice how to store the information of the books using Structures. Then Alice written a c program to store the information of books using book structure by taking different attributes like book_name, author, book_id, price. Write a C program to read and display the attributes of the books using structures.

  Sample Input:

  Enter number of books: 1

  Enter the book name: c Programming

  Enter the author name: balaguruswamy

  Enter the book ID: 23413

  Enter the book price: 500

  Sample Output:

  The details of the book are:

  The book name is: c Programming

The author name is: balaguruswamy

The book ID is: 23413

The book price is: 500.00

- Ramesh wants to do addition on complex numbers. He did it with regular practice but Charan asked him to do with the help of structures by following below Criteria.

  Write a C program that defines a structure named 'Complex' consisting of two floating point members called "real and imaginary". Let c1 and c2 are two Complex variables; compute the sum of two variables.

  Example:

  c1= 2 8
  c2= 6 4
  Sum= 8.000000+12.000000i

- Customer Payment Details is a structure with members as customers_name, address, account_number, payment_status(paid(1)/ not_paid(0)), due_date, and amount. In this example, payment_date is another structure with month, day and year as integer members. So, every customer record can be considered as an array of structures.

  Write a C program that displays the amount to be paid by each customer along with their names. If payment_status is 1, display NIL for such customers.

  Input Format:

  First line of input contains 'n' number of customers, followed by 8 lines of input for each customer. Each line represents (customers_name, address, account_number, amount payment_status(paid(1)/ not_paid(0)), and due_date).

  Output Format:

  First line of output is Amount to be paid by each customer as on date: followed by n lines of output. Each line contains name of the customer followed by tab space, and amount to be paid.

  Hint: Use nested structure to represent date.

  Write a 'C' program to accept customer details such as: Account_no, Name, Balance using structure. Assume 3 customers in the bank. Write a function to print the account no. and name of each customer whose balance < 100 Rs.

- Write a C program to accept details of 'n' employee(eno, ename, salary) and display the details of employee having highest salary. Use array of structure.
- Write a C program to print the bill details of 'N' number of customers with the following data: meter number, customer name, no of units consumed, bill date, last date to deposit and city. The bill is to be calculated according to the following conditions:

No. of units	**Charges**
For first 100 units	Rs.0.75 per unit
For the next 200 units	Rs.1.80 per unit
For the next 200 units	Rs.2.75 per unit

  Sample Input

  Enter no. of customers

  1

  Enter Meter Number AP01213

  Enter Customer Name: Karthik

  Enter No. of units consumed: 200

  Enter Bill date:22/01/2021

  Enter Last date: 12/2/2021

  Enter City: Guntur

  Sample Output

  Meter Number AP01213

  Customer Name: Karthik

No. of units consumed: 200

Bill date:22/01/2021

Last date: 12/2/2021

City: Guntur

Total Amount: 255.000000

- Write a C program that creates a student file containing {Roll No, Student Name, Address, Stream}, where the data will be inserted and display the list of students who are in CSE (Stream=CSE).

  Input: A file name

  Output: The attributes such as Roll_No, Student_Name, Stream, Address.

  Sample Input

201fa4200	Raja	CSE	Guntur
201fa4201	Bala	IT	Tenali

  Sample Output

201fa4200	Raja	CSE	Guntur

- Write a C program that reads content from an existing text file and write the same in a new file by changing all lowercase alphabetic character to upper case. (Existing file may contain digit and special characters).

  Example:

  Input: Enter the file name.

  Output: New file with updated content.

- Write a C program to count the occurrences of the given string in a file.

  Example:

  Input: Enter the File name to read the string to be counted.

  Output: Display the count of occurrences of the string.

- Write a C Program to transfer the data from one location to another location without changing the order of the content.

  Example:

  Read the file name from the user. If the source file exists, Transfer the data and display the message as “Data is transferred successfully” otherwise display the message “No such file is existing in the directory.”

- Write a C program that reads numbers and write them into a text-file. Also find odd and even numbers in that file and store it in 2 separate files named odd.txt and even.txt. All the values should be in ascending order.

  Input: Enter the values.

  Output: Creates a separate file for Even and Odd numbers.

  Sample Input:

  4 43 2 53 45

  Sample Output:

  Even.txt: 2 4

  Odd.txt: 43 45 53

- Write a C program to replace the content in the given text file.

  Input: Enter the file name, line number to be replaced and the new content

  Output: New file with replaced lines.

  Example:

  Sample Input: Enter the file name: abc.txt

  Enter the line no to replace: 3

  Enter the content: Files stores data presently.

Sample Output:

Line no 3 is replaced with the given content.

The content of the file abc.txt contains:

test line 1

test line 2

Files stores data presently

test line 4

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify suitable data type for operands and design of expressions having right precedence.	Apply	1,2	1
2	Apply decision making and iterative features of C Programming language effectively.	Apply	1,2	1
3	Select problem specific data structures and suitable accessing methods.	Analyze	1,2	1,2
4	Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.	Evaluate	1,2	3,4
5	Design and develop non- recursive and recursive functions and their usage to build large modular programs and also able to design string manipulation functions.	Create	1,2	3

TEXT BOOKS:

1. Behrouz A. Forouzan, Richard F.Gilberg, “Programming for Problem Solving”, 1st edition, Cengage publications, 2019.
2. Ajay Mittal, “Programming in C - A Practical Approach”, 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. Reema Thareja, “Computer Fundamentals and Programming in C”, 1st edition, Oxford University Press, India, 2013.
2. Herbert Schildt, “C: The Complete Reference”, 4th edition, Tata McGraw-Hill, 2017.
3. Byron S Gottfried, “Programming with C”, 4th edition, Tata McGraw-Hill, 2018.

22EN102 ENGLISH PROFICIENCY AND COMMUNICATION SKILLS

Image source: https://www.scribd.com/document/502301821/Cambridge-Complete-B1-Preliminary-for-Schools-Workbook-2020-Edition

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: Basics of grammar, Read and understand for global context, Cultural sensitivity and Basic writing skills.

COURSE DESCRIPTION AND OBJECTIVES:

English Proficiency and Communication Skills seeks to develop the students' abilities in grammar, speaking, reading, writing and overall comprehension skills. The course will provide students an exposure on a wide range of language use in everyday situations. It will make the students to equip with functional English and make them use it confidently in their professional and social contexts. Finally, students will strengthen their reading, writing, listening and speaking skills in English

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

MY LIFE AND HOME – MAKING CHOICES – HAVING FUN:

Reading: Understanding main message, factual information global meaning, specific information and paraphrasing.
Writing: Developing hints based mail, Writing short messages/paragraphs.
Listening: Understanding short monologues or dialogues and choose the correct visual.
Speaking: Express simple opinions /cultural matters in a limited way.
Vocabulary: Discerning use of right word suiting the context, B1 Preliminary word list.
Grammar: Frequency Adverbs, State Verbs, AFV and Prepositions.

UNIT-2 **0L+0T+8P=8 Hours**

ON HOLIDAY - DIFFERENT FEELINGS – THAT'S ENTERTAINMENT!:

Reading: Longer text for detailed comprehension, gist and inference.
Writing: Developing notes and responding to penfriends or 'e-pals'.
Listening: Understand straightforward instructions or public announcements.
Speaking: Describing people, things and places in a photograph.
Vocabulary/Grammar:
Comparatives and Superlatives, Gradable and non-gradable adjectives, Cloze tests.

PRACTICES:

- Developing hints based mail.
- Writing short message.
- Writing paragraphs.
- Expressing opinions and cultural matters.
- Understanding short monologues.
- Understanding straightforward instructions and public announcements.
- Describing people, things and places in a photograph.

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

GETTING AROUND – INFLUENCES - STAY FIT AND HEALTHY:

Reading: Reading for understanding coherence of the text and drawing inferences.
Writing: Reading an announcement from a magazine or website for preparing an article.

SKILLS:

- ✓ *Use of appropriate grammar and vocabulary with syntactic patterns in short texts.*
- ✓ *Read and extract the main message, global meaning, specific information, detailed comprehension, understanding of attitude, opinion and writer purpose and inference.*
- ✓ *Listen to understand key information, specific information, gist and detailed meaning and to interpret meaning.*
- ✓ *Understand questions and make appropriate responses and talk freely on everyday topics.*

Listening: Discussion activities and listening to understand the gist of each short dialogue.

Speaking: Snap Talks, Make and respond to suggestions, discuss alternatives and negotiate agreement.

Vocabulary / Grammar: Punctuation, Prepositions, Phrasal Verbs, B1 Preliminary word list.

UNIT-2 **0L+0T+8P=8 Hours**

LOOKS AMAZING! – THE NATURAL WORLD – EXPRESS YOURSELF!:

Reading: Content, Communicative Achievement, Organisation and Language.

Writing: Developing a story with clear links to the given opening sentence.

Listening: An interview for a detailed understanding of meaning and to identify attitudes and opinions.

Speaking: Discuss likes, dislikes, experiences, opinions, habits, etc.

Vocabulary/Grammar: Modals, Conditionals, Verb forms (Time and Tense).

PRACTICES:

- Listening to understand the gist of each short dialogue.
- Listening to an interview for a detailed understanding of meaning and to identify attitudes and opinions.
- Preparing an article.
- Discuss for alternatives and negotiate agreement.
- Discussion on likes, dislikes, experiences, opinions, habits, etc.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply to read and grasp content on a range of topics/ texts related to their everyday life like notifications, advertisements, travel brochures, news reports, articles.	Apply	1	7, 8, 9, 10, 12
2	Apply suitable strategies to achieve comprehension, like listening for main points and checking comprehension using contextual clues etc.	Apply	1	7, 8, 9, 10, 12
3	Demonstrate vocabulary beyond that of the familiar subjects.	Analyze	1, 2	7, 8, 9, 10, 12
4	Show sufficient control of English grammar and sentence variety to coherently organise information at sentence and discourse levels.	Evaluate	2	7, 8, 9, 10, 12
5	Use functional English to communicate and interact effectively in everyday situations.	Create	2	7, 8, 9, 10, 12

TEXT BOOKS:

1. Emma Heyderman and Peter May, “Complete Preliminary”, Student’s Book with Answers, 2nd edition, Cambridge University Press, 2019.

REFERENCE BOOKS:

1. Annette Capel and Rosemary Nixon, “Introduction to PET”, Oxford University Press, 2009.
2. Adrian Doff and Craig Thaine, “Empower Pre intermediate”, Cambridge University Press, 2015.
3. Louise Hashemi and Barbara Thomas, “Objective PET”, Cambridge University Press, 2010.

22TP101 CONSTITUTION OF INDIA

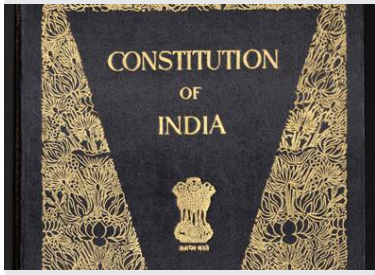


Image: https://commons.wikimedia.org/wiki/File:Constitution_india.jpg

Hours Per Week :

L	T	P	C
0	2	0	1

PREREQUISITE KNOWLEDGE: High School-level Civics and Social Studies.

COURSE DESCRIPTION AND OBJECTIVES:

To provide students with a basic understanding of Indian Polity and Constitution and make students understand the functioning of government at the center and state level besides local self-government. This course also equips students with knowledge pertaining to fundamental rights and fundamental duties of a citizen in a democracy such as India.

MODULE-1

UNIT-1 **0L+8T+0P=8 Hours**

HISTORICAL BACKGROUND TO THE INDIAN CONSTITUTION:

Meaning of the constitution law and constitutionalism; Historical perspective of the Constitution of India; Salient features and characteristics of the Constitution of India.

UNIT-2 **0L+8T+0P=8 Hours**

FUNDAMENTAL RIGHTS, DUTIES, DIRECTIVE PRINCIPLES, AND AMENDMENT:

Scheme of the fundamental rights - scheme of the Fundamental Right to Equality; scheme of the Fundamental Right to certain Freedom under Article 19; scope of the Right to Life and Personal Liberty under Article 21; Scheme of the Fundamental Duties and its legal status; Directive Principles of State Policy – its importance and implementation; Amendment of the Constitution - Powers and Procedure.

PRACTICES:

- Enactment of Constituent Assembly debates to further understand the rationale for the provisions of the constitution.
- Fundamental Rights in our popular culture - discussion in the movie Jai Bhim.

MODULE-2

UNIT-1 **0L+8T+0P=8 Hours**

STRUCTURE AND FORM OF GOVERNMENT:

Federal structure and distribution of legislative and financial powers between the Union and the States; Parliamentary Form of Government in India – The constitution powers and status of the President of India; Emergency Provisions: National Emergency, President Rule, Financial Emergency.

UNIT-2 **0L+8T+0P=8 Hours**

LOCAL SELF GOVERNMENT:

Local Self Government – Constitutional Scheme in India – 73rd and 74th Amendments.

PRACTICES:

- Debate on federalism in India.
- Collect news published in the local papers about panchayats in the nearby areas.

SKILLS:

- ✓ *Understanding the basics of the Indian constitution.*
- ✓ *Know the fundamental rights, fundamental duties, and Directive Principles of State Policy.*
- ✓ *Fair knowledge about the functioning of various institutions in a democracy.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse major articles and provisions of the Indian constitution.	Analyze	1	6
2	Appreciation for the constitution and safeguarding individual rights.	Apply	1	6
3	Evaluating functions of various organs of the State in a democracy.	Evaluate	2	6

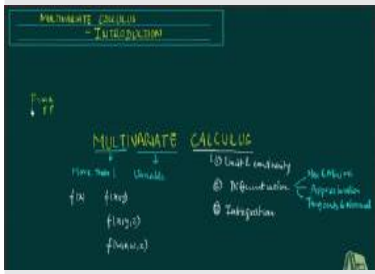
TEXTBOOK:

1. PM Bhakshi, “Constitution of India”, 15th edition, Universal Law Publishing, 2018.

REFERENCE BOOKS:

1. B. R. Ambedkar, “The Constitution of India” Educreation Publishing, India, 2020.
2. Subhash Kashyap, “Our Constitution” 2nd edition, National Book Trust, India, 2011.
3. Arun K. Thiruvengadam, “The Constitution of India: A Contextual Analysis”, Hart Publishing India, 2017.

22MT111 MULTI VARIATE CALCULUS



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Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basic set theory and determinants.

COURSE DESCRIPTION AND OBJECTIVES:

The course covers the fundamental concept of vector and multivariate calculus. The primary focus of the course will be to study the basic concepts of limit, continuity and differentiability. Students will learn some important theorems (Mean value theorem, Taylor's theorem, Green's theorem, Gauss divergence theorem, Stokes' theorem), multiple integrals and convergence of sequence and series which will be helpful to understand the optimization problems, the motion of race cars, the mass of a wire or a spring and various applications arise on science and engineering.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

SEQUENCE, SERIES AND DIFFERENTIABILITY:

Real number system, Sequence, Convergence of a sequence, Monotone sequence Infinite series, Convergence of series, Testing of convergence by ratio test, nth root test, p-test Real functions of one variable, Limits, Continuity, Differentiability Functions of several variables, Partial differentiation.

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS:

Mean value theorems, Bolzano-Weierstrass theorem (without proof), Taylor's theorem, Leibnitz theorem. Maxima and Minima of a function of two variables, Conditions for extreme values, Lagrange method of undetermined multipliers.

PRACTICES:

- Calculate whether the sequence or series is convergent or not.
- Derive the partial differentiation of a function.
- Apply mean value theorem.
- Approximation of function by Taylor's series.
- Find extreme value.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

VECTOR CALCULUS:

Introduction to vectors, Vector algebra (review), Scalar and vector point functions, Gradient, Divergence and Curl.

Introduction to Multiple integrals (review), Line integral, Surface integral, Volume integral

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF VECTOR CALCULUS:

Normal vector, Directional Derivate, Solenoidal and Irrotational vectors, Scalar potential Green's theorem for plane, Gauss divergence theorem, Stokes' theorem.

SKILLS:

- ✓ *Understanding of sequence and series of real numbers.*
- ✓ *Ability to compute the maximum and minimum of a function.*
- ✓ *Approximation of Taylor series of a function.*
- ✓ *Fluency in vector operation and understanding of gradient, divergence and curl.*
- ✓ *Ability to compute multiple integrals and to change variables in multiple integrals.*

PRACTICES:

- Apply Gradient, Divergence and Curl.
- Calculate Line, Surface and Volume integral.
- Find Directional derivative.
- Check whether a vector is Solenoidal or Irrotational.
- Apply Green's theorem, Gauss divergence theorem, Stokes' theorem.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of convergence, continuity and differentiability.	Apply	1	1, 2, 9, 10, 12
2	Apply vector integration to find areas and volumes.	Apply	2	1, 2, 9, 10, 12
3	Evaluate the extreme values	Evaluate	1	1, 2, 9, 10, 12
4	Evaluate the gradient, curl and directional derivatives	Evaluate	2	1, 2, 9, 10, 12

TEXT BOOKS:

1. B. S. Grewal, "Higher Engineering Mathematics", 44 Edition, Khanna Publishers, 2018.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, Inc, 2015.

REFERENCE BOOKS:

1. H. K. Dass and Er. Rajanish Verma, "Higher Engineering Mathematics", Third revised edition, S. Chand and Co., 2015
2. B. V. Ramana, "Engineering Mathematics", TMH Publishers, 2015.
3. N. P. Bali, K. L. Sai Prasad, "A Textbook of Engineering Mathematics I, II, III", Universal Science Press, New Delhi, 2018
4. E. Herman, G. Strang, "Calculus Volume 3", Openstax, 2016.

22EC104 SEMICONDUCTOR PHYSICS AND DEVICES

https://www.elprocus.com/wp-content/uploads/2016/06/2016-06-10_11-36-59.jpg

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Physics

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed at offering fundamental concepts of semiconductor devices and circuits. It starts with the concepts of the Junction Diode, Transistor, MOSFET and other basic devices that are designed with semiconductor materials. As a first-level course in electronics, the objective of this course is to form the basis for the understanding of advanced electronic courses that are offered in subsequent semesters.

UNIT-1 **8L+0T+8P=16 Hours**

SEMICONDUCTOR PHYSICS:

Classifications of semiconductors, drift and diffusion currents, Fermi-level, Energy band diagram, P-N Junction diode, V-I Characteristics, Temperature dependence of V-I characteristics, diode current equation.

UNIT-2 **8L+0T+8P=16 Hours**

SEMICONDUCTOR DEVICES:

Zener diode, Varactor diode, PNPN diode, SCR, Construction, working and characteristics of BJT and MOSFET

PRACTICES:

- P-N Junction diode characteristics.
- Zener diode characteristics and Zener diode as Voltage regulator.
- Verification of UJT Characteristics
- Transistor CB characteristics (Input and Output).
- Transistor CE characteristics (Input and Output).
- Transistor CC characteristics (Input and Output).
- MOSFET characteristics.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

DIODE APPLICATIONS:

Rectifier, clippers, clampers, Zener diode as voltage regulator.

UNIT-2 **8L+0T+8P=16 Hours**

BJT BIASING AND APPLICATIONS:

Transistor biasing and stabilization, small signal analysis, Determination of h-parameters form CE characteristics, BJT as a switch, BJT as amplifier, frequency response of CE amplifier.

PRACTICE:

- Determination of the ripple factor and efficiency of Half wave Rectifier with and without filter.
- Determination of the ripple factor and efficiency of Centre tapped Full wave Rectifier with and without filter.
- Determination of the ripple factor and efficiency of Bridge Rectifier with and without filter.

SKILLS:

- ✓ *Identify a Semiconductor Diode for a specific application.*
- ✓ *Implement a RPS for a specific Application.*
- ✓ *Construct a stable biasing circuit for an amplifier.*
- ✓ *Design an electronic switch.*
- ✓ *Design an amplifier for a specific application.*

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Make use of the basic material concepts to construct the semiconductor devices.	Apply	1,2	1,2,12
2	Apply the usage of semiconductor device concepts in circuit making.	Apply	2	1,2,12
3	Develop electronic circuits using various components.	Apply	1,2	1,2,5,12
4	Analyse the various types of amplifiers.	Analyse	2	1,2,3,5,12

TEXT BOOKS:

1. J. Millman and C.C. Halkias, “Electronic Devices and Circuits”, 4th edition, Tata Mc-Graw Hill, 2015.
2. R.L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuits”, Pearson/Prentice Hall, 4th edition, 2015.

REFERENCE BOOKS:

1. J. Millman and Christos C. Halkias, “Integrated Electronics”, 2nd Edition, Tata Mc-Graw Hill, 2017.
2. K. Thomson, “Electronic Switching Circuits”, 2nd edition, Oxford University Press, 2012.
3. Salivahanan and N Suresh Kumar,” Electronic Devices and Circuits”, 4th edition, Tata McGraw Hill, 2016.

22ME101 ENGINEERING GRAPHICS

Image source: https://depositphotos.com/5087383/stock-photo-the-engineering-drawing.html
Image file name: Engineering Graphics

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Geometry

COURSE DESCRIPTION AND OBJECTIVES:

Engineering graphics is the language of engineers and is the most effective way of communicating and sharing technical ideas in the form of pictures/drawings. The objective of this course is to familiarize the students with the conventional concepts of engineering drawing and computer aided drawing.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

ENGINEERING CURVES:

Types of lines; Lettering, Dimensioning, Geometric constructions - lines, polygons (Angle, ARC, General and Inscribe in circle method), Conical curves (General method), Ellipse by Oblong method.

UNIT-2 **10L+0T+10P=20 Hours**

ORTHOGRAPHIC PROJECTIONS OF POINTS, LINES & PLANES:

Principles of projection; Projections of points; Projection of straight lines - Inclined to one plane, inclined to both planes; Projection of planes - Inclined to one plane.

PRACTICES:

- Construction of polygons using different methods (i.e. ARC, Angle, General).
- Inscribe a regular hexagon & pentagon in a circle of the given diameter.
- Tracing of conical curves (Ellipse, Parabola, Hyperbola) by using General Method.
- Draw the projections of the points situated in all the 4 quadrants.
- Draw the projections of a line when it is inclined to one plane (HP or VP).
- Draw the projections of a line when it is inclined to both the planes (HP &VP).
- Draw the projections of a plane when it is inclined to one plane (HP or VP).

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

PROJECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES:

Projections of Solids: Projection of solids axis inclined to one reference plane - Prisms, pyramids, Cylinder and cone.

Development of Surfaces: Development of lateral surfaces of simple solids - Prisms, Pyramids, Cylinder and cone.

UNIT-2 **10L+0T+10P=20 Hours**

ORTHOGRAPHIC VIEWS AND DRAFTING USING COMPUTER PACKAGE:

Orthographic Views: Conversion of pictorial views into orthographic views.

Drafting Using Computer Package: Introduction to 2D modelling software - AutoCAD; Conversion of Isometric view into Orthographic views of simple castings; Conversion of Orthographic views into Isometric view of simple solids - Prisms, Pyramids, Cylinders and cones.

SKILLS:

- ✓ *Convert iso-metric views of objects into orthographic views and vice versa.*
- ✓ *Visualize the shape of the 3D components.*
- ✓ *Create pictorial views by using AutoCAD.*
- ✓ *Understand projections by visualization.*

PRACTICES:

- Draw the projections of Prisms, when they are inclined to one reference plane (HP or VP).
- Draw the projections of Pyramids, when they are inclined to one reference plane (HP or VP).
- Draw the projections of cylinder & cone, when they are inclined to one reference plane (HP or VP).
- Draw the complete surface development of prisms & pyramids with the given dimensions.
- Draw the complete surface development of cylinder & cone with the given dimensions.
- Draw the orthographic view's (i. e. front view, top view, and side view) of the given pictorial view of the sketches by using AutoCAD.
- Draw the Isometric view of simple solids (Prisms & Pyramids) by using AutoCAD.
- Draw the Isometric view of simple solids (Cylinder & Cone) by using AutoCAD.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Communicate the technical ideas in the form of drawings.	Apply	1	1,2,3,5
2	Apply the drawing skills in representing various geometrical features.	Apply	1	1,2,3,5
3	Develop orthographic projections and isometric views of various objects.	Apply	1	1,2,3,5
4	Estimate the lateral surface area of regular geometrical solids.	Analyze	2	1,2,3,5
5	Sketch simple objects and their pictorial views using AutoCAD.	Analyze	2	1,2,3,5

TEXT BOOKS:

1. J Hole, "Engineering Drawing", 2nd edition, Tata McGraw-Hill, 2019.
2. N D Bhatt, "Engineering Drawing", 53rd edition, Charotar Publication, 2014.

REFERENCE BOOKS:

1. Basant Agrawal and C.M. Agrawal "Engineering Drawing", 2nd edition, Tata Mc Graw- Hill, 2018.
2. K L Narayana, "Engineering drawing", 3rd edition, SciTech Publications, 2011.
3. Colin H. Simmons, Dennis E. Maguire, Manual of Engineering Drawing, 2nd edition, 2003.

22TP104 BASIC CODING COMPETENCY

Source: https://www.geeksforgeeks.org/best-way-to-start-with-competitive-programming-geeksforgeeks-cp-live-course/

Hours Per Week :

L	T	P	C
0	1	3	2

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on advanced concepts of C programming language and problem solving. At the end of this course, students will be able to design, implement, test and debug complex problems using features of C.

MODULE-1

UNIT-1 **0L+4T+12P=16 Hours**

NUMBER CRUNCHING :

PRACTICES:

Problems On Number Crunching

- Write a program to check if a given number is perfect or not.
- Write a program to check if a given number is deficient or not.
- Write a program to check if 2 given numbers are amicable or not.
- Write a program to check if 2 given numbers are betrothed or not.
- Write a program to check whether a given number is an Armstrong number or not.
- Write a program to print the series of prime numbers in the given range.
- Write a program to print all the perfect numbers in a given range.
- Write a program to generate all deficient numbers in a given range.
- Write a program to generate all the amicable numbers in a given range.
- Write a program to generate all the betrothed numbers in a given range.
- Write a program to find the largest prime factor of a given number.
- Write a program to check whether the given number is a palindrome or not.
- Write a program to calculate sum of the individual digits for the given number.
- Write a program to find the first number that has more than ‘n’ factors, excluding 1 and that number.
- Write a program to accept a number as input and print its factorial.
- Write a program to accept a number n, print first N Fibonacci numbers.
- Write a program to check if an input number is Armstrong number or not.
- Write a program that takes input a,b. Print a power b.
- Write a program that takes input a number n, check if it a perfect square or not.
- Print array in spiral format.
- Print sum of each row in a matrix.
- Print sum of each column in matrix.
- Print left->right and right->left diagonals in a matrix.
- Initially you are at (0,0) find the shortest path count to reach the (n, n) block in matrix.
- Remove all the elements present in row and column of unsafe elements. An element is called unsafe if it is equal to smallest or largest value. Count number of remaining elements.
- Write a program to check if the string contains all the letters of alphabet.

SKILLS:

- ✓ *Analysis of the problem to be solved.*
- ✓ *Application of various file operations effectively in solving real world problems.*
- ✓ *Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

- Check if a string is matching password requirements.
- Check if String A contains String B (String searching).
- Check if a number is harshad number or not.
- Write a program to get 3 numbers as input. The first is the number num1 and second is the digit that needs to be replaced. The third is the digit that is to replace the 2nd digit. Print the number after performing this operation.
- Write a program to accept a number and swap its alternate digits. Print the number generated.
- Write a program to accept a number and choice as input. If the choice is 0 rearrange the number such that the odd digits are ordered first followed by the even digits. If the choice is 1 rearrange the number such that the even digits are ordered first followed by the odd digits. Print the rearranged number. The order of occurrence of the digits is to be preserved.
- Write a program to determine that whether the given quadrilateral is cyclic or not. You are given the sizes of angles of a simple quadrilateral (in degrees) A, B, C and D, in some order along its perimeter.

  Note: A quadrilateral is cyclic if and only if the sum of opposite angles is 180^0.
- Chef is a very lazy person. Whatever work is supposed to be finished in x units of time, he finishes it in m*x units of time. But there is always a limit to laziness, so he delays the work by at max d units of time. Given x,m,d, find the maximum time taken by Chef to complete the work.
- Suppose Chef is stuck on an island and currently he has x units of food supply and y units of water supply in total that he could collect from the island. He needs xr units of food supply and yr units of water supply per day at the minimal to have sufficient energy to build a boat from the woods and also to live for another day. Assuming it takes exactly D days to build the boat and reach the shore, tell whether Chef has the sufficient amount of supplies to be able to reach the shore by building the boat? Read five integers x,y,xr,yr,D from the user and display “YES” if Chef can reach the shore by building the boat and “NO” if not (without quotes).
- There are 3 problems in a contest namely A,B,C respectively. Alice bets Bob that problem C is the hardest while Bob says that problem B will be the hardest.

  You are given three integers SA,SB,SC which denotes the number of successful submissions of the problems A,B,C respectively. It is guaranteed that each problem has a different number of submissions. Determine who wins the bet.

  1) If Alice wins the bet (i.e. problem C is the hardest), then output Alice.

  2) If Bob wins the bet (i.e. problem B is the hardest), then output Bob.

  3) If no one wins the bet (i.e. problem A is the hardest), then output Draw.

  Note: The hardest problem is the problem with the least number of successful submissions.

  Input Format

  - The first line of input contains a single integer T denoting the number of test cases. The description of T test cases follows.
  - The first and only line of each test case contains three space-separated integers SA,SB,SC, denoting the number of successful submissions of problems A,B,C respectively.

  Output Format

  For each test case, output the winner of the bet or print Draw in case no one wins the bet.

  Sample Input 1

  3

  1 4 2

  16 8 10

  14 15 9

  Sample Output 1

  Draw

  Bob

  Alice

- In a season, each player has three statistics: runs, wickets, and catches. Given the season stats of two players A and B, denoted by R, W, and C respectively, the person who is better than the other in the most statistics is regarded as the better overall player. Tell who is better amongst A and B. It is known that in each statistic, the players have different values.

  Input

  The first line contains an integer T, the number of test cases. Then the test cases follow.

  Each test case contains two lines of input.

  The first line contains three integers R1, W1, C1, the stats for player A.

  The second line contains three integers R2, W2, C2, the stats for player B.

  Output

  For each test case, output in a single line "A" (without quotes) if player A is better than player B and "B" (without quotes) otherwise.

- Write a program to find the direction.

  Chef is currently facing the north direction. Each second he rotates exactly 90 degrees in clockwise direction. Find the direction in which Chef is facing after exactly X seconds.

  Note: There are only 4 directions: North, East, South, West (in clockwise order). Initially chef is at 0th second i.e., facing North direction.

  Input Format

  - First line will contain T, number of testcases. Then the testcases follow.
  - Each testcase contains of a single integer X.

  Output Format

  For each testcase, output the direction in which Chef is facing after exactly X seconds.

  Sample Input 1

  3

  1

  3

  6

  Sample Output 1

  East

  West

  South

- Chef is playing in a T20 cricket match. In a match, Team A plays for 20 overs. In a single over, the team gets to play 6 times, and in each of these 6 tries, they can score a maximum of 6 runs. After Team A's 20 overs are finished, Team B similarly plays for 20 overs and tries to get a higher total score than the first team. The team with the higher total score at the end wins the match.

  Chef is in Team B. Team A has already played their 20 overs, and have gotten a score of R. Chef's Team B has started playing, and have already scored C runs in the first O overs. In the remaining 20−O overs, find whether it is possible for Chef's Team B to get a score high enough to win the game. That is, can their final score be strictly larger than R?

  Input: There is a single line of input, with three integers, R, O, C.

  Output: Output in a single line, the answer, which should be "YES" if it's possible for Chef's Team B to win the match and "NO" if not.

- Make Array Zeros using pointers

  You are given an array A of length N (size should be created using Dynamic memory allocation) and can perform the following operation on the array:

  Select a subarray from array A having the same value of elements and decrease the value of all the elements in that subarray by any positive integer x.

  Find the least possible number of operations required to make all the elements of array A equal to zero.

The first line contains an integer N denoting the number of elements in the array.

The next line contains space-separated integers denoting the elements of array A.

Print the least possible number of operations required to make all the elements of array A equal to zero.

Sample Test case

Input:

5

2 2 1 3 1

Output:

4

UNIT-2 **0L+4T+12P=16 Hours**

PATTERNS

PRACTICES:

Problems on Number Patterns

- Write a program to generate Floyd triangle. Sample input N= 4.
  1
  2 3
  4 5 6
  7 8 9 10
- Write a program to generate the following pattern. Sample input N=5.
  13579
  3579
  579
  79
  9
- Write a program to generate the following pattern. Sample input N=4.
  1111111
  222222
  33333
  4444
  333
  22
  1
- Write a program to generate the following pattern. Sample input N=5.
  5432*
  543*1
  54*21
  5*321
  *4321
- Write a program to generate the following pattern. Sample input N=5.
  12 21
  123 321
  1234 4321
  123454321

- Write a program to generate the following pattern. Sample input N=5.

  1
  2*2
  3*3*3
  4*4*4*4
  4*4*4*4
  3*3*3
  2*2
  1
- Write a program to generate the following pattern. Sample input N=4.

  1
  212
  32123
  4321234
- Write a program to generate the following pattern. Sample input N=5.

  *
  * *
  * * * *
  * *
  *
- Write a program to print Pascal triangle for the given number of rows. Sample input N=5.

```
                1
            1       1
        1       2       1
    1       3       3       1
1       4       6       4       1
```

- Write a program to generate the following pattern. Sample input N=4.

  1234
  2341
  3421
  4321
- Print Hollow Diamond pattern.
- Print pascals triangle.
- Print Floyds triangle.
- Print Butterfly Pattern.
- Print palindromic pattern.
- Print full inverted number triangle.
- Check if a number is prime or not (Efficient Approach).
- Find sum of all the digits of the number.
- Print transpose of given matrix.
- Rotate a two dimensional matrix by 90, 180, 270 degrees.

MODULE-2

UNIT-1 **0L+4T+12P=16 Hours**

ARRAYS:

PRACTICES:

Problems On Arrays

- Given an unsorted array of size N, and the array elements are in the range of 1 to N. There are no duplicates, and the array is not sorted. One of the integers is missing. Write a program to find the missing number.
- Given an array consisting of only 0s and 1s in random order rearrange the array such that all the 0s are to the left of the array and 1s to the right.
- Give an array consisting of odd and even numbers in random order, rearrange the array such that all the odd numbers are to the left of the array and even numbers are to the right of the array.
- Write a program to find all the unique elements in an array.
- Write a program to merge two arrays of the same size sorted in descending order.
- Write a program to count the frequency of each element in an array of integers.
- Write a program to find the second largest element in an array.
- Write a program to find the second smallest element in an array.
- Write a program to find that one element in array that occurs odd number of times, where every other element appears even number of times.
- Create a jagged array (adjacency list representation of a graph) with no of rows and no of columns in each row as specified by the user.

  Hint: Use Dynamic memory allocation (malloc() or calloc())

  Input:

  Enter no of rows: 3

  Enter no of columns Row in 1: 3

  Enter no of columns Row in 2: 5

  Enter no of columns Row in 3: 2

  Enter the elements row wise:

  8 6 5

  8 4 6 9 7

  9 2

  Output:

  8 6 5

  8 4 6 9 7

  9 2
- Write a program to find second largest number in the array.
- Write a program to find first repeating element in the array.
- Write a program to left rotate the array.
- Write a program to right rotate the array.
- Write a program to find the largest continuous sum.
- Write a program to print the sum of 2nd largest and 2nd smallest elements.
- Write a program to find the maximum product of two numbers multiplies in array (same index should not be used twice).
- Rearrange an array consisting of 1s and 0s such that they are alternatively arranged. Print minimum number of moves required.
- In a given array, find two numbers whose sum equal k.
- Find the difference between positive and negative elements in the array.
- Implement sorting algorithms (Insertion, selection, bubble).

UNIT-2 **0L+4T+12P=16 Hours**

STRINGS:

PRACTICES:

Problems on Strings:

- Write a program to reverse a given string word by word.
- Write a program to find the first occurrence of non-repeating character in the given string.
- Write a program to compress the string as provided in the example.
- Write a program to expand a string as provided in the example.
- Write a program to reverse those words of a string whose length is odd.
- Write a program to check if a given matrix is symmetric or not.
- Write a program to convert all the cases of letter (Lower case -> Upper Case, Upper Case-> Lower Case).
- Write a program to reverse all the words (Not the entire sentence but individual words).
- Find the longest palindrome in a given string.
- Check if two strings are anagrams or not.
- Find minimum number of changes to be done to make a string palindrome.
- Convert Excel sheet name to number (A-1, B-2, Z-26, AA-27).
- Find number of possible palindromes present in a string.
- Write a C program to read a string s, and determine the number of words in s.

  Example : s=oneTwoThree

  There are 3 words in the string: ‘one’, ‘Two’, ‘Three’.
- Write a C program that reads a string S and remove all duplicates characters from the given string S.

  NOTE: 1) Order of characters in output string should be same as given in input string.

  2) String S contains only lowercase characters [‘a’-’z’].

  Example: S = Vignanuniversity

  The program should generate the output as: Vignauersty
- Today Ron is reading the book. Due to some reason, he started hating the word ‘are’ (without quotes). So he decided to replace the substring ‘are’ with ‘R’. Write a C program that reads a line of message ‘s’ and replace the substring ‘are’ with ‘R’. Example: s= Howareyou.

  The program should generate the output as: HowRyou
- Write a program to concatenate the characters of the two given strings alternatively.
- Given a string S consisting of uppercase and lowercase letters, change the case of each alphabet in this string. That is, all the uppercase letters should be converted to lowercase and all the lowercase letters should be converted to uppercase.

  Input: Vignan University

  Output: vIGNAN uNIVERSITY
- Write a program to insert a given character at the beginning and end of the given string.
- Given two Strings A and B. They are said to be friends if ASCII sum of the each individual string is divisible by 4 else they are not friends. You need to find whether given two strings are friends or not.

  Sample Test case:

  Input:

  man nam

  vignan university

  Output:

  YES

  NO

- Write a program to find the frequency of each digit in the given string.

  Input Format

  The first line contains a string, which is the given number.

  Output Format

  Print ten space-separated integers in a single line denoting the frequency of each digit, indicate that the integers are from 0 to 9.

  Sample Input 0

  a11472o5t6

  Sample Output 0

  0 2 1 0 1 1 1 1 0 0

  Explanation 0

  In the given string:

  · 1 occurs two times.
  · 2,4,5,6 and 7 occur one time each.
  · The remaining digits and don't occur at all.

- Sherlock considers a string to be valid if all characters in the given string appear the same number of times. It is also valid if he can remove just 1 character at 1 index in the string, and the remaining characters will occur the same number of times.

  Write a C program that reads a string s and determine whether it is valid or not. If valid, return YES, otherwise return NO.

  Example: S=abc
  This is a valid string because frequencies are {a:1,b:1,c:1}
  S=abcc
  This is a valid string because we can remove one c and have 1 of each character in the remaining string.
  S=abccc
  This string is not valid as we can only remove 1 occurrence of c. That leaves character frequencies of {a:1,b:1,c:2}

- Read a string containing characters A and B only. Your task is to change it into a string such that there are no matching adjacent characters. To do this, you are allowed to delete zero or more characters in the string.

  Write a C program that finds the minimum number of deletions required.

  Example: S=AABAAB

  Remove A at positions 0 and 3 to make S=ABABA in 2 deletions.

  Input Format

  The first line contains an integer (the number of queries).

  The next q lines each contain a string s to analyze.

  Sample Input:

  5

  AAAA

  BBBBB

  ABABABAB

  BABABA

  AAABBB

  Sample Output:

  3
  4
  0
  0
  4

- Write a C program that reads a string 's' and it is said to be complete if it contains all the characters from a to z.
  Input Format
  First line of the input contains the number of strings N. It is followed by N lines each contains a single string.
  Output Format
  For each test case print "YES" if the string is complete, else print "NO"
  Constraints 1 <= N <= 10
  The length of the string is at max 100 & the string contains only the characters a to z.
- Write a C program that reads two strings and determine whether they share a common substring or not. A substring may be as small as one character.
  Example;
  S1=and
  S2=art
  The common substring in these two strings: a.
  Sample Input
  2
  hello
  world
  hi
  world
  Sample Output
  YES
  NO

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Mod-ule No.	Mapping with POs
1	Write simple, but complete, C programs.	Apply	1,2	1
2	Identify suitable data type for operands and design of expressions having right precedence.	Apply	1,2	1
3	Apply decision making and iterative features of C Programming language effectively.	Apply	1,2	1
4	Select problem specific data structures and suitable accessing methods.	Analyze	1,2	1,2
5	Design and develop non- recursive and recursive functions and their usage to build large modular programs and also able to design string manipulation functions.	Create	1,2	3
6	Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.	Create	1,2	3,4

TEXT BOOKS:

1. Behrouz A. Forouzan, Richard F.Gilberg, "Programming for Problem Solving", 1st edition, Cengage publications, 2019.
2. Ajay Mittal, "Programming in C - A Practical Approach", 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. Reema Thareja, "Computer Fundamentals and Programming in C", 1st edition, Oxford University Press, India, 2013.
2. Herbert Schildt, "C: The Complete Reference", 4th edition, Tata McGraw-Hill, 2017.
3. Byron S Gottfried, "Programming with C", 4th edition, Tata McGraw-Hill, 2018.

Image source: https://www.abebooks.com/9781316640081/English-Technical-Communication-Students-Book-1316640086/plp

22EN104 TECHNICAL ENGLISH COMMUNICATION

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basic sentence formation, understanding contextual meanings, basic writing skills and moderate fluency in English.

COURSE DESCRIPTION AND OBJECTIVES:

In this course students will read, analyze, and interpret material from technical and general fields, and practice reading, writing, listening and speaking skills to gain exposure and functional English on a variety of contemporary topics. The overall course objective is to provide English for Specific Purposes(ESP) instruction to enhance students' reading, writing, listening and speaking skills through a practice in the language. It will aim to build students' confidence and motivation through exposure to academic skills like Note making/taking, Paraphrasing, Summarizing, Report Writing, Making Presentations etc., so as to generate interest in the language from an ESP perspective. Finally, students are expected through the course to gain key strategies and expression for communicating with professionals and non-specialists.

MODULE-1

UNIT-1 **8L+0T+8P=16 Hours**

GENETICS:

Reading: Reading for Note Making Sub skills: Reading for global understanding (skimming), specific information (scanning), understanding main ideas and supporting ideas, guessing contextual meanings from the text. -Vocabulary building: commonly used roots, prefixes, and suffixes.

Writing: Note making, organising main points and sub points, numbering and sequencing, suggesting titles, paraphrasing and summarising.

Functional grammar: Common Errors in Articles and Prepositions (Handout).

Listening: Listening for Note Taking: top down and bottom up approach, listening for main ideas and supporting points.

Speaking: Presentation in teams - ideas on the topic summarised, making a PPT, effective introductions and conclusions, logical organisation of content, using appropriate structure and cohesive devices.

UNIT-2 **8L+0T+8P=16 Hours**

ALIENS:

Reading : Predicting, skimming, scanning, reading for inference, extrapolative reading

Vocabulary building: Academic vocabulary from the text: synonyms, antonyms, Words often confused.

Writing : Paragraph writing; writing a topic sentence, supporting sentences, effective introductions and conclusions, use of cohesive devices. Types of Paragraphs: Descriptive, narrative, argumentative and expository.

Functional grammar: Common Errors in Verb forms and Conditional sentences (Handout).

Listening : Listening for identifying parts from a description, listening to and sorting information, listening for specific information.

Speaking : Narrating/Retelling an incident, using suitable cohesive devices/discourse markers Speaking of past and present habits/ activities/events - Speaking of future plans.

PRACTICES:

- Note making.
- Summarizing.
- Paragraph Writing.
- Error correction and Restructuring.
- Vocabulary building.
- Listening comprehension.
- Note taking.

SKILLS:

- ✓ *Apply different sub skills like skimming, scanning, reading for information, reading for inference etc. to understand different kinds of text.*
- ✓ *Apply different sub skills like top down, bottom up approaches to listening.*
- ✓ *Use functional vocabulary relevant to engineering and technology to express ideas lucidly.*
- ✓ *Use appropriate sentence structure, cohesive devices to construct simple text in regular correspondence like e-mails and letters.*

MODULE-2

UNIT - 1 **8L+0T+8P=16 Hours**

SOCIAL MEDIA – HEALTH AND NUTRITION:

Reading : Reading for factual information researching for supporting evidence - skimming, scanning, Vocabulary building: One-word substitutes.

Writing : Letter Writing- E-mail writing – New age communication – Format, protocol, and style- WhatsApp, Facebook and Twitter Functional grammar: Common Errors in Sub-Verb Agreement and Modals.

Listening : Listening to a Business Presentation: Listening for deducing information, for abstract details and specific details, listening for taking a message.

Speaking : Making a presentation with a PPT on a topic assigned- organising the presentation using appropriate discourse markers - presenting a point of view - Extempore.

UNIT-2 **8L+0T+8P=16 Hours**

FASHION:

Reading : Reading for data interpretation and information transfer from graphical aids to text reports (pictograms. tables, graphs, pie charts, flow charts), deducing specific information and general information

Vocabulary building: Business vocabulary, collocations, idioms and phrasal verbs.

Writing: Writing a Report: Drafting general and factual reports - writing an overview - an effective introduction - organising information into paragraphs (Stages of writing: planning /organising /writing / editing /rewriting)

Functional grammar: Transformations and miscellaneous common errors.

Listening : Listening to a Ted talk and sorting information – taking notes from a discussion.

Speaking : Group Discussion – prerequisites -generating content - initiating a discussion - expressing one's opinion ~ leading a discussion - agreeing/ disagreeing to someone's view - cutting into a speech - body language and voice modulation.

PRACTICES:

- E-mail writing.
- Letter writing.
- Report writing.
- Messaging in Social media.
- Extempore.
- Making PPTs.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply a variety of strategies to interpret and comprehend spoken texts/ discourse using contextual clues.	Apply	1	6, 7, 8, 9, 10, 12
2	Apply appropriatereading strategies to interpret content / material related to engineering and technology domain.	Apply	1	6, 7, 8, 9, 10, 12
3	Possess an ability to write clearly on topics related to technology and workplace communication.	Analyze	2	6, 7, 8, 9, 10, 12
4	Choose functional language, grammar structures, cohesive devices and skills of organisation to express clearly in speaking.	Evaluate	2	6, 7, 8, 9, 10, 12
5	Participate in discussions and make short presentations on general and technical topics.	Create	2	6, 7, 8, 9, 10, 12

LANGUAGE LAB ACTIVITIES:

Session - 1: Dictionary Skills

Session - 2: Introduction to Phonetics and Identifying Phonemes

Session - 3: Pronunciation Practice (Commonly mispronounced words)

Session - 4: Rosetta Stone (Exercises on LSRW)

Session - 5: Listening Comprehension (Summarising exercise on a Ted Talk)

Session - 6: Technical Presentations (Individual)

Session - 7: Technical Presentations (Team)

Session - 8: TOEFL Mastery

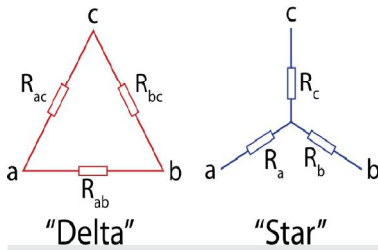
TEXT BOOK:

1. N P Sudharshana & C Savitha, “English For Technical Communication”, Cambridge University Press, 2016.

REFERENCE BOOKS:

1. Balasubramanian T,“A Text book of Phonetics for Indian Students”, Orient Longman, New Delhi, 1989.
2. Krishnaswamy, N and Sriraman, T, “Current English for Colleges”, Trinity publications, 2016.
3. Mohan Krishna and Meera Banerjee, “Developing Communication Skills”, Macmillan India Ltd. New Delhi, 1990.
4. Ashraf Rizvi M, “Effective Technical Communication”, 2nd Edition, McGraw Hill Education, 2017.
5. Narayana Swamy V R, “Strengthen your Writing”, Third Edition Orient Black Swan, New Delhi, 2005.

22EC102 NETWORK THEORY



Source- https://en.m.wikipedia.org/wiki/File:Delta-Star_Transformation.svg

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Knowledge on Algebra, calculus, and vectors.

COURSE DESCRIPTION AND OBJECTIVES:

This is a basic course for electronic engineers and provides foundation for electronic circuit analysis. It helps the students to understand basic passive elements, circuit analysis using different theorems, transient responses of RC, RL and RLC circuits, steady state response of circuits to sinusoidal excitation in time domain, and two-port network analysis.

MODULE–1

UNIT-1 **12L+8T+0P=20 Hours**

INTRODUCTION TO CIRCUIT ELEMENTS:

Source transformation, Voltage and current division, V-I characteristics of passive elements and their series / parallel combination, Energy stored in Inductors and capacitors, Kirchhoff's voltage law and Kirchhoff's current law, Mesh and nodal analysis, Star and delta conversions.

UNIT-2 **12L+8T+0P=20 Hours**

NETWORK THEOREMS:

Superposition, Thevenin's, and Norton's, Maximum power transfer, Reciprocity, Compensation, and Duality-dual networks.

PRACTICES:

- Apply KVL and KCL
- Analyse different networks with dependent and independent sources
- Apply mesh analysis
- Apply nodal analysis
- Superposition Theorem
- Thevenin's theorem
- Norton's theorem
- Maximum power transfer theorem
- Dual networks

MODULE–2

UNIT-1 **12L+8T+0P=20 Hours**

TRANSIENTS AND TWO-PORT NETWORKS:

Network Transient Analysis: Transient response of R-L, R-C, R-L-C circuits (Series and parallel combinations) for D.C excitation.

Two Port Network Parameters: Introduction to Two port networks, Open circuit impedance (Z) and short circuit admittance (Y), Transmission (ABCD), and Hybrid parameters (h), Relation between parameter sets.

SKILLS:

- ✓ *Understand different components and their characteristics.*
- ✓ *Able to analyze/ find responses using theorems.*
- ✓ *The behavior of RL/RC/RLC can be evaluated for different inputs.*
- ✓ *Able to analyze regulated power supply.*

UNIT-2 **12L+8T+0P=20 Hours**

SINUSOIDAL STEADY STATE ANALYSIS AND RESONANCE:

Instantaneous, Peak, Average, RMS values, Crest factor and form factor of periodic waveforms, Response of R, L, C series and parallel combination circuits to sinusoidal excitation, Resonance-Series and parallel resonance circuits, Concept of bandwidth and Q-factor.

PRACTICES:

- Transient response of RC with different inputs
- Transient response of RL with different inputs
- Transient response of RLC with different inputs
- Two port network parameters and inter relation
- Solving different two-port networks using Z,Y and ABCD parameters
- Find the different parameters of different waveforms
- Find the response of the network for sinusoidal excitation
- Series RLC network
- Parallel RLC network

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply Kirchhoff's laws and theorems to linear circuits.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Analyze current and voltage behaviour for the given circuit under transient conditions.	Analyze	2	1, 2, 3, 5, 9, 10
3	Analyze the given network using specified two port network parameter like Z or Y or T or h.	Analyze	2	1, 2, 3, 5, 9, 10
4	Evaluate the steady state analysis of RL, RC and RLC circuits and resonance.	Evaluate	2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. A Sudhakar and Shyammohan S Palli, "Circuits & Networks: Analysis and Synthesis", 5th edition, Tata McGraw-Hill,2015.
2. M.E. Van Valkenburg and TS Rathore "Network analysis", Prentice India Education Services Pvt.Ltd, 3rd edition, 2019.

REFERENCE BOOKS:

1. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", 7th edition,Tata McGraw-Hill,2007.
2. Franklin F.Kuo, "Network Analysis and Synthesis", 2nd Edition, John Wiley and Sons, 2003.
3. A Chakrabarthy, Electric Circuitsǁ, Dhanpat Rai & Sons, 6th Edition, 2010.
4. Mahmood Nahvi and Joseph Edminister, "Electric Circuits", 4th edition, Schaum's Outline series, Tata McGraw-Hill, 2004.

II

YEAR

B.Tech.

ELECTRONICS AND COMMUNICATION ENGINEERING

I SEMESTER

22EC202	-	Probability Theory and Stochastic Processes
22CT201	-	Environmental Studies
22TP201	-	Data Structures
22CS209	-	Printed Circuit Board Design
22EC205	-	Signals and Systems
22EC203	-	Digital Electronics
22EC201	-	Analog Circuits
22SA201	-	Life Skills-I

II SEMESTER

22TP203	-	Advanced Coding Competency
22MS201	-	Management Science
22EC206	-	Communication Systems
22EC208	-	Control Systems
22EC207	-	Computer Architecture and Organization
	-	Department Elective – 1
	-	Open Elective – 1
22SA202	-	Life Skills-II

COURSE CONTENTS

I SEM & II SEM

22EE201 PROBABILITY THEORY AND STOCHASTIC PROCESSES

Source- https://www.dreamstime.com/royalty-free-stock-photo-two-red-glass-dices-image1652105

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Knowledge of calculus.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to enable the students to learn probability theory, random variables, random processes and analysis of random process and applications in the communication systems.

MODULE-1

UNIT-1 **9L+6T+0P=15Hours**

FUNDAMENTALS OF PROBABILITY THEORY:

Statistics: Basics of descriptive Statistics and Simple linear regression

Probability Theory: Introduction to probability, set theory, axioms of probability, sample space, Joint probability, Conditional probability, Total probability and Bayes' theorems, Bernoulli trails and independent events.

UNIT-2 **15L+10T+0P=25 Hours**

SINGLE RANDOM VARIABLE:

Definition of a random variable, Conditions for a function to be a random variable, Classifications of random variables, Density and distribution functions, Properties of random variables, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional distribution, Methods of defining conditioning event, Conditional density and distribution functions, Properties, Operations on Random variables - Introduction, Expected value of a random variable, Function of a random variable, Moments about the origin, Central moments, Variance, Characteristic function, Moment generating function, Monotonic transformations for a continuous and discrete random variables.

PRACTICES:

- Develop a regression model for any general problem.
- Apply total probability theorem.
- Apply Bayes theorem.
- Use probability density and distribution functions to solve a given problem.
- Solving any general probability problem with the help of standard distributions.
- Use the significance of moments to analize a given random variable.
- Transformation of random variables.

MODULE - 2

UNIT-1 **9L+6T+0P=15Hours**

MULTIPLE RANDOM VARIABLES:

Joint distribution function and its properties, Marginal distribution functions, Conditional distribution and density functions, Statistical Independence, Sum of two Random variables, Central limit theorem.

SKILLS:

- ✓ *Able to model linear regression model for any given problem.*
- ✓ *Able to find individual, joint and conditional probabilities for any given problem.*
- ✓ *Able to trans-form any analog/ digital random variable to another random variable.*
- ✓ *Able to compute the moments for any given problem and understand the behavior of the probability distribution.*
- ✓ *Able to find the response of linear system for random input.*

UNIT -2 **15L+10T+0P=25 Hours**

RANDOM PROCESSES:

Temporal characteristics, Random process concept, Classification of processes, Distribution and density functions, Concept of stationary and statistical independence, Wide sense stationary, Time averages and ergodicity, Autocorrelation and cross correlation, Gaussian random process, Poisson random process.

Random signal response of linear systems, System response – Convolution, Mean and Mean square value, Autocorrelation function; Cross-correlation functions of input and output, Spectral characteristics of system response, Power density spectrum, Relation between power spectral density and autocorrelation.

PRACTICES:

- Use joint and marginal probability distribution functions to solve multivariable random variables.
- Check whether given random variables are independent or not
- Check the level of stationarity for the given random process
- Identify the type of ergodicity for the given random process
- Observe the response of linear system for random inputs
- Relate power spectral density and auto correlation functions

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Devise a linear regression model for any general problem to predict the parameters.	Analyze	1	2,9
2	Apply the total probability, Bayes theorems and standard probability distributions to find individual, joint and conditional probabilities of general problems	Apply	1,2	1,9
3	Discover the nature of probability distributions with the help of moments	Apply	1	1,9
4	Categorize the given random process falls into which level of stationarity and which type of ergodic random process	Analyze	2	2
5	Analyze the response of linear time invariant system for random inputs	Analyze	2	2

TEXT BOOKS:

1. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, 4th edition, 2017, TMH.
2. Probability, Random Variables and Stochastic Processes –Athanasios Papoulis and Unnikrishna Pillai, 4th ed., TMH, 2017.

REFERENCE BOOKS:

1. Principles of Communication systems–H.Taub, Donald.L.Schilling, Goutam Saha, 3rd ed., 2007, TMH.
2. Theory of Probability and Stochastic Processes- Pradip Kumar Gosh, University Press, 2010
3. Probability and Random Processes with Application to Signal Processing –Henry Stark and John W.Woods, 3rd ed., Pearson Education, 2001.
4. H. Kobayashi, B. L. Mark, and W. Turin, Probability, Random Processes, and Statistical Analysis, Cambridge, 2012.
5. R. Gallager, Stochastic Processes: Theory for Applications, Cambridge, 2014.

22CT201 ENVIRONMENTAL STUDIES

Image source: Biogas plant at VFSTR

Hours Per Week :

L	T	P	C
1	1	0	1

PREREQUISITE KNOWLEDGE: General awareness regarding environmental problems and importance of environmental protection.

COURSE DESCRIPTION AND OBJECTIVES:

It is a multidisciplinary subject where different aspects of society and environment are dealt using a holistic approach. It is evolving to be the education for sustainable and ethical development both at a local and global level. It helps to prepare the next generation for planning appropriate strategies to address environmental issues. It identifies and creates solutions that conserve to manage ecosystem and biodiversity and helps to eliminate pollutants, toxicants, preserve air, water and soil quality. Environmental education recognizes impacts of global issues, enhances the public awareness and helps to take decisions towards environmentally responsible actions.

MODULE-1

UNIT-1 **4L+4T+0P=8 Hours**

INTRODUCTION TO ENVIRONMENT: NATURAL RESOURCES, ECOSYSTEMS AND BIODIVERSITY:

Environment and sustainable development; Natural resources- forest, water, energy and land resources; Ecosystem – basic structural components, function and interactions in ecosystem, ecological succession.

UNIT-2 **4L+4T+0P=8 Hours**

BIODIVERSITY AND CONSERVATION:

Introduction to biodiversity, types of biodiversity- species, genetic and ecosystem diversity; Threats to biodiversity - natural and anthropogenic, species extinctions, man wildlife conflicts; Biodiversity conservation - principles and strategies; in-situ and ex-situ conservation.

PRACTICES:

- Visit to a Biogas plant, Solar Power plant.
- Visit to a local area: river / pond / lake / forest / grassland / hill / mountain and study of different types of ecosystems, biodiversity study and documentation (herbarium sheet preparation).
- Set up an aquarium.
- Case study: Renewable energy use.

MODULE-2

UNIT-1 **4L+4T+0P=8 Hours**

ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE:

Air, water, soil, radioactive and noise pollution; Study of different pollutants (SOx, NOx, PAN, PAH etc.); Toxicity study; Climate change - greenhouse effect, acid rain, ozone layer depletion.

UNIT-2 **4L+4T+0P=8 Hours**

POLLUTION CONTROL DEVICES AND WASTEWATER TREATMENT TECHNOLOGIES:

Air pollution control devices - Gravitational settling chambers, cyclonic separators, electrostatic precipitators, fabric filters and bio filters, Wastewater management.

SKILLS:

- ✓ *Create a bio-diversity map of any habitat/ ecosystem.*
- ✓ *Strategize different ways of using renewable energy resources.*
- ✓ *Design novel strategies and approaches for pollution control and waste management.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic concepts of sustainable development, natural resource utilization and ecology for the purpose of environmental protection	Apply	1	1,6,7, 9, 10, 11, 12
2	Design remediation technologies for their abatement	Apply	2	1, 3,6,7, 9, 10, 11, 12
3	Analyze the biodiversity of different ecosystems and formulate various conservation approaches	Analyze	1	1, 7, 8, 9, 10, 11, 12
4	Analyze the presence of various environmental pollutants	Analyze	2	1, 6,7,9, 10, 11, 12
5	Recommend various waste management approaches and their implementation strategies	Evaluate	2	1,2, 7,8,9,10,11, 12

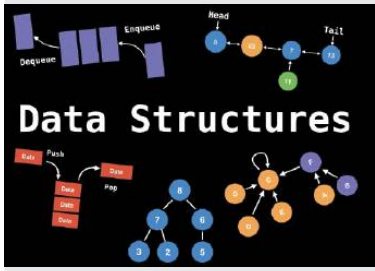
TEXT BOOKS:

1. A. Kaushik and C. P. Kaushik, “Perspectives in Environmental Studies”, New Age International Publishers, 5th Edition, 2016.
2. Y. Anjaneyulu, “Introduction to Environmental Science”, B. S. Publications, 2015.

REFERENCE BOOKS:

1. B. Joseph, “Environmental Studies”, Mc Graw Hill Education, 2nd Edition, 2015.
2. S. Subash Chandra, “Environmental Science”, New Central Book Agency, 2011.
3. M. Basu and S. Xavier, “Fundamentals of Environmental Studies”, Cambridge University Press, 2016.
4. K. Mukkanti, “A Textbook of Environmental Studies”, S. Chand Company Ltd., 2009.
5. M. Anji Reddy, “A Textbook of Environmental Science and Technology”, B. S. Publications, 2008.

22TP201 DATA STRUCTURES



Source: https://www.youtube.com/watch?v=Qmt0QwzEmh0

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION & OBJECTIVES:

This course is aimed at offering fundamentals concepts of data structures and explains how to implement them. It begins with the basic concepts of data, data structures and then introduces the primitive and non-primitive data structures in detail. It forms the basis for understanding various ways of representing data and its usage in different computing applications.

MODULE-1

UNIT-1 **5L+6T+6P = 17 Hours**

DATA STRUCTURES BASICS:

Basic Terminology – data, information, datatype; Data Structures – Introduction, storage structures-sequential and linked storage representations; classification of data structures; Applications of data structures.

Sorting: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort and Merge Sort.

Searching: Linear Search and Binary Search.

UNIT-2 **11L+10T+10P = 31 Hours**

LINKED LISTS AND STACKS, QUEUES:

Linked List: Introduction, Types of linked list – Singly linked list, doubly linked list and circular linked list, representation of linked list, Operations of linked list: Traverse forward/ reverse order, searching, insertion and deletion; Applications of linked lists.

Stack – Introduction, array and linked representations, implementation and their applications; Queue – Introduction, array and linked representations, implementation; Types – Linear, circular and doubly ended queues – operations; Applications of Queues.

PRACTICES:

Problems on Recursion – Level 1

- Find the product of 2 numbers using recursion.
- Find the sum of natural numbers using recursion.
- Find the factorial of a number using recursion.
- Find the Nth term of Fibonacci series using recursion.
- Calculate the power using recursion.
- Write a recursive program for checking if a given number is a prime number.
- Given two integers write a function to sum the numbers without using any arithmetic operators.
- Convert a decimal to binary using recursion.
- Print all factors using recursion.
- Find the maximum product of digits among numbers less than or equal to N.

SKILLS:

- ✓ *Experienced to Store data and various types of data to handle.*
- ✓ *Ordering and sorting of data.*
- ✓ *Indexing and Searching of required data from large data sequences.*
- ✓ *Exposed to various characteristics such as Linear or non-linear, Homogeneous or heterogeneous and Static and Dynamic.*

Problems Recursion – Level 2

- Implement insertion sort recursively.
- Write a program to find the numbers less than N that are product of exactly 2 distinct prime numbers - using recursion.
- Implement selection sort recursively.
- Find the middle of a singly linked list using recursion.
- Find the sum of even numbers of an array using recursion.
- Check if a given array is in sorted order using recursion.
- Print alternate nodes of a linked list using recursion.
- Reverse a doubly linked list using recursion.
- Write a recursive function that returns all permutations of a given list.
- Implement bubble sort recursively.

Problems on Sorting and Searching – Level 1

- Implement the insertion sort function.
- Implement the bubble sort function.
- Implement the quick sort function.
- Implement the merge sort function.
- Implement the selection sort function.
- Implement linear search function.
- Implement binary search function.

Problems on SLL – Level 1

- Implement the insert function to insert nodes into a singly linked list (ascending order).
- Implement the insert function to insert nodes into a singly linked list (descending order).
- Implement the search node function.
- Implement the delete node function.
- Display forwards function.
- Display backwards function.
- Count the number of nodes in a singly linked list.
- Swap alternate nodes of a singly linked list.
- Move last node to the front of the linked list.
- Move first node to the last of the linked list.

Problems on Stacks – Level 1

- Implement two stacks using a single array.
- Given an array replace every element with nearest greater element on the right.
- Given a stack reverse the elements using only push and pop functions.
- Postfix evaluation using stack.
- Balance symbols.
- Find middle element in a stack.
- Remove middle element from a stack.
- Implement push and pop using linked list.
- Given an array of characters with the middle marked by X, check if the string is a palindrome.
- Maximum sum in sliding window.

Problems on Queues – Level 1

- Write a program to accept two numbers as input check if they are equal.
- Write a program to accept two characters as input and check if they are equal.
- Write a program to accept two numbers as input and print the greater of the 2 numbers.
- Write a program to accept two numbers as input and print the lesser of the 2 numbers.
- Write a program to accept 3 numbers as input and print the maximum of the 3.
- Write a program to accept 3 numbers as input and print the minimum of the 3.
- Write a program to accept a number as input and print EVEN if it is an even number and ODD if it is an odd number.
- Write a program to accept a number as input and check if it is divisible by 3. If it is divisible by 3 print YES else print NO.
- Write a program to accept a number as input and check if it is divisible by both 3 & 5. If it is divisible print YES else print NO.
- Write a program to accept a number as input and check if it is positive, negative or zero.

Problems on DLL – Level 1

- Implement insert function.
- Implement display forward function.
- Implement display backward function.
- Implement search function.
- Implement delete function.
- Reverse a doubly linked list from M to N.
- Find the sum of the odd and even nodes.
- Count odd keys of the linked list.
- Merge two sorted lists.
- Delete adjacent duplicate nodes.

Problems on CLL – Level 1

- Insert function (circular doubly linked list).
- Search function.
- Display forward.
- Display backward.
- Delete node (circular doubly linked list).
- Print the middle N nodes of a circular singly linked list.
- Move the last node of a circular singly linked list to the beginning.
- Delete adjacent duplicate nodes of a circular singly linked list.
- Delete nodes greater than a value from a circular doubly linked list.
- Find the sum of the nodes of a circular linked list.

Problems on Linked List – Level 2

- Given 2 sorted linked lists, print the common elements.
- Reverse a list (using Stack).
- Given a pointer to a node (not the last node), delete the node.
- Reverse a list (Recursive).
- Reverse a list (Iterative).
- Reverse a singly linked list in pairs (recursive).
- Reverse a singly linked list in pairs (iterative).
- Check if a singly linked list is a palindrome or not.
- Remove the loop if exists.
- Given 2 linked lists with data in the ascending order, merge them into a single list.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

TREES:

Trees: Basic Terminology, Types of Trees, Binary Tree – Introduction, properties, array and linked representations; Tree traversals and their implementation; Expression trees; BST – definition and operations, AVL trees – definition and construction; Applications of binary trees.

UNIT-2 **8L+8T+8P=24 Hours**

GRAPHS & HASHING:

Graphs: Basic Terminology, Types of Graphs, Graphs representations – adjacency matric, adjacency list; Traversals - breath first search and depth first search; Applications of graphs.

Hashing: Introduction, Different hash functions, collision: avoidance and handling methods.

PRACTICES:

Problems on BST – Level 1

- Insert function.
- Insert function (recursive).
- Search function.
- Pre order traversal.
- Post order traversal.
- In order traversal.
- Level order traversal.
- Delete child node.
- Delete parent node.
- Delete nodes greater than a value from a circular doubly linked list.

Problems on Priority Queues – Level 1

- Meeting rooms problem.
- Ugly number.
- Find median from data stream.
- Find the top K frequent elements.
- Find K Pairs with smallest sums.
- Find the Kth smallest element in a sorted matrix.
- Trapping Rain Water.
- Rearrange String k distance apart.
- Sort characters by frequency.
- Solve the maze problem.

Problems on Graphs – Level 1

- Implement Graph data structure.
- Implement BFS - iterative solution.
- Implement BFS - recursive solution.
- Implement DFS - iterative solution.
- Implement DFS - recursive solution.
- Check if given graph is strongly connected or not.
- Check if given graph is strongly connected or not - using DFS.
- Given a graph find the arrival and departure time of its vertices in DFS. Arrival time is the time when the vertex was explored for the first time, and departure time is the time at which all the neighbours are explored and are ready to backtrack.
- Given a directed acyclic graph and a source vertex, find the cost of the shortest path from source vertex to all other vertices present in the graph. If a vertex cannot be reached from given source vertex that distance may be printed as infinite.
- Given an undirected graph, check if the graph is 2 edge connected or not.

Problems on Hashing – Level 1

- Print a binary tree in vertical order.
- Find whether an array is subset of another array.
- Given an array A [] and a number x, check for pair in A [] with sum as x.
- Minimum operation to make all elements equal in array.
- Maximum distance between two occurrences of same element in array.
- Check if a given array contains duplicate elements within k distance from each other.
- Find duplicates in a given array when elements are not limited to a range.
- Most frequent element in an array.
- Smallest subarray with all occurrences of a most frequent element.
- First element occurring k times in an array.

Problems on Graphs – Level 2

- Find the shortest graph distances between every pair vertex in a given path. Assume that the graph does not have any negative edges.
- Find the shortest graph distances between every pair of vertices in a given path. The graph can have negative edges.
- Detect cycle in DFS.
- Count the number of connected components of a graph represented in the adjacent matrix.
- Count the number of connected components of a graph represented in the adjacent matrix - using DFS.
- Find a spanning tree - not necessarily a minimum spanning tree.
- Detect cycle in an undirected graph.
- Given an undirected graph, find its depth.
- Determine if a directed graph has a unique topological ordering.
- Given a directed acyclic graph and two vertices v and w, find the lowest common ancestor.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

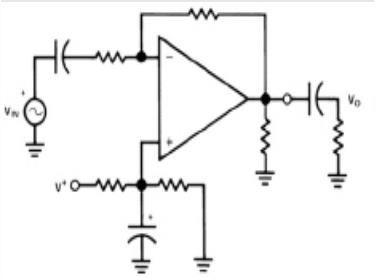
CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Explore the organization of several ADTs and the manipulation (searching, insertion, deletion, traversing) of data stored in various data structures.	Apply	1,2	1
2	Apply different data structures to solve a given problem.	Apply	1,2	1
3	Analyze the efficiency of using different data structures and choose the efficient data structure for solving a given problem.	Analyze	1,2	2
4	Develop new algorithms to solve various problems.	Create	1,2	3,4

TEXT BOOKS:

1. Reema Thareja, “Data Structures Using C”, 2nd Edition, Oxford University Press, 2014.
2. Seymour Lipschutz, “Data Structures with C”, 1st Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, illustrated edition, Computer Science Press, 2006.
2. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2nd Edition, CENAGE Learning, 2005.
3. R G Dromey and Pearson, “How to solve it by Computer”, 2nd edition, Impression edition, 1998.



Source- https://www.electronicshub.org/analog-circuits-and-digital-circuits/

22EC201 ANALOG CIRCUITS

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Semiconductor Physics.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this syllabus, as its name implies, is to allow the reader to become proficient in the analysis and design of circuits utilizing modern linear ICs.

MODULE–1

UNIT-1 **12L+0T+8P=20 Hours**

BJT AMPLIFIERS:

Small signal amplifiers and Large signal amplifiers.

UNIT-2 **12L+0T+8P=20 Hours**

OPERATIONAL AMPLIFIER AND APPLICATIONS:

Differential Amplifier, current mirror biasing, IC 741 operational amplifier, Ideal and practical characteristics, Inverting and non-inverting configurations. Op-amp as Instrumentation amplifier, Summing amplifier, Integrator, Differentiator, Active filters, Schmitt triggers.

PRACTICES:

Design and Implementation of

- Design a CE amplifier for a particular gain and plot its frequency response.
- Verify the effect of cascading on gain and bandwidth of a multistage amplifier.
- Verify the conduction angle of all power amplifiers.
- Determine the conversion efficiency of a class B complementary symmetry power amplifier.
- Determine the conversion efficiency of a class AB complementary symmetry power amplifier
- Design an integrator and a differentiator using 741 Op-Amp IC.
- Design an inverting summing amplifier for a given equation.
- Design an instrumentation amplifier using 741 Op-Amp IC.
- Design a low pass filter and a high pass filter with certain cutoff frequency using 741 Op-Amp IC.
- Verify the working of Schmitt trigger using 741 IC.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

OP-AMP BASED OSCILLATORS & PLL:

Barkhausen's criterion for oscillations, Oscillators (RC and LC), PLL and its applications

UNIT-2 **12L+0T+8P=20 Hours**

TIMERS & DATA CONVERTERS:

IC555 timer and applications as astable and monostable multivibrator, Op-amp based DACs and ADCs - Characteristics of A/D and D/A converters, weighted resistor DAC, R-2R ladder DAC, flash ADC, successive approximation ADC and dual slope ADC.

PRACTICES:

- Design a RC phase shift oscillator using 741 IC for audio frequency range.
- Verify the functionality of PLL using IC 565.
- Design an astable multivibrator using 555 timer to generate a clock pulse with 60% duty cycle.
- Verify the functionality of an R-2R ladder DAC circuit.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse and design of single stage, multistage and Power Amplifiers	Analyse	1	1, 2, 3,4, 5, 9, 10, 12
2	Design and elucidate linear and non-linear applications of op-amp and other ICs.	Apply	1, 2	1, 2, 3,4, 5, 9, 10, 12
3	Apply the concepts of op-amps to design oscillators and timers.	Apply	2	1, 2, 3,4, 5, 9, 10, 12
4	Analyse ADC's and DAC's.	Analyse	2	1, 2, 3,4, 5, 9, 10, 12

TEXT BOOKS:

1. J. Millman, C. Halkias and C. D Parikh "Integrated Electronics", 2nd edition, Tata McGraw-Hill, 2018.
2. D. Roy Choudhury and Shail B Jain, "Linear Integrated Circuits", 5th edition, New Age International (p) Ltd, 2018.

REFERENCE BOOKS:

1. Adel S. Sedra. Kenneth C. Smith and Arun N. Chandorkar, "Micro Electronic Circuits: Theory and Applications", 7th edition, Oxford University Press, 2017.
2. J M Fiore, Operational Amplifiers & Linear Integrated Circuits: Theory and Application Theory and Applications, Cambridge U Press, 2003.
3. M.H. Rashid, "Micro Electronic Circuits: Analysis and Design", 1st edition, Thomson PWS Publications, 1999.
4. Sergio Franco, "Design with Operational Amplifiers & Analog Integrated Circuits", 4th edition, McGraw Hill,1988.

SKILLS:

- ✓ *Design simple analog circuits to verify their behavior.*
- ✓ *Explain the operation of circuits using transistors in switching mode to achieve a variable DC output.*
- ✓ *Apply practical skills in the simulation, construction and testing of complex electrical and electronic circuits.*

Source - https://www.javatpoint.com/number-system-in-digital-electronics

22EC203 DIGITAL ELECTRONICS

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Boolean algebra

COURSE DESCRIPTION AND OBJECTIVES:

Digital Electronics deals with fundamentals Boolean Algebra and Boolean expressions that are used to realize combinational and sequential circuits. Its objective is to minimize the logical expressions using Boolean postulates and K-maps, and to design various combinational and sequential circuits and to provide with sufficient number of applications.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

BASICS OF LOGIC FUNCTIONS AND SIMPLIFICATIONS:

Switching Functions: Canonical and Standard Forms - SOP and POS forms, Logic Gates: Logic gates, Algebraic simplification and realization with basic gates and universal gates, Simplification of logic functions: Karnaugh maps - 3, 4, 5 variables.

UNIT-2 **10L+10T+10P=30 Hours**

COMBINATIONAL LOGIC DESIGN:

Combinational Logic Design Part I: Design using conventional logic gates, Half adder, Full adder, Half Subtractor, Full Subtractor, Ripple carry adder, Adder/Subtractor, BCD adder, Code converters, Comparator, Parity generator/detector.

Combinational Logic Design Part II: Decoder, Encoder, Multiplexer, De-multiplexer, Design of combinational circuits using multiplexer and decoder.

PRACTICES:

Design and Implementation of

- Basic Logic Gates.
- Adders: Half Adder, Full Adder, Ripple carry adder, Adder/Subtractor, BCD adder
- Subtractors: Half Subtractors, Full Subtractors.
- Encoder & Decoder.
- Multiplexer & De-Multiplexer.
- Parity Circuits.
- Code Converters.
- Comparator

MODULE-2

UNIT-1 **6L+6T+6P=18 Hours**

SEQUENTIAL DESIGN:

Sequential Logic Design Part I: Classification of sequential circuits, Latches, Flip-Flops - SR, JK, D, T, Master slave flip flop, Triggering and excitation tables

UNIT-2 **10L+10T+10P=30 Hours**

ASYNCHRONOUS & SYNCHRONOUS CIRCUITS:

Sequential Logic Design Part II: Shift registers, Counters - Ripple counters, Mod-n counter. Finite State Machines: State diagram, State table, Design of sequential counter, Mealy FSM, Moore FSM, Case study: Sequence Detectors, Traffic light control system.

PRACTICES:

Design and Implementation of

- Flip Flops: SR, JK, D, T.
- Registers.
- Counters.
- Sequence Detectors

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of digital logic concepts to optimize digital circuits..	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Develop Combinational digital circuits for given problem statement by applying the digital techniques.	Apply	1	1, 2, 5, 9, 10
3	Analyze sequential digital circuits for given problem statement	Analyze	2	1, 2, 3, 5, 9, 10
4	Design a given application using Finite State machines	Analyze	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:

1. M. Morris Mano, “Digital Design”, 6th Edition, Pearson Education, 2018.
2. ZviKohavi, Niraj K. Jha, “Switching and Finite Automata Theory”, 3rd Edition, Cambridge University Press, 2009.

REFERENCE BOOKS:

1. John.M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006.
2. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
3. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, 6th Edition, TMH, 2006.

SKILLS:

- ✓ *Minimize the logic functions using Boolean Algebra/K-map*
- ✓ *Identify the different gates and their properties.*
- ✓ *Design combinational and sequential circuits for a given application.*

Source - https://engineerinGinterviewquestions.com/signals

22EC205 SIGNALS AND SYSTEMS

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Basics of Integration, differentiation and complex numbers.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to build a grasp of the fundamental concepts of signals and systems found in engineering. The methods for characterizing and analyzing continuous-time signals and systems will be the primary focus. Students will learn transform techniques (Laplace transform and Fourier transform) that will help them understand digital communication systems, feedback control systems, satellite and mobile communications, digital signal processing, and digital image processing.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

BASICS OF CONTINUOUS TIME SIGNALS AND SYSTEMS:

Signals: Classification of continuous time signals - even/odd signals, periodic/non-periodic signals, deterministic/random signals, energy/power signals, causal/non causal signals, Standard signals - unit step, unit impulse, sinusoidal and complex exponential signals, etc., Basic operations on signals,

Systems: Representation, Classification of continuous time systems - linear/nonlinear, causal/noncausal, time invariant/time variant, with/without memory, BIBO stability, feedback system.

UNIT-2 **10L+10T+10P=30 Hours**

LTI SYSTEM AND FOURIER SERIES:

LTI system: Causality and stability of a systems, Response of LTI system, Convolution integral- properties, Continuous time LTI system described by differential equations.

Fourier series: Representation of signals using orthogonal function, Representation of continuous time periodic signals, Convergence and Properties of the Fourier series, complex Fourier spectrum.

PRACTICES:

- Plot various signals.
- Determine whether the signal is an energy or power signal.
- Tell whether the signal x(t) is symmetric, and if yes what kind of symmetry. Also, analyze x(t) in even and odd parts and confirm your result.
- Operation on signals and plot it.
- If x(t) is the applied to the system as input signal and y(t) is the output signal of the system. Determine whether the system is
  i. Linear or nonlinear,
  ii. Causal or non-causal,
  iii. Static or dynamic,
  iv. Time invariant or time variant,
  v. Stable or unstable.
- Suppose that a system is described by the impulse response h(t). Compute and plot the system response to the input signal x(t).
- Plotting the amplitude spectrum and phase spectrum (using exponential Fourier series coefficients) for the periodic signal, x(t).

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

ANALYSIS IN FREQUENCY DOMAIN:

Fourier transform: Properties of the continuous time Fourier transform, Fourier transforms of arbitrary signals, Frequency response. Laplace transform: Introduction to Laplace transform and region of convergence, Properties of the Laplace transform, Inverse Laplace transform, Analysis of LTI systems using Laplace transform, Differential equation representation and solution.

UNIT-2 **8L+8T+8P=24 Hours**

SAMPLING:

Sampling theorem, Nyquist rate, Nyquist interval, Sampling of continuous time signals, Reconstruction of signal, Aliasing.

PRACTICES:

- Compute and plot the Fourier transforms of arbitrary signals.
- Use the Fourier transform to compute (and plot) the convolution between the signals.
- Compute and plot the frequency response of a system described by the impulse response.
- Compute the unilateral Laplace of arbitrary signals.
- A system is described by the impulse response h(t). Compute the transfer function H(s) of the system.
- Sampling, Reconstruction and Analysis of signals.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the various properties and Apply transform techniques on continuous time signals and systems.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Identify the impulse response of an LTI system.	Apply	1, 2	1, 2, 5, 9, 10
3	Analyse the frequency spectrum of continuous time signals.	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Inspect sampling theorem.	Analyze	2	1, 2, 5, 9, 10, 12
5	Evaluate the properties, magnitude/phase response of various signals and systems.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

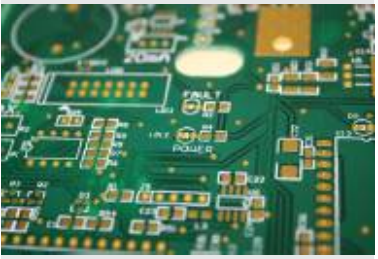
1. Alan V. Oppenheim, Alan S. Willsky, and S. Hamid Nawab, “Signals and Systems”, 2nd edition, Pearson, 2015.
2. B.P. Lathi and Roger Green, “Linear Systems and Signals,” Oxford University Press, 3rd edition, 2020.

REFERENCE BOOKS:

1. Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd edition, Wiley, 2007.
2. Hwei P. Hsu, “Schaum’s Outline of Signals and Systems”, McGraw-Hill Education, 4th edition, 2020.
3. Luis F. Chaparro and Aydin Akan, “Signals and Systems using Matlab”, Academic Press, 3rd edition, 2019.
4. Taan S. Elali, “Continuous Signals and Systems with Matlab”, CRC Press, 3rd edition, 2021.

SKILLS:

- ✓ *Design and test a LTI system.*
- ✓ *Choose the various transforms and their applications in the analysis of signals and systems.*
- ✓ *Apply transformation to real-world problems involving bio-signals.*
- ✓ *Analyze the abnormalities present in the physiological systems.*
- ✓ *Choose the desired sampling frequency for a given application.*



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22EC209 PRINTED CIRCUIT BOARD DESIGN

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: Basics of electronic devices.

COURSE DESCRIPTION AND OBJECTIVES:

This is an introduction to PCB design using software. Electronic products need a printed circuit board (PCB), and this program is meant to prepare students to design PCBs up to industrial standards for their own projects.

MODULE-1

PRACTICES:

- Introduction to PCB design flow, materials used and CAD tools.
- Introduction to circuit and layout creation using the software DIPTRACE.
- Design of power supply circuit
- Design of half wave rectifier
- Design of full wave rectifier
- Design clipper circuits
- Design clamper circuits
- Design a RLC resonance circuit

MODULE-2

PRACTICES:

- Design of CE amplifier circuit.
- Design of Op-Amp based inverting and non-inverting amplifiers.
- Design of Op-Amp based waveform generators.
- Design of Adder and Subtractor using digital ICs.
- Design of double layer PCB Design for FM receiver Circuit.
- Understanding Multilayer PCB Design.
- Two Stage RC Coupled Amplifier.
- 10 Watts Audio Amplifier.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the PCB designing concepts, materials and apply for making PCB.	Apply	1	1, 2, 3, 5
2	Develop the schematic diagrams for a given circuit.	Apply	1, 2	1, 2, 3, 5
3	Build the PCB for various Electronic Circuits.	Create	1, 2	1, 2, 3, 5

TEXT BOOKS:

1. R. Khandpur, “Printed Circuit Boards: Design, Fabrication, and Assembly”, McGraw-Hill Electronic Engineering, 2005.
2. Clyde F. Coombs, Jr. and Happy T. Holden, “Printed Circuits Handbook”, 7th edition, McGraw-Hill Education, 2016.

REFERENCE BOOKS:

1. Boylestad and Nashelsky, “Electronic Devices and Ciruit”, 11th edition, Pearson, 2015.
2. Ramakant A. Gayakwad, “Op-amps and Linear Integrated Circuits”, 4th edition, Pearson, 2015.

SKILLS:

- ✓ *Identify suitable materials for PCB fabrication.*
- ✓ *Identify PCB type required for specific application.*
- ✓ *Choose appropriate tool for PCB design.*

Source: https://www.geeksforgeeks.org/best-way-to-start-with-competitive-programming-geeksforgeeks-cp-live-course/

22TP203 ADVANCED CODING COMPETENCY

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: Programming in C, Data Structures.

COURSE DESCRIPTION AND OBJECTIVES:

This course helps to understand the impact of the choice of data structures and design strategies to solve the problem in an efficient manner. This course also provides the understanding of advanced graph applications and also throw light in tractable intractable problems.

MODULE-1

UNIT-1 **0L+0T+8P =8 Hours**

STACKS, QUEUES AND SINGLE LINKED LISTS:

PRACTICES:

Problems On Stacks & Queues

- Check if given stack of integers are consecutive or not (could be ascending or descending).
- Find the maximum sum in a sliding window using queues.
- Given a queue of integers, rearrange the elements by interleaving the first half with the second half.
- Given an integer k and a queue of integers, reverse the order of the first k elements of the queue.
- Given a maze in the form of a rectangular matrix filled with O, X or M where O represents an open cell, X represents a blocked cell and M represents landmines, find the shortest distance of every open cell in the maze from its nearest mine.
- For a given parenthesis expression, check whether it is balanced parenthesis or not.
- Reverse a number using stack.
- You are given a string s consisting of lowercase English letters. A duplicate removal consists of choosing two adjacent and equal letters and removing them. We repeatedly make duplicate removals on s until we no longer can.
- Find first Unique character in a string (Queue).
- Implement Tower of Hanoi problem.

Problems On Linked Lists

- Given a random pointer to a random node in a singly linked list, clone the list.
- Given a list rotate the list to the right by k places.
- Remove duplicates from a sorted list.
- Find fractional node in a singly linked list.
- Sort a linked list using constant space complexity.
- Delete a node in start, middle, end of Singly linked list.
- Add a node in start, middle, end of Singly linked list.
- Find whether given single linked list is circular or not.
- Arrange a singly linked list in Descending order.
- Addition of two numbers using Singly Linked List.

UNIT-2 **0L+0T+8P =8 Hours**

DOUBLY LINKED LISTS, CIRCULAR LINKED LISTS:

PRACTICES:

Problems on Double Linked Lists and Circular Linked Lists

- Implement a clockwise rotation of a doubly linked list by N places.
- Count triplets in a sorted doubly linked list whose product is equal to a given value x.
- Find the product of all prime nodes in a doubly linked list.
- Find the count of common nodes in two doubly linked lists.
- Find pairs with given product in a sorted doubly linked list.
- Delete all the even nodes of a circular singly linked list.
- Count nodes in a circular linked list.
- Delete all prime nodes from a circular singly linked list.
- Exchange first and last nodes in a circular linked list.
- Reverse a doubly circular linked list.
- Linear search using a stack of incomplete sub problems.
- 1 2 3 4 5 6 in stack S is push X is pop, SSSSXXSSSXXX.
- Recursively remove all adjacent duplicates.
- Check if a given singly linked list is a palindrome using stack.
- Convert a multilevel singly linked list to a singly linked list.
- Remove duplicates from an unsorted doubly linked list.
- Sort a doubly linked list using insertion sort.
- Check if a doubly linked list of characters is palindrome or not.
- Swap Kth node from beginning with Kth node from end in a Double Linked List.
- Convert a Binary Tree into Double Linked List.

MODULE-2

UNIT-1 **0L+0T+8P =8 Hours**

TREES:

PRACTICES:

Problems on Trees

- Given a sorted doubly linked list, convert it into a balanced BST.
- Given a singly linked list with data in the ascending order, convert it into a height balanced BST.
- Print the leaf to root path for every leaf node in a binary tree.
- Write a function to implement the reversed level order traversal of a binary tree.
- Truncate a given binary tree to remove nodes that lie on a path having sum less than K.
- Find the vertical sum in a given binary tree.
- Delete minimum & Maximum element from a BST.
- Implement Inorder, preorder and postorder tree traversal techniques.
- Print Kth largest element in a BST.
- Implement Zig-Zag tree traversal.

SKILLS:

- ✓ *Experienced to Store data and various types of data to handle.*
- ✓ *Ordering and sorting of data.*
- ✓ *Indexing and Searching of required data from large data sequences.*
- ✓ *Exposed to various characteristics such as Linear or non-linear, Homogeneous or heterogeneous and Static and Dynamic.*

UNIT-2 **0L+0T+8P =8 Hours**

GRAPHS:

PRACTICES:

Problems on Graphs

- Given a directed acyclic graph, determine whether there is a path that visits every vertex exactly once.
- Reverse a directed graph such that each edge from v to w is replaced by an edge from w to v.
- Find the shortest path in a graph that visits each vertex at least once, starting and ending at the same vertex.
- Find the minimum number of throws required to win a snake and ladder game.
- Implement DFS of a Graph.
- Implement BFS of a Graph.
- Detect whether a cycle is present in an undirected graph.
- Detect cycle in a Directed Graph.
- Find Shortest Distance to goal node from root node in a graph.
- Find no. of nodes in Kth level of a Graph.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various data structures to solve a different algorithm.	Apply	1,2	1
2	Investigate the various data structures to solve a given problem in an efficient manner.	Analyse	1,2	2
3	Design and implement an appropriate hashing function for an application.	Create	1,2	4

TEXT BOOKS:

1. Reema Thareja, “Data Structures Using C”, 2nd Edition, Oxford University Press, 2014.
2. Seymour Lipschutz, “Data Structures with C”, 1st Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, illustrated edition, Computer Science Press, 2006.
2. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2nd Edition, CENAGE Learning, 2005.
3. R G Dromey and Pearson, “How to solve it by Computer”, 2nd edition, Impression edition, 1998.

22MS201 MANAGEMENT SCIENCE

Source : https://previews.123rf.com/images/belchonock/belchonock1712/92124008-text-management-science-and-books-on-white-background.jpg

Hours Per Week :

L	T	P	C
2	2	0	3

PRE-REQUISITE KNOWLEDGE: Basic knowledge on management

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to analyse the importance of management, significance of operation management and carry out production operations through work-study. Students will be able to analyse the markets, customers, competitors, and then plan HR function effectively.

MODULE- 2

UNIT-1 **6L+6T+0P =12 Hours**

INTRODUCTION TO MANAGEMENT:

Concepts of Management and organization- nature, importance and Functions of Management, Systems approach to Management - Taylor's Scientific Management Theory, Fayol's Principles of Management, Mayo's Hawthorne Experiments, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Leadership Styles, Social responsibilities of Management.

UNIT-2 **10L+10T+0P =20 Hours**

OPERATIONS MANAGEMENT:

Principles and Types of Plant Layout-Methods of production (Job, batch and Mass Production), Work Study -Basic procedure involved in Method Study and Work Measurement, Objectives, Need for Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records. Statistical Quality Control: control charts for variables and attributes (simple Problems), Acceptance Sampling

PRACTICES:

- Collect some examples with videos for types of production.
- Carry out production operations through work-study
- Practice problems with Inventory control methods and Quality Control charts

MODULE- 2

UNIT-1 **8L+8T+ 0P =16 Hours**

HUMAN RESOURCES MANAGEMENT:

Concepts of Human Resource Management, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating.

UNIT-2 **8L+8T+0P =16 Hours**

MARKETING MANAGEMENT:

Evolution of Marketing, Functions of Marketing Selling Vs Marketing, 4 P's of Marketing – Product Mix - Product Life Cycle – Place Mix – Channels of Distribution – Price Mix – Pricing Methods – Promotion Mix – Tools of Promotions.

SKILLS:

- ✓ *To be an expert in managerial skills*
- ✓ *Able to maintain social relations*
- ✓ *Able to evaluate pricing strategies*

PRACTICES:

- Select any Designation in an organization and try to describe its job description and job specifications
- How do you deal with grievances at your work
- Analyze marketing mix in various situations

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the nature and importance of management	Analyze	1	1,2,4,6
2	Significance of Operations Management.	Analyze	1, 2	1,2,5
3	Carry out production operations through work-study	Apply	1, 2	1, 2, 3, 5
4	Analyze the markets, customers, and competition	Analyze	2	1,2,4,5,6
5	Plan and control the HR function effectively	Evaluate	1, 2	1,2,3,4,5,6

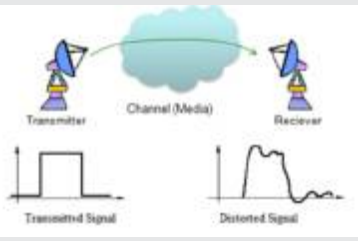
TEXT BOOKS:

1. Stoner, Freeman, Gilbert, Management, 6th Ed, Pearson Education, New Delhi, 2004.
2. P. Vijay Kumar, N. Appa Rao and Ashnab, Chnalill, Cengage Learning India, 2012.

REFERENCES :

1. Kotler Philip & Keller Kevin Lane: Marketing Mangement 12/e, PHI, 2005.
2. Koontz & Weihrich: Essentials of Management, 6/e, TMH, 2005.
3. Thomas N. Duening & John M .Ivancevich Management — Principles and Guidelines, Biztantra, 2003.
4. Aryasri: Management Science, TMH, 2004.

22EC206 COMMUNICATION SYSTEMS



Source- https://thefactfactor.com/facts/pure_science/physics/communication/5058/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of Integration, differentiation and complex numbers.

COURSE DESCRIPTION AND OBJECTIVES:

This course will focus on the how signals are encoded for transmission and reception. The first part of the course will examine analog communication systems such as AM and FM radio. The second part will concern digital communications, and how digital signals can be encoded and decoded over analog channels.

MODULE-1

UNIT-1 **12L+0T+8P=20 Hours**

AMPLITUDE MODULATION:

Overview of the different modulation schemes and mediums that are used for communications. Amplitude modulation schemes, including commercial AM radio, SSB Modulation and Demodulation.

UNIT-2 **12L+0T+8P=20 Hours**

ANGLE MODULATION SCHEMES:

Narrowband FM, Wideband FM Modulation and Demodulation, Commercial FM, Phase Modulation, Pulse modulation: PAM, PWM, and PPM.

PRACTICES:

- To design the Simulink model of the DSB-AM to analyze each signal in time and frequency domains using time scope and spectrum analyzer
- To examine the effects of the Additive Gaussian Channel (AWGN) in the Simulink Model of DSB-AM
- To observe the real-time music transmission for DSB-AM modulated signal via trans-receiver (Example – USRP)
- To implement the Simulink models for FM including a basic sinusoid and a multimedia file (music) to analyze each signal in time and frequency domains using time scope and spectrum analyzer
- To examine the effects of the Additive Gaussian Channel (AWGN) in the Simulink for FM
- To observe the real-time music transmission for a FM modulated music file Universal Software Radio Peripheral (USRP) USRP trans-receiver

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

DIGITAL TRANSMISSION:

Sampling, and the basis for digital communications, Quantization, PCM, line coding, and reducing ISI,

UNIT-2 **15L+0T+10P=25 Hours**

DIGITAL MODULATION SCHEME:

Digital carrier modulation, including ASK, FSK, PSK, QPSK, and QAM SNR and system performance Methods of synchronization,

SKILLS:

- ✓ *Identify the need for modulation and choice of modulation.*
- ✓ *Choose the choice of frequency bands of AM/FM/T.V/ Mobile/Satellite.*
- ✓ *Select the detector/discriminator required in FM.*
- ✓ *Mathematical analysis of the digital modulated signals. !*
- ✓ *Realize 8-PSK, 16-PSK and 32-PSK*

Synchronizing power., Effect of change in excitation and prime mover torque, Two reaction theory - direct and quadrature axis synchronous reactance; Slip test.

PRACTICES:

- Building Simulink Model of BPSK Modulator and Demodulator to measure Bit Error Rate (BER)
- BPSK Modulator and Demodulator Using USRP Hardware
- A Music File Transmission with QPSK
- Building Simulink Model of 16 QAM Modulator and Demodulator.
- A Music File Transmission with 16 QAM
- Simulating Real 16 QAM Transmission

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Make use of different amplitude modulation techniques.	Apply	1	1, 2, 12
2	Analyze performance of different types of modula-tion techniques for a given set of parameters.	Analyze	1,2	1, 2, 5, 12
3	Examine the performance of various digital modulation techniques.	Analyze	2	1, 2, 12
4	Perceive the modulation techniques and analog and Digital communication sub-systems.	Evaluate	1,2	1, 2, 3, 5, 12

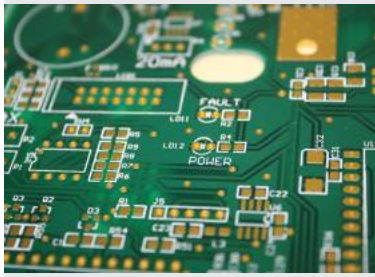
TEXT BOOKS:

1. B.P. Lathi and Z. Ding “Modern Digital and Analog Communication Systems”, 5th Edition, Oxford University Press, 2018.
2. S.L. Kalkani and Priyanka “Communication Systems”, 5th Edition, New Age International Publications, 2017.

REFERENCE BOOKS:

1. Simon Haykin and Michael Moher “Communication Systems” 5th Edition, Wiley, 2009.
2. Bruce Carlson and P.B Chilly, Communication System, 5th Edition, Tata McGraw-Hill, 2011
3. Herbert Taub and Donald L Schilling, Principles of Communication Systems, 4th edition, Tata McGraw Hill, 2012,

22EC207 COMPUTER ARCHITECTURE AND ORGANIZATION



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Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Basics of Computers, Digital Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the principles of computer organization and the basic architecture concepts. The course emphasizes design issues involved in the design and utilization of computing systems, including components, functions, instruction set architecture, performance evaluation, arithmetic, implementation, memory, input/output, pipeline, and multiprocessors.

MODULE–1

UNIT-1 **6L+6T+0P=12 Hours**

STRUCTURE OF COMPUTERS:

Introduction: History of computers; Von-Neumann, Harvard, Super Harvard architectures, Computer components, Computer Function.

Instruction Set Architecture (ISA): The Evolution of the Intel x86 Architecture, ARM Architecture, CISC Vs RISC; Designing for performance, Amdahl's law.

UNIT-2 **10L+10T+0P=20 Hours**

COMPUTER ARITHMETIC AND CPU:

Computer Arithmetic: Integer representation, Integer arithmetic, Floating-point representation, IEEE Standard 754, Floating-point arithmetic.

Instruction Sets: Address format, Instruction format, Types of operands, Intel x86 and ARM data types, Types of operations, and Addressing modes.

CPU Implementation: Processor organization, Register organization, Stack organization, Hardwired logic, Micro programmed logic.

PRACTICES:

- Examples of Von-Neumann, Harvard architectures.
- CISC and RISC instructions.
- 8086, 8051, ARM7 basics.
- Evaluating Performance.
- Arithmetic and Logic Micro-Operations.
- Integer arithmetic.
- Single precision representation in IEEE Standard 754.
- Floating point arithmetic.
- Problem Solving on Instruction Format.
- Examples for status flags.
- Instruction sets and addressing modes of 8086.
- Register Transfer Language.
- RTL interpretation of instructions.
- Arithmetic Logic Unit design.
- Difference between Hardwired and Micro-programmed Control Unit.

MODULE–2

UNIT-1 **8L+8T+0P=16 Hours**

MEMORY ORGANIZATION:

Memory: Internal memory - RAM, ROM; External memory - Magnetic disk, RAID, Cache memory,

SKILLS:

- ✓ *Understand the specifications and how well different components work together for a computer.*
- ✓ *Learn different data and number representations.*
- ✓ *Design ALU and Control unit.*
- ✓ *Identify the types of memories and their uses.*
- ✓ *Choose the appropriate data transfer mechanism for a given application.*

Mapping techniques, Virtual memory, Paging and Segmentation.

UNIT-2 **8L+8T+0P=16 Hours**

I/O ORGANIZATION AND MULTIPROCESSORS:

Input/Output: Memory-mapped I/O, Isolated I/O, Programmed I/O, Interrupt driven I/O, DMA. Pipeline: Arithmetic pipeline, Instruction pipeline, RISC pipeline.Multiprocessors: Characteristics of multiprocessors, Interconnection structures.

PRACTICES:

- Memory hierarchy.
- Memory capacity.
- Memory interface with 8086.
- Hit and Miss ratio.
- Mapping techniques.
- Write through and write back.
- Cache performance.
- I/O communication.
- IN/OUT instructions of 8086.
- Interfacing of 8086 with 8255.
- Pipeline dependencies.
- Flynn's taxonomy.
- Introduction to Visio/edraw/Verilog.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Build the computer system with functional units and levels of programming languages.	Apply	1	1, 2, 12
2	Make use of number system for data representation and binary arithmetic in digital computers.	Apply	1	1, 2, 5, 12
3	Apply arithmetic algorithms and interpret the processed data to build the CPU.	Apply	1	1, 2, 3, 5, 12
4	Categorize various memory mechanisms and different data transfer techniques.	Analyze	2	1, 2, 12
5	Classify various pipelining and multiprocessors.	Analyze	2	1, 2

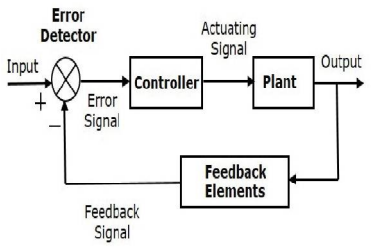
TEXT BOOKS:

1. William Stallings, "Computer Organization & Architecture: Designing for Performance", 11th Edition, Pearson, 2019.
2. John D. Carpinelli, "Computer Systems Organization and Architecture", Pearson, 1st Edition, 2010.

REFERENCE BOOKS:

1. M. Morris Mano, "Computer System Architecture", Pearson, 3rd Edition update, 2017.
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design-ARM Edition: The Hardware/Software Interface", Morgan Kaufmann Publication, Elsevier, 2017.
3. Linda Null and Julia Lobur, "Essentials of Computer Organization and Architecture", Jones & Bartlett Publishers, 5th Edition, 2018.
4. Sajjan G. Shiva, "Computer Organization, Design, and Architecture", CRC Press, Taylor & Francis, 5th Edition, 2014.
5. Jim Ledin, "Modern Computer Architecture and Organization", Packt Publishing, 2020. Applications and Design", 3rd edition, Wiley, 2022.

22EC208 CONTROL SYSTEMS



Source- https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

Hours Per Week :

L	T	P	C
2	2	0	3

PRE-REQUISITE KNOWLEDGE: Basics of circuit theory, differentiation and complex numbers, and Laplace transform.

COURSE DESCRIPTION AND OBJECTIVES:

This course will focus on the, how to obtain mathematical model of any physical system. To be able to do time-domain and frequency-domain analyses of the model to predict the system's behavior. To be able to design control systems that meet design specifications.

MODULE- 2

UNIT-1 **8L+8T+0P=12 Hours**

INTRODUCTION OF CONTROL SYSTEMS:

Motivation, Concept of control systems, classification of control systems, Transfer function and block diagram representation for electrical systems, block diagram algebra, signal flow graph representation.

UNIT-2 **8L+8T+0P=12 Hours**

TIME RESPONSE ANALYSIS AND STABILITY:

Time response analysis for first and second order system. Time domain specifications, Steady state response, Steady state errors, Characteristic equation of feedback control systems and Concept of stability, Routh-Hurwitz test.

PRACTICES:

- Plot various test signals.
- Determine systems that can be modeled by Ordinary Differential Equations (ODEs) and Transfer Function.
- Tell how the input affects the output (or, vice-versa, what inputs should be given to generate a desired output)
- analyze time domain specifications to understand system behavior
- analyze systems obtained as interconnections (e.g., feedback) of two or more other systems.
- analyze the effect of pole zero locations for on system behaviors time

MODULE- 2

UNIT-1 **8L+8T+0P=12 Hours**

PROPERTIES OF FEEDBACK:

Basic idea of feedback control systems. Error analysis. P, PI, PD, PID controllers. Design of controllers: The root-locus technique, steps in obtaining a root-locus. Design of controllers using root-locus.

UNIT-2 **8L+8T+0P=12 Hours**

FREQUENCY DOMAIN ANALYSIS:

Bode plot, Nyquist plot, Nyquist stability criterion, gain and phase margins, robustness. Design of compensator.

SKILLS:

- ✓ *Model any physical system.*
- ✓ *Determine overall transfer function of a system using block diagram reduction technique and SFG method.*
- ✓ *Analyze first and second order systems in time domain.*
- ✓ *Determine design specifications like rise time, settling time, steady state error.*
- ✓ *Determine open loop gain variation in a stable system using root locus method.*
- ✓ *Stability analysis of any system in the time and frequency domain.*

PRACTICES:

- Routh-Hurwitz criterion in terms of stability and root-locus techniques for performance by investigating the effect of parameter variations on the roots of the system characteristic equation.
- analyze the effect of variation of system gain
- Use Bode diagram approach to the design of lead, lag, and lag-lead compensator.
- Use Root Locus approach to the design of lead, lag, and lag-lead compensator.
- Design controller for various systems

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Applying different techniques for calcu-lating transfer function of a linear sys-tems.	Apply	1	1,2,3,4,5,10
2	Analyze the transient and steady state behavior of the open and closed loop systems.	Analyze	1,2	1,2,3,10,12
3	Calculate the stability of linear control system in time and frequency domain.	Evalu-ate	2	1,2,3,4,5 6,10,12
4	Design compensators and controller for a linear system.	Create	1,2	1,2,3,5, 6,10,12

TEXT BOOKS:

1. J. Nagrath and M. Gopal, “Control Systems Engineering”, 7th edition, New Age International (P) Limited, 2021.
2. Katsuhiko Ogata, “Modern Control Engineering”, 5th edition, Prentice Hall of India Private Ltd, New Delhi, 2020.

REFERENCES :

1. M. Gopal, “Control Systems: Principles and Design”, 3rd edition, McGraw Hill, 2008.
2. Benjamin C Kuo and Farid Golnaraghi, “Automatic Control systems”, 9th edition, Prentice Hall of India Private Ltd, New Delhi, 2009.
3. Richerd C. Dorf and Robert H. Bishop, “Modern Control Systems”, 12th edition, Prentice, Hall, 2010.

III

YEAR

B.Tech.

ELECTRONICS AND COMMUNICATION ENGINEERING

I SEMESTER

22TP301	-	Soft Skills Laboratory
22EC301	-	Microcontrollers
22EC303	-	VLSI Design
22EC305	-	Electromagnetic waves and Transmission Lines
	-	Department Elective – 2
	-	Open Elective – 2
22EE306	-	Industry interface course (Modular course)
22EE305	-	Inter-Disciplinary Project – Phase-I
		NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication
		Minor / Honors – 2

II SEMESTER

22TP204	-	Professional Communication
22TP302	-	Quantitative Aptitude and Logical Reasoning
22EC308	-	Digital Signal Processing
22EC309	-	Antenna Theory: Analysis and Design
	-	Department Elective – 3
	-	Department Elective – 4
	-	Open Elective – 3
22EE309	-	Inter-Disciplinary Project – Phase-II
	-	Minor / Honors – 3

COURSE CONTENTS

I SEM & II SEM

22TP301 SOFT SKILLS LABORATORY

Source: https://choosework.ssa.gov/blog/2019-07-23-soft-skills-an-intro-to-effective-communication

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: Grasp on their own academic achievements.

COURSE DESCRIPTION AND OBJECTIVES:

To impart employability skills like resume preparation and facing interviews. To enable trainees to develop interpersonal and leadership skills and to train them on work place skills like making presentations, participating in group discussions etc.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

PERSONALITY DEVELOPMENT:

Soft Skills: Need for soft skills, professionalism, employability skills; Communication: Need for effective communication - the process of communication, levels of communication, flow of communication, choice of diction and style with reference to setting (formal, semi-formal or informal); communication networks, barriers to communication, miscommunication, noise and ways to overcome the barriers; Career Planning: Job vs. career, SWOT analysis.

UNIT-2 **0L+0T+8P=8 Hours**

LANGUAGE AND VOCABULARY:

Vocabulary Building: Word etymology, roots, prefixes & suffixes, synonyms & antonyms, collocations, one-word substitutes, analogies, idioms and phrases, contextual guessing of unfamiliar words, task-oriented learning; Reflection of language on Personality, Gender sensitive language in MNCs, Mind your language, Seven essential skills for a team player; attentive listening, intelligent questioning, gently persuading, respecting other's views, assisting others, sharing, participating actively.

PRACTICES:

- Self-Introduction.
- Personal and Academic SWOC.
- Johari Window.
- Giving and taking opinions of Self Vs others and assessing oneself.
- Goal setting.
- Short, Mid and Long Term goals planning the semester.
- Time management: four quadrant system.
- Stephen Covey Time Management Matrix planning a semester.
- Stress-management.
- Questionnaire to assess level of stress.
- 50 words towards resume preparation and interviews.
- Newly coined words.
- Gender sensitive words and Words acceptable in Indian context and objectionable international context.

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

LANGUAGE IN ACTION:

Functional English: Situational dialogues, Role plays (including small talk); Group Discussion: Articulation and flow of oral presentation, dynamics of group discussion, intervention, summarizing and conclusion, voice modulation, content generation, Key Word Approach (KWA), Social, Political, Economic, Legal

SKILLS:

- ✓ *Balance social and emotional intelligence quotients though SWOC, JOHARI etc. activities.*
- ✓ *Prepare tailor made resume and face various job interviews with enriched personality traits.*
- ✓ *Career planning with clear personal and professional goals.*
- ✓ *Solve personal and professional life hiccups with confidence and maturity.*

and Technical Approach (SPELT), View Point of Affected Part (VAP), language relevance, fluency and coherence – 11th and 12th weeks; Resume preparation: Structure and presentation, defining career objective, projecting one's strengths and skill-sets, summarizing, formats and styles and covering letter-Statement of Purpose.

UNIT-2 **0L+0T+8P=8 Hours**

PREPARING FOR PRESENTATIONS AND INTERVIEWS:

Facing Interviews: Interview process, understanding employer expectations, pre-interview planning, opening strategies, impressive self-introduction, answering strategies, other critical aspects such as body language, grooming, other types of interviews such as stress-based interviews, tele- interviews, video interviews, frequently asked questions (FAQs) including behavioral and HR questions and the aspect looked at by corporate during interviews; Presentation Skills: Selection of a topic, preparing an abstract, gathering information, organizing the information, drafting the paper, citing reference sources – writing striking introductions, discussing the methodology used, developing the argument, presentation style, language, presenting the paper and spontaneously answering audience questions.

PRACTICES:

- Opening and closing a telephonic conversation.
- Making an appointment.
- Making a query.
- Offering/Passing on information.
- Communicating with superiors.
- Expressing agreement/objection.
- Opening bank account (combination of prepared and impromptu situations given to each student).
- Group Discussions on various topics.
- Preparing SoP and Resume.
- Mock interviews on the FAQs including feedback.
- Oral presentation with the help of technology (Preparing PPT and presenting).

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Mod-ule No.	Mapping with POs
1	Have the ability to introspect on individual strengths and weaknesses, and emerge as a balanced personality with improved self-awareness and self-worth .	Apply	1	12
2	Observe gender sensitive language and workplace etiquette in his professional life.	Analyze	1	9
3	Be able to prepare a resume and gain the confidence to face an interview.	Create	1&2	10
4	Possess the interpersonal skills to conduct himself/herself effectively in everyday professional and social contexts.	Apply	2	8
5	Bring professionalism into his/her daily activities.	Create	2	8

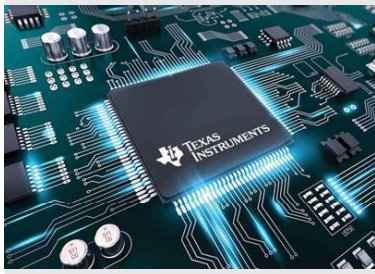
TEXT BOOKS:

1. Adrian Furnham, "Personality and intelligence at work", Psychology Press, 2008.
2. S. P. Dhanvel, "English and Soft skills", Orient Blackswan, 2011.

REFERENCE BOOKS:

1. Edward Holffman, "Ace the corporate personality", McGraw Hill, 2001.
2. John Adair Kegan Page, "Leadership for innovation", Kogan, 2007.
3. Krishna Mohan & NP Singh, "Speaking English effectively", Macmillan, 2008.
4. Rajiv K. Mishra, "Personality Development", Rupa & Co. 2004.

22EC301 MICROCONTROLLERS



Source-https://www.ti.com/microcontrollers-mcus-rocessors/microcontrollers/overview.html

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Basics of digital electronics, computer architecture and organization, Microprocessors and Microcontrollers.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the architectural features, internal registers, operating modes, organization, hardware components, peripherals and instruction sets of ARM7-TDMI and ARM LPC2148.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

ARM 7 TDMI:

ARM Architecture and Programming Model: ARM design philosophy, Programmers model: Registers, status register, modes of operation; Organization diagram, Instruction pipeline; Instruction set: Conditional execution, Data processing instructions, Branch instructions, Load-Store instructions, PSR instructions.

UNIT-2 **10L+10T+10P=30 Hours**

LPC2148 CONTROLLER:

LPC 2148 Controller Architecture: Features, Architecture, Functional pin description, On-chip Flash memory, On chip SRAM, General purpose I/O.

PRACTICES:

- Introduction to Keil uVision 4 software.
- 8-bit, 16-bit, 32 bit Arithmetic and Logical operations.
- Searching a number, Find and replace the number in a given array.
- Find the smallest/largest number, Arrange the given numbers in sorting order.
- Block transfer using load/store instructions.
- Blinking of LEDs in port 0 or port 1 in LPC2148.
- Read the input from one port and display into output port using LPC2148.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

LPC-2148 PERIPHERALS:

LPC 2148 Peripherals-1: PLL, ADC, Timers and counters, Real-time clock, pulse width modulator.

UNIT-2 **8L+8T+8P=24 Hours**

LPC-2148 PERIPHERALS:

LPC 2148 Peripherals-2: UART, USB, I2C bus controller, Vector interrupt controller.

SKILLS:

- ✓ *Identify suitable hardware components for a specific application.*
- ✓ *Design a micro-controller-based system using LPC 2148.*
- ✓ *Develop the environment for interfacing peripherals with ARM proces-sors.*
- ✓ *Develop Em-bedded-C or As-sembly language programs using LPC 2148.*

PRACTICES:

- Blinking of LEDs with specific time delay using on-chip Timer of LPC2148.
- Generation of PWM signals using LPC2148.
- Demonstrate the on-chip components of LPC2148.
- Minor project based on the interest of students with LPC2148.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Mod-ule No.	Mapping with POs
1	Understand and analyze the architectures and functional components of ARM7 and LPC2148.	Analyze	1,2	1, 2, 4, 5, 9, 10, 12
2	Apply the knowledge of addressing modes and instructions to develop ARM assembly programs.	Apply	1	1, 2, 5, 9, 10
3	Categorize various on-chip peripherals of ARM LPC2148.	Analyze	1, 2	1, 2, 5, 9, 10
4	Experiment to interface various peripherals to ARM LPC2148.	Analyze	2	1, 2, 3, 4, 5, 9, 10, 12
5	Assess the techniques, skills, and modern engineering tools necessary for programming applications using ARM LPC2148.	Evalu-ate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Steve Furber, “ARM System on Chip Architecture”, 2nd edition, Pearson education, 2014.
2. Andrew N Sloss, Dominic Symes and Chris Wright, “ARM system developer’s guide”, Morgan Kaufmann Publication, Elsevier, 2004.

REFERENCE BOOKS:

1. William Hohe and Christopher Hinds, “ARM Assembly Language: Fundamentals and Techniques”, 2nd edition, CRC Press, 2015.
2. “LPC214x User Manual (UM10139)”, Volume 1, Philips Semiconductors, 2015. (https://www.nxp.com/docs/en/user-guide/UM10139.pdf)
3. https://www.engineersgarage.com/arm-projects/how-to-start-programming-arm7-based-lpc2148-microcontroller.
4. https://circuitdigest.com/search/node?keys=lpc2148.
5. http://www.electronicwings.com/arm7.
6. https://onlinecourses.nptel.ac.in/noc20_cs15/preview

22EC303 VLSI DESIGN

Source - https://www.electronicshub.org/vlsi-projects-for-engineering-students/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Electronics Components and Devices

COURSE DESCRIPTION AND OBJECTIVES:

VLSI design course deals with understanding of the basic electrical properties characteristics of CMOS circuit construction and also introduce the concepts and techniques of fabrication.

MODULE–1

UNIT-1 **12L+0T+8P=20 Hours**

ELECTRICAL CHARACTERISTICS OF MOS TRANSISTOR:

MOS TRANSISTOR INTRODUCTION: NMOS and PMOS Transistor operation, IDS-VDS relationship, Channel Length Modulation, Transistor parameters - threshold voltage, body effect, transconductance, output conductance, figure of merit.

UNIT-2 **12L+0T+8P=20 Hours**

CMOS DIGITAL CIRCUITS:

Static CMOS Logic gates: NMOS inverter, Various pull ups, CMOS Inverter, Static CMOS logic gates, Bi-CMOS inverter.

Logic Design: Pass transistor, Transmission gate logic, Alternate forms of CMOS logic – pseudo NMOS logic, dynamic CMOS logic, clocked CMOS logic, domino CMOS logic and DCVS logic, Combinational circuit design – 1-bit adder, array multiplier, Sequential Circuit Design - design of latches and flip-flops.

PRACTICES:

- Simulation of characteristics of MOSFET.
- Simulation of CMOS Inverter and all other logic gates.
- Simulation of logic gates using Pseudo nMOS logic.
- Simulation of logic gates using Dynamic logic.
- Simulation of 1-bit adder.
- Simulation of flipflops.

MODULE –2

UNIT-1 **12L+0T+8P=20 Hours**

CMOS ANALOG CIRCUITS:

CMOS Analog circuits: Single stage Amplifiers: Common-source stage, Source follower, Common-gate, Differential Amplifiers, current mirrors.

UNIT-2 **12L+0T+8P=20 Hours**

DESIGN FLOW, FABRICATION AND TESTING:

VLSI Design flow, Layout diagrams for nMOS and CMOS logic gates, Vlsi Fabrication: CMOS processes - NWell, PWell, Twin tub and Silicon on insulator, introduction to fabrication techniques, Introduction to testing, BIST.

SKILLS:

- ✓ *Design logic gates using CMOS logic, Pseudo, Dynamic, Domino and DCVSL logics.*
- ✓ *Design Digital circuits using CMOS logic.*
- ✓ *Design analog circuits using CMOS logic.*

PRACTICES:

- Simulation of CS Amplifier
- Simulation of CG Amplifier
- Simulation of CD Amplifier
- Simulation of differential Amplifier
- Simulation of current mirror
- Design of CMOS Inverter Layout

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the characteristics of MOSFET.	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Construct digital circuits using CMOS gates.	Apply	1,	1, 2, 5, 9, 10
3	Design analog circuits using CMOS gates.	Apply	2	1, 2, 3, 5, 9, 10
4	Outline the fabrication and testing	Apply	2	1, 2, 5, 9, 10, 12

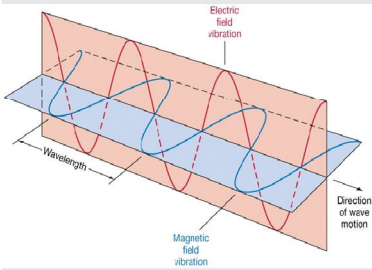
TEXT BOOKS:

1. Douglas A Pucknell and Kamran Eshranghian, “Essentials of VLSI Circuits and systems”, 3rd edition, Prentice Hall of India, 2011.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd Edition, McGraw Hill Education, 2016.

REFERENCE BOOKS:

1. S.M. Sze, “VLSI Technology”, 2nd edition, TMH, 2007.
2. Amar Mukherjee, “Introduction to nMOS and CMOS VLSI System Design”, 1st edition, Prentice Hall, 1986.
3. Ajay Kumar Singh, “Digital VLSI Design”, 1st edition, PHI Learning Private Limited, 2011.

22EC305 ELECTROMAGNETIC WAVES AND TRANSMISSION LINES



Source - https://i.stack.imgur.com/OvzDn.jpg

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Physics

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the fundamental knowledge of electromagnetic fields involving in various engineering applications. It gives the foundation in electromagnetic waves and Transmission lines and its use in modern communication areas such as wired and wireless. The objective of the course is to enable the student familiarize with the propagation, reflection, and transmission of plane waves in bounded and unbounded media and transmission lines.

MODULE-1

UNIT-1 **8L+0T+8P=16 Hours**

ELECTROSTATIC AND MAGNETOSTATIC FIELDS:

Review of coordinate systems and vector analysis.

Electrostatic Fields: Coulomb's law, Gauss's law, Applications of Gauss's law, Boundary conditions, Capacitance, Parallel Plate capacitor, Poisson's and Laplace's equations.

Magnetostatic Fields: Biot-Savart law, Ampere's Circuital law, Magnetic boundary conditions, Self-inductance and mutual inductance.

UNIT-2 **8L+0T+8P=16 Hours**

MAXWELL'S EQUATIONS AND TIME-VARYING FIELDS:

Faraday's law, Displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, Wave equations for free space and conducting medium, Uniform plane wave equation.

PRACTICES:

- Generate Electromagnetic Wave using MATLAB software.
- Verification of Maxwell equation.
- Experiments on tracing of electric and magnetic flux lines for standard configuration
- Calculation of wave propagation in free space and conducting medium
- Calculation of uniform plane wave equation.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

WAVE PROPAGATION IN DIFFERENT MEDIA:

Free space, conducting medium, good dielectrics, good conductors; Skin depth, Wave polarization. Normal incidence of waves on perfect conductor and dielectric, Oblique incidence of waves on perfect conductor and dielectric, Poynting theorem and Poynting vector.

UNIT-2 **8L+0T+8P=16 Hours**

TRANSMISSION LINES:

Equations of voltage and current on TX line, Propagation constant and characteristic impedance, Reflection coefficient and VSWR, Impedance transformation on loss less and low loss transmission

SKILLS:

- ✓ *Analyze different coordinate systems the concept of gradient, divergence, and curl of a vector.*
- ✓ *Analyze application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.*
- ✓ *Study the behaviour of the electric field across a boundary between a conductor and dielectric and between two different dielectrics.*
- ✓ *Study the time-varying fields and propagation of waves in different media.*
- ✓ *Analyze the transmission line impedance parameters.*

line, Power transfer on TX line, Smith Chart, Admittance Smith chart, Applications of transmission lines - impedance matching.

PRACTICES:

- Calibrate the Network Analyzer for Transmission line.
- Study the characteristics of a series RC and RL Circuit.
- Verification Scattering parameters using Smith chart.
- Microstrip Line design using HFSS.
- Analyze SW Pattern and SWR.
- Impedance Matching verification.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of static Electric & Magnetic fields to study Time-varying electro-magnetic field	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems of electromagnetic wave propagation.	Analyze	1	1, 2, 4,5, 9, 10,12
3	Analyze the phenomena of wave propagation in different media. Illustrate the concepts of electro-magnetic wave propagation and wave characteristics.	Analyze	2	1, 2,4,5, 9, 10,12
4	Analyze the characteristics of transmission lines and solve the parameters using smith chart.	Analyze	2	1, 2,3,4,5, 9, 10, 12

TEXT BOOKS:

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", 7th edition, Oxford Univ. Press, 2021.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian 8th edition, 2017.

REFERENCE BOOKS :

1. Jordan, E.C. and Balmain, K.G., 1968. Electromagnetic waves and radiating systems. Prentice-Hall.
2. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2017.
3. E.V.D. Glazier and H.R.L. Lamont, Transmission and Propagation, The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi, 2014.
4. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
5. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.

22TP204 PROFESSIONAL COMMUNICATION LABORATORY

Source: https://www.coursera.org/specializations/improve-english

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: High School-level English.

COURSE DESCRIPTION AND OBJECTIVES:

To improve the overall professional communication skills (LSRW) of students and prepare them for their profession as engineers and managers. To provide them exposure to conventions of corporate communication and training them on how to function in the business world.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

BASICS OF BUSINESS WRITING SKILLS, PRACTICING BUSINESS CORRESPONDENCE AND REPORT WRITING:

Business English Vocabulary: Glossary of most commonly used words (formal and informal usage).

Elements of Technical Writing: Sentence structure, reducing verbosity, arranging ideas logically, building coherence, cohesive devices and transitional words.

Mechanics of Writing: Elementary rules of grammar, choice of diction, elementary principles of composition, matters of form, punctuation, conventions of business communication, language and professional tone, code of conduct (not sending illegal, offensive, disparaging personal remarks or comments) in written business communication.

Business Correspondence: E-mail: nature and scope, e-mail etiquette, clear call for action, common errors in composing e-mails, office communication such as meeting agenda and notice, circular and memo.

Letter-Writing: Formal and informal letters, structure of formal letters, expressions of salutations, different types of letters [such as sales letter, complaint letter, response to the complaint letter (dispute resolution), letter of permission, letter of enquiring, claim letter – letter of apology etc], introductory and concluding paragraphs and clear call for action.

Professional Proposal/Report: Differentiating proposals and reports, Drafting formal business proposals, types of reports such as factual reports, feasibility reports and survey reports, parts of a report (such as title page, declaration, acknowledgements, table of contents, abstract, introduction, findings, conclusion and recommendations).

New Age Corporate Communication Media: Importance of social media communication and Etiquettes, form and structure, sharing texts through Twitter, Whatsapp, instgram etc.

UNIT-2 **0L+0T+8P=8 Hours**

PRACTICING COMMUNICATIVE LANGUAGE IN VARIOUS PROFESSIONAL CONTEXTS:

Speaking: Speaking in business context, assertiveness, politeness, making requests, queries and questions, negotiations, asking for information, offering suggestions, conflict resolution, contacting clients, initiating, addressing delegates (in public), delivering the presentation effectively, telephone etiquettes, delivering seminar/proposal/report effectively, team meeting etiquettes (face to face and conference call), making effective one minute presentations(JAM) and participating in Group Discussions.

PRACTICES:

- Basic grammar practice, framing paragraphs on topics allocated, paraphrasing an article or a video in your own words, finding topic sentences in newspaper articles, finding out new words from a professional viewpoint and understanding the meaning and its usage.

SKILLS:

- ✓ *To enhance listening and spoken abilities of students needed for professional and social success in interpersonal situations, group interactions, and personal and professional presentations.*
- ✓ *Understand and practice specific functions and vocabulary in a business context.*
- ✓ *Produce short business reports, proposals and correspondence.*
- ✓ *Write various business documents through reading techniques.*

- Perusing samples of well-prepared business emails, memo, letter writing and short proposals and reports, students will draft business correspondence writing tasks and different proposals/ reports on topics assigned.
- Watching videos/listening to audios of business presentations, classroom activities of team and individual presentations, using PPTs, mock exercises for BEC speaking, agreeing, disagreeing politely, developing content, extended speaking in Group Discussion(s).

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

READING AND COMPREHENDING BUSINESS DOCUMENTS:

Reading: Reading and comprehending business documents, learning business register, regularizing the habit of reading business news, suitable vocabulary, skimming and scanning a text for effective and speedy reading and dealing with ideas from different sectors of corporate world in different business contexts.

UNIT-2 **0L+0T+8P=8 Hours**

IMPARTING AND PRACTICING LISTENING SKILLS:

Listening: Specific information in business context, listening to telephonic conversations / messages and understanding the correct intended meaning, understanding the questions asked in interviews or in professional settings, summarizing speaker's opinion or suggestion, enable active listening.

PRACTICES:

- Hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choices, using right vocabulary as per the given context and editing a paragraph.
- Working out BEC/TOEFL/IELTS listening exercises with hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choice- multiple choices, using right vocabulary in context-editing a paragraph, listening to a long conversation such as an interview and answer MCQ s based upon listening.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Possess comprehensive skills in listening and reading business texts in formal context.	Apply	2	7
2	Communicate effectively both in their academic as well as professional environment.	Apply	2 &1	10
3	Clear grasp on the register of business language.	Analyze	1	8
4	Possess the ability to write business reports and proposals clearly and precisely to succeed in their future.	Create	1	12
5	Make effective presentations and participate in formal context.	Create	2	10

TEXT BOOK:

1. S. Schnurr, "Exploring Professional Communication: Language in Action", London: Routledge, 2013

REFERENCE BOOKS:

1. Brook Hart Guy, "Cambridge English Business Bench Mark: Upper Intermediate", 2nd Edition: CUP, 2014.
2. Cambridge University Publication, "Cambridge: BEC VANTAGE Practice Papers", CUP, 2002.
3. J. Seely, "The Oxford Guide to Effective Writing and Speaking", Oxford University Press, 2005.

22TP302 QUANTITATIVE APTITUDE & LOGICAL REASONING

Source: https://images.app.goo.gl/kvtVgA8TkvDCqLhj7

Hours Per Week :

L	T	P	C
1	2	0	2

PREREQUISITE KNOWLEDGE: Basic Logical Thinking and Problem Solving Ability.

COURSE DESCRIPTION AND OBJECTIVES:

The Students will be introduced to various Arithmetic and Reasoning Problems. The students will have acquaintance with various problems like Time & Work, Time & distance, Percentages, Profit & Loss etc. besides solving puzzles and Critical Reasoning.

MODULE-1

UNIT-1 **4L+8T+0P=12 Hours**

Number system, LCM & HCF of numbers, Percentage, Ratio and proportion, Profit, loss and discount, Average & Mixtures, Simple Interest & Compound interest.

UNIT-2 **4L+8T+0P=12 Hours**

Time and work, Time & distance, Problems on trains, Problems on ages, Permutation & Combinations, Probability.

PRACTICES:

- Each concept would be taught in detail in the class followed by 10 problems solved in the class. Students would have to solve 10 additional problems as homework assignment in each concept.

MODULE-2

UNIT-1 **4L+8T+0P=12 Hours**

Number series, Letter series, Analogy, Odd man out, Coding and decoding, Syllogisms- Statement & Conclusions, Puzzle test.

UNIT-2 **4L+8T+0P=12 Hours**

Blood relations, Direction sense test, Order & Ranking, Seating Arrangements, Calendar & Clocks.

PRACTICES:

- Each concept would be taught in detail in the class followed by 10 problems solved in the class. Students would have to solve 10 additional problems as home work assignment in each concept.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Meet the demands of current job market besides equipping them higher studies like CAT, GMAT etc.	Apply	1	2, 5
2	Solve Arithmetic and Reasoning Problems within shortest possible time without paper work.	Apply	1	2, 5
3	Exhibit better analytical skills and aptitude skills.	Analyse	2	2, 4
4	Develop interpretational skills.	Evaluation	2	2, 4

SKILLS:

- ✓ *Helps in developing and improving problem solving skills*
- ✓ *Allow students to develop critical thinking skills*

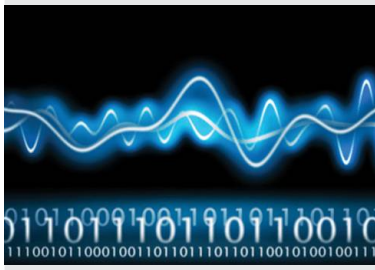
TEXT BOOKS:

1. R. S. Aggarwal- Quantitative Aptitude for Competitive Examinations- S. CHAND Publications- Revised Edition-2017.
2. ARIHANT- A New Approach To Verbal & Non-Verbal Reasoning- Arihant Publication- Revised Edition-2021.

REFERENCE BOOKS:

1. Trishna Knowledge Systems- Quantitative Aptitude for Competitive Examinations- Pearson Publication- First Edition- 2013.
2. R. S. Aggarwal- A Modern Approach to Verbal & Non-Verbal Reasoning-S. CHAND Publications- Revised Edition-2018.

22EC308 DIGITAL SIGNAL PROCESSING



Source- https://d3f1iyfxxz8i1e.cloudfront.net/courses/course_image/8dd6e763ac6a.png

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Signals and systems.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to build a grasp of the fundamental concepts of discrete time signals and systems found in engineering. The students will learn methods for characterizing z-plane analysis, the interrelationships of these analytic method, designs and structures of digital (IIR and FIR) filters from analysis to synthesis for a given specifications.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

INTRODUCTION TO DIGITAL SIGNAL PROCESSING:

Discrete time signals, systems and their classification, linear shift invariant systems, stability, and causality, linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems.

UNIT-2 **10L+10T+10P=30 Hours**

FOURIER SERIES AND FOURIER TRANSFORMS:

Discrete Fourier series representation of periodic sequences, Properties of discrete Fourier series, Discrete Fourier transforms: frequency domain sampling, linear convolution of sequences using DFT, Computation of DFT, Relationship of DFT to other transforms, Properties of DFT, Fast Fourier transforms (FFT) - Radix-2 FFT algorithm, Inverse FFT.

PRACTICES:

- Find the output y(n) for an input x(n), for the discrete time system represented by impulse response h(n).
- Compute Linear Convolution for two sequences.
- Compute Circular Convolution for two sequences.
- Find the Fourier transform, frequency response of x(n), and plot its magnitude and phase.
- Compute the Discrete Fourier Transform and IDFT with and without FFT and IFFT.
- Implementation of Decimation-in-time / Decimation-in-frequency radix-2 FFT algorithm.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

DESIGN OF FIR AND IIR DIGITAL FILTERS:

FIR: Symmetric and anti-symmetric FIR filters, Design of linear phase FIR Digital Filters using Windows and Frequency Sampling method.

IIR: IIR filter design by Approximation of Derivatives, IIR filter design by impulse invariance, IIR filter design by bilinear transformation, Characteristics of commonly used analog filters (Butter worth and Chebyshev), Frequency transformations, comparison of IIR & FIR filters.

SKILLS:

- ✓ *Identify the frequency response discrete time system.*
- ✓ *Identify the type and order of the filter for any given application.*
- ✓ *Analyze the stability of the designed filter.*
- ✓ *Design FIR/ IIR filter to a real-world problem's application.*

UNIT-2 **8L+8T+8P=24 Hours**

TRANSFORMS AND REALIZATION:

Transforms: Review of Z-transforms, Properties of Z-transform, Inverse Z- transforms, stability and causality.

Realization of Digital Filters: Structures for FIR systems: Direct form structure, Cascade form structures, Structures for IIR systems: Direct form structures, Signal flow graphs and transposed structures, cascade form structures, Parallel form structures.

PRACTICES:

- Implementation of FIR digital filter using windows.
- Implementation of FIR digital filter using frequency sampling method.
- Implementation of IIR digital filter Butterworth/Chebyshev using bilinear / impulse transformation.
- For the system described by difference equation with input and initial conditions
  a. Find the output y(n) using MATLAB.
  b. Find the system transfer function.
  c. Is the system stable?
- Compute Direct form – I, II realization of the given IIR system function.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Summarize the characteristics of signals and systems and Apply to find the response of the system.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Apply Fourier techniques to find the frequency response.	Apply	1	1, 2, 5, 9, 10
3	Analyse discrete-time systems in both time & transform domain and also through pole-zero placement.	Analyse	1, 2	1, 2, 3, 5, 9, 10
4	Inspect the significance of various digital filter structures.	Analyse	1,2	1, 2, 5, 9, 10, 12
5	Design a digital filter using various techniques.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education, 2013.
2. A. V. Oppenheim, and R. W. Schaffer, "Discrete Time Signal Processing", Pearson, 3rd edition, 2014.

REFERENCE BOOKS:

1. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006.
2. Sanjit K. Mitra, "Digital Signal Processing: A Computer-Based Approach", The MIT Press, 2007.
3. B. P. Lathi and Roger Green, "Essentials of Digital Signal Processing", Cambridge University Press, 2014.
4. M. H. Hayes (2007), Schaums Outlines of Digital Signal Processing, Tata McGraw Hill, India.
5. Steven Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists", Newnes, 2002.
6. Taan S. ElAli, "Discrete Systems and Digital Signal Processing with Matlab", CRC Press, 2nd edition, 2012.
7. Samir I. Abood, "Digital Signal Processing: A Primer with Matlab", CRC Press, 2020.

22EC309 ANTENNA THEORY: ANALYSIS AND DESIGN

Source- http://www.cmg-change.com/wp-content/uploads/2018/03/Listening-antenae.jpg

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Electromagnetic waves and Transmission Lines

COURSE DESCRIPTION AND OBJECTIVES:

This course offers fundamental knowledge of antenna theory analysis and design. The objective of this course is to make the student familiarize with parameters of antenna, antenna array, VHF, UHF and Microwave Antennas. By the end of this course students will have good understanding of antenna fundamentals and the know-how of designing various kind of antennas such as dipole, loop, micrsotrip patch antennas and arrays. Students will also learn industry standard simulation software Ansys HFSS, ADS, Matlab which they will use for their design projects. Students will design an antenna from scratch, will simulate it in HFSS and at the end write a report on this project.

MODULE –1

UNIT-1 **8L+0T+8P=16 Hours**

ANTENNA FUNDAMENTALS:

Antenna Radiation Mechanism: Single wire and Two wire. Current distribution on Thin wire antenna.

Antenna Parameters: Radiation patterns, Patterns in principal planes, Beam widths, Radiation intensity, Directivity, Gain, Reciprocity theorem, Radiation resistance of dipole antenna, Relation between effective aperture and directivity, Effective height, Field regions, Polarization, Friis transmission equation. Radiation resistance of Half wave dipole antenna.

UNIT-2 **8L+0T+8P=16 Hours**

LINEAR ANTENNA ARRAY DESIGN AND ANALYSIS:

Analysis of uniformly spaced arrays: Two element array, N element array, Non Uniform Excitation: Binomial array, Dolph - Tschebyscheff array. Principle of multiplication of patterns, Smart Antenna.

PRACTICES:

- Half wave dipole design and analysis using HFSS.
- Radiation pattern of wire antennas using Matlab.
- Radiation pattern of Broad side and End fire array using Matlab.
- Radiation pattern of Binomial and Dolph- Chebyshev array using Matlab.
- Half wave dipole design and analysis using HFSS.
- Radiation pattern of wire antennas using Matlab.
- Radiation pattern of Broad side and End fire array using Matlab.
- Radiation pattern of Binomial and Dolph- Chebyshev array using Matlab

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

WIRE AND APERTURE ANTENNAS:

Folded dipole, Loop antenna, Yagi-Uda array, Helical antenna, Pyramidal Horn antenna, Parabolic reflector antennas, Slot Antenna.

SKILLS:

- ✓ *Determine the dipole size for the given frequency range.*
- ✓ *Draw the radiation patterns in various planes for uniform linear array (Broad side/endfire).*
- ✓ *Draw the radiation patterns of helical/ horn / aperture antennas.*
- ✓ *Determine the possible link distance for a given antenna height and vice versa.*
- ✓ *Design of microstrip antenna.*

UNIT-2 **8L+0T+8P=16 Hours**

MICROSTRIP PATCH ANTENNA:

Introduction, Working principle, basic characteristics, feeding methods, design of rectangular and circular patch antennas. MIMO patch Antenna.

PRACTICES:

- Design Horn Antenna using HFSS.
- Design Rectangular Microstrip patch antenna using HFSS.
- Design Circular Microstrip patch antenna using HFSS.
- Design Helical Antenna using HFSS
- Design Series Fed microstrip patch antenna array
- Design Corporate fed microstrip patch antenna array.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts and properties of Electro-Magnetism to obtain parameters of antennas.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Analyse the different array techniques to improve directivity.	Analyse	1	1, 2, 4,5, 9, 10,12
3	Analyse the antennas based on frequency, configure the geometry and establish the radiation patterns of VHF, UHF and Microwave antennas.	Analyse	2	1, 2,4,5, 9, 10,12
4	Analyse the basic concept of patch antenna and MIMO antenna.	Analyse	2	1, 2,3,4,5, 9, 10, 12

TEXT BOOKS:

1. Constantain A Balanis, “Antenna Theory: Analysis and Design”, 4th edition, Wiley Publishers, 2015.
2. J.D.Kraus and Ronald J Marhefka, “Antennas and Wave propagation”, 4th edition, TMH, 2014.

REFERENCE BOOKS:

1. Edward C Jordan and Keith G Balmain, “Electromagnetic Waves and Radiating Systems”, 2nd edition, PHI, 2003
2. Keith henney, Radio Engineering Handbook, 3rd edition TMH.
3. John Leonidas Volakis, Antenna Engineering Handbook, 3rd edition, 2007.
4. W. L.Stutzman, and G.A. Thiele,”Antenna Theory and Design”, 2 nd Ed., John Wiley & Sons., 1998.
5. R.S.Elliot,”Antenna Theory and Design”, Revised edition, Wiley-IEEE Press., 2003.

IV

YEAR

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech.

I SEMESTER

22EC401	-	Data Communications and Computer Networks
22EC402	-	Microwave Engineering
	-	Department Elective – 5
	-	Department Elective – 6
	-	Department Elective – 7
	-	Department Elective – 8
	-	Minor / Honors – 4

II SEMESTER

22EC403	-	Project Work
22EC404	-	Internship
	-	Minor / Honors – 5 (for Project)

COURSE CONTENTS

I SEM & II SEM

22EC401 DATA COMMUNICATIONS AND COMPUTER NETWORKS

Source - https://nizamtaher.wordpress.com/topics/topic-1-introduction-of-computer-network/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Communication Systems.

COURSE DESCRIPTION AND OBJECTIVES:

Students will be familiar with the components required to build different types of networks and also exposed and learn to the required functionality at each layer and the flow control and congestion control algorithms.

MODULE-1

UNIT-1 **10L+0T+6P=16 Hours**

COMPUTER NETWORKS AND THE INTERNET:

Internet, The Network Edge, The Network Core, Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layers and Their Service Models, Networks Under Attack, History of Computer Networking and the Internet

Application Layer: Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet DNS—The Internet's Directory Service

UNIT-2 **14L+0T+10P=24 Hours**

Application Layer: Peer-to-Peer Applications, P2P File Distribution, Video Streaming and Content Distribution Networks, Socket Programming: Creating Network Applications

Transport Layer: Introduction and Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Reliable Data Transfer - Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N (GBN), Selective Repeat (SR), Connection-Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Principles of Congestion Control, TCP Congestion Control, Evolution of transport-layer functionality

PRACTICES:

Using Wireshark tool:

- Introduction to Wireshark Tool
- Study and analyse the Hyper Text Transfer Protocol (HTTP)
- Study and analyse the Domain Name System (DNS)
- Study and analyse the Transmission Control Protocol (TCP)
- Study and analyse the User Datagram Protocol (UDP)

MODULE –2

UNIT-1 **12L+0T+8P=20 Hours**

THE NETWORK LAYER - DATA PLANE:

Overview of Network Layer - Forwarding and Routing: The Network Data and Control Planes, What's Inside a Router? The Internet Protocol (IP): IPv4, Addressing, IPv6, and More, Generalized Forwarding and SDN

SKILLS:

- ✓ *Implement Local Area Networks with different topologies.*
- ✓ *Able to simulate various routing protocols.*
- ✓ *Able to perform Network trouble shooting.*

The Network Layer - Control Plane: Introduction, Routing Algorithms - The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Intra-AS Routing in the Internet: OSPF, Routing Among the ISPs: BGP, The SDN Control Plane -The SDN Control Plane: SDN Controller and SDN Control Applications, ICMP: The Internet Control Message Protocol

UNIT-2 **12L+0T+8P=20 Hours**

The Link Layer and LANs: Introduction to the Link Layer, Error Detection and Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks, Link Virtualization: A Network as a Link Layer, Data Center Networking, Retrospective: A Day in the Life of a Web Page Request

PRACTICES:

Using Wireshark tool:

- Study and analyse the Internet Protocol (IP)
- Study and analyse the Network Address Translation (NAT)
- Study and analyse the Dynamic Host Configuration Protocol (DHCP)
- Study and analyse the Internet Control Message Protocol (ICMP)
- Study and analyse the Ethernet and ARP
- Study and analyse the 802.11 WiFi

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic Network types, topologies and internet protocols	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Understand and analyze the mechanisms of IP addressing, routing, congestion control, domain naming, world wide web and multimedia streaming.	Apply	1	1, 2, 5, 9, 10
3	Understand and analyze the protocols that belong to various layers and open flow models for SDN	Analyse	1, 2	1, 2, 3, 5, 9, 10
4	Understand and analyze various network security mechanisms of Networks.	Analyse	1,2	1, 2, 5, 9, 10, 12
5	Implementation of various Protocols that belong to application Layer, transport Layer, network layer, and link layer	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. James F. Kurose, Keith Ross, “Computer Networking: A Top-Down Approach”, 8th edition, Pearson Education, 2020.
2. Andrew S Tanenbaum, “Computer Networks”, 5th edition, Pearson Education, 2014.

REFERENCE BOOKS:

1. Behrouz A. Forouzan, “Data communications and Networking”, 3rd edition, TataMcGraw Hill, 2003.
2. James F. Kurose, Keith Ross, “Computer Networking: A Top-Down Approach”, 7th edition, Pearon Education, 2017.
3. William Stallings, “Data and Computer Communications”, 9th edition, Pearson Education/ Prentice Hall, 2013.

22EC402 MICROWAVE ENGINEERING

Source- https://www.cobhameee.com/microwave-components-and-systems/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Electromagnetic waves and Transmission Lines, Antenna Theory.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers concepts of Microwave Frequencies, waveguides, microwave Devices, microwave Systems. The objective of this course is to enable the student to understand wave guides for transmission lines, microwave components, microwave solid-state devices, microwave tubes and microwave measurement techniques.

MODULE–1

UNIT-1 **12L+0T+8P=20 Hours**

MICROWAVE WAVEGUIDES:

Microwave Frequencies, Microwave Devices, Microwave Systems.

Rectangular Waveguides: Wave equations in Rectangular Waveguides, TE, and TM Modes in Rectangular Waveguides.

Circular Waveguides: Wave equations in Circular Waveguides, TE, TM, and TEM Modes in Circular Waveguides.

UNIT-2 **20L+0T+8P=20 Hours**

MICROWAVE COMPONENTS AND MEASUREMENTS:

Microwave Components: Cavity Resonators, Microwave Hybrid Circuits (E-plane, H-plane, and Magic Tee), Directional Couplers, Circulators, and Isolators.

Microwave Measurements: Components of Microwave Bench Set-Up, Frequency and Wavelength Measurement, VSWR Measurement, and Microwave Power Measurement.

PRACTICES:

Design and verify the following Microwave Wave waveguide and components using Simulation Software (HFSS/CST/ANSYS).

- Verify the Mode pattern and cut-off frequency of TE and TM Modes Rectangular waveguide.
- Verify Mode Pattern and cut-off frequency of TE, TM, TEM Modes Circular waveguide
- Verify the Q-factor and Resonant frequency of Cavity Resonators (Rectangular and Circular).
- Verify S-Parameters of Hybrid Circuits.
- Verify S-Parameters Circulators and Isolators.

MODULE–2

UNIT-1 **12L+0T+8P=20 Hours**

MICROWAVE LINEAR BEAM TUBES (O-TYPE):

Introduction, Limitations of Conventional Tubes.

Two-Cavity Klystron: Velocity Modulation Process, Bunching Process, Output Power, and Efficiency.

Reflex Klystron: Velocity Modulation, Power Output, and Efficiency.

SKILLS:

- ✓ *Choose the required component for power coupling in the microwave communication systems.*
- ✓ *Select the high-power amplifier/oscillator for the microwave frequency operation.*
- ✓ *Identify the required low power oscillator for receiver applications.*
- ✓ *Measure the impedance value of the given load through VSWR measurement.*

UNIT-2 **12L+0T+8P=20 Hours**

MICROWAVE CROSS-FIELD TUBES (M-TYPE):

Magnetron Oscillators: Cylindrical Magnetron.

Microwave Solid State Devices: Gunn Diode, PIN Diode, and Schottky Diode.

PRACTICES:

Design and verify the following Microwave Wave waveguide and components using Simulation Software (HFSS/CST/ANSYS).

- Analyze of microwave linear beam tubes.
- Analyze of microwave cross field tubes.
- Verify S-Parameters of Reconfigurable switch using PIN diode.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the Microwave Frequencies and Waveguides	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Apply S-parameter concept to analyze various microwave components and perform various microwave measurements.	Apply	1	1, 2, 4,5, 9, 10,12
3	Analyze the Microwave O-Type Tubes.	Analyze	2	1, 2,4,5, 9, 10,12
4	Analyze the Microwave M-Type Tubes, and various Microwave Solid State Devices	Analyze	2	1, 2,3,4,5, 9, 10, 12

TEXT BOOKS:

1. Samuel. Y. Liao, “Microwave Devices and Circuits”, Pearson Education, Third Edition, 2008.
2. David M. Pozar, “Microwave Engineering”, 4th edition, John Wiley and Sons, 2012.

REFERENCE BOOKS:

1. John Wiley and Robert E. Collin, “Foundations for Microwave Engineering”, 2nd edition, John Wiley and sons, 2002.
2. Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, “Microwave Principles”, CBS Publishers and Distributors, 2004.
3. M.Kulkarni, “Microwave and Radar Engineering”, 5th edition, Umesh Publications, 2014.

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DEPT.
ELECTIVES

ELECTRONICS AND COMMUNICATION ENGINEERING

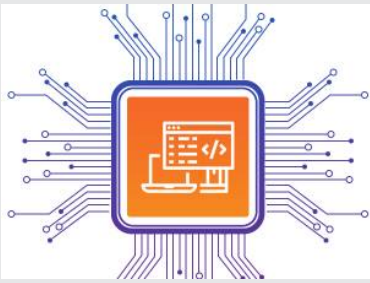
B.Tech.

22EC834	-	C-Based VLSI Design
22EC835	-	FPGA Based System Design
22EC836	-	Hardware Verification Techniques
22EC837	-	PERL & TCL Programming
22EC838	-	Python for Software/Hardware Co-Design
22EC839	-	System on Chip Design
22EC840	-	Testing of VLSI Circuits
22EC841	-	Verification Using System Verilog

COURSE CONTENTS

I SEM & II SEM

22EC834 C-BASED VLSI DESIGN



Source: https://www.tessolve.com/vlsi-design/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: C programming & VLSI Design.

COURSE DESCRIPTION AND OBJECTIVES:

Synthesize ANSI-C descriptions using state of the art commercial High-Level Synthesis tools. Convert behavioural Software (SW) descriptions (e.g., ANSI C) into synthesizable ANSI C descriptions, understanding the limitations. Apply C-based hierarchical design methods, including functions, multiple processes, and bus structures to synthesize complete HW systems.

MODULE–1

UNIT -1 **8L+8T+0P=16 Hours**

ELECTRONIC DESIGN AUTOMATION:

Overview of high-level synthesis, Logic synthesis and physical synthesis. HIGH-LEVEL SYNTHESIS (HLS) FUNDAMENTALS: Overview HLS flow, Scheduling Techniques, Resource sharing and Binding Techniques, Datapath and Controller Generation Techniques.

UNIT-2 **8L+8T+0P=16 Hours**

C-CODING ON HARDWARE:

Data types, Synthesis of Loops, Functions, RAM, ROM, Shift register inference from arrays, Impact of Compiler optimizations like copy propagation, Constant propagation, Common sub-expression elimination, Loop transformations, Code motions, etc., in HLS results.

PRACTICES:

- Scheduling techniques.
- Binding techniques.
- Data types.
- Synthesis of loops.
- Inference from arrays

MODULE–2

UNIT-1 **8L+8T+0P=16 Hours**

HLS FOR SECURITY AND OPTIMIZATION:

RTL Locking, Logic Locking, Attack and defence techniques, RTL optimizations techniques, Various optimization techniques to improve latency, area and power in C-based VLSI designs.

UNIT – 2 **8L+8T+0P=16 Hours**

HIGH-LEVEL SYNTHESIS VERIFICATION:

BDD, Simulation based verification, Equivalence checking between C and RTL, Hardware acceleration of Machine Learning Algorithms, Domain Specific High-level Synthesis.

PRACTICES:

- RTL locking.
- Logic locking.

SKILLS:

- ✓ *Design C-code for effective hardware generation and enhance the circuit efficiency using compiler optimization*
- ✓ *Provide support for HLS, FPGA targets, verification and RTL optimization required for EDA industry*
- ✓ *Realize FSM using C based VLSI.*

- RTL optimization techniques
- Verifications
- Machine learning algorithms
- High level synthesis

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand and analyse the overall High-Level Synthesis (HLS) flow.	Analyse	1	1, 2, 4, 5, 9, 10, 12
2	Build C-codes for efficient hardware generation.	Apply	1	1, 2, 5, 9, 10
3	Identify software compiler optimization to improve the circuit performance.	Apply	2	1, 2, 3, 5, 9, 10
4	Evaluate HLS for FPGA targets, Security, and optimizations at RTL level and verification.	Evaluate	2	1, 2, 5, 9, 10, 12

TEXTBOOKS:

1. G. De Micheli, “Synthesis and optimization of digital circuits”, McGraw Hill, India Edition, 2003.
2. J. P. Elliot, “Understanding Behavioural Synthesis: A Practical guide to High-level Synthesis”, Springer, 2nd edition, 2000.

REFERENCEBOOKS:

1. Steve Kilts, “Advanced FPGA Design”, Wiley, 2007.
2. K. Parhi, “VLSI Digital Signal Processing Systems: Design and Implementation”, Wiley, 1999.
3. M. Huth and M. Ryan, “Logic in Computer Science: Modelling and Reasoning about Systems”, 2nd edition, Cambridge University Press, 2004.

22EC835 FPGA BASED SYSTEM DESIGN

Source: https://www.elprocus.com/fpga-architecture-and-applications/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Digital Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the advanced design and analysis of digital circuits with HDL. The primary goal is to provide in depth understanding of system design. The course enables students to apply their knowledge for the design of advanced digital hardware systems with help of FPGA tools.

MODULE –1

UNIT-1 **8L+0T+8P=16 Hours**

OVERVIEW OF FPGA ARCHITECTURES AND TECHNOLOGIES:

The role of FPGA in digital design, FPGA types, FPGA Vs Custom VLSI, FPGA Architectures, SRAM based FPGAs, Antifuse based FPGAs, EPROM based FPGAs, Chip I/O, Circuit design of FPGA Fabrics: Logic elements & interconnects.

UNIT-2 **8L+0T+8P=16 Hours**

VERILOG HDL CODING STYLES:

Lexical conventions, Ports and modules, Operators, Gate level modelling - Introduction, AND gate and other gate primitives, Examples, Data flow modelling and switch level modelling - Introduction, Continuous assignment structures, Basic transistor, Switches, CMOS switch, Bi-directional gates.

MODULE –2

UNIT-1 **8L+0T+8P=16 Hours**

BEHAVIORALLEVEL MODELING:

Operations and assignments, Initial construct, always construct, Examples, Assignments with delays, Wait construct, Multiple always blocks, Designs at behavioural level, Blocking and non-blocking assignments, The case statement, If and if-else constructs, Assign-design construct, Repeat construct, For loop, While loop, Forever loop, Parallel blocks, Tasks & Functions.

UNIT-2 **8L+0T+8P=16 Hours**

VERILOG MODELING OF COMBINATIONAL AND SEQUENTIAL CIRCUITS:

Behavioural, Data flow and structural realization – Adders, Multipliers, Comparators, Flip-Flops, Shift register, Synchronous and asynchronous counters, FIFO, Single port and dual port RAM, Pseudo random LFSR.

PRACTICES:

- Design of combinational circuits - adders and subtractors.
- Design of combinational circuits - multiplexers and demultiplexers.
- Design of combinational circuits - decoder and encoder.
- Design of combinational circuits - magnitude comparator.
- Design of sequential circuits - flip flops.
- Design of 4-bit binary, BCD counters (synchronous/ asynchronous reset).

SKILLS:

- ✓ *Write a synthesizable more efficient Verilog code and test bench for verification of complex combinational and sequential circuits.*
- ✓ *Analyze various FPGS architectures and technologies to implement the complex designs in FPGA.*

- Design of a N- bit Register.
- Design of 4- Bit multiplier, divider.
- Serial adder.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Model the FPGA Architecture	Apply	1	1, 2, 12
2	Model Combinational and sequential digital circuits with Verilog HDL at behavioural, structural, and RTL Levels.	Apply	1	1, 2, 4, 5, 12
3	Develop test benches to simulate combinational and sequential circuits.	Apply	2	1, 2, 3, 5, 12
4	Design the combinational and sequential digital circuits in FPGA.	Create	2	1, 2, 3, 12

TEXT BOOKS:

1. Stephen Brown & ZvonkoVranesic, “Digital Logic Design with Verilog HDL” TATA McGraw Hill Ltd. 2nd Edition 2007.
2. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis” Prentice Hall, Second Edition, 2003.
3. Wayne Wolf, “FPGA Based System Design”, PTR Prentice Hall, 2004.

REFERENCES BOOKS:

1. T.R. Padmanabhan, B.Bala Tripura Sundari, “Design through Verilog HDL” Wiley Interscience, 2004.
2. S. Ramachandran, “Digital VLSI System Design: A Design Manual for implementation of Projects on FPGAs and ASICs Using Verilog” Springer Publication, 2007.
3. Clive Maxfield, “The Design Warriors’s Guide to FPGAs”, Elsevier, 2004.
4. Peter Ashenden, “Digital Design using Verilog”, Elsevier, 2007.

22EC836 HARDWARE VERIFICATION TECHNIQUES

Source: https://www.gsaglobal.org/forums/a-systematic-approach-to-verification-validation-using-hardware-assisted-verification/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: VLSI Design & Testing of VLSI Circuits.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides knowledge about various verification methods for software and hardware, addressing the industry needs in software/hardware co-designs. The objective of the course is to deal with the techniques for verification of hardware and concurrent software programs.

MODULE-1

UNIT -1 **8L+8T+0P=16 Hours**

VERIFICATION:

Testbench -The importance of verification, Reconvergence model, Automation, Poka- Yoke redundancy, Equivalence checking model, Checking functional verification, Functional verification, Testing versus verification design and verification reuse.

UNIT-2 **8L+8T+0P=16 Hours**

VERIFICATION TOOLS:

Linting tools - Simulators, Verification intellectual property, Code coverage, Functional coverage verification languages, Assertions, Revision control, Issue tracking metrics, Interpreting metrics.

PRACTICES:

- Examples of Poka- Yoke redundancy
- Implementation of equivalence checking model.
- Functional verification.
- Simulation of assertions.
- Examples of Interpreting metrics

MODULE-2

UNIT -1 **8L+8T+0P=16 Hours**

VERIFICATION PLAN:

The role of the verification plan, Levels of verification-from specification to features, directed testbenches approach, Coverage driven, Random based approach directed testcases. STIMULUS AND RESPONSE: Reference signals, Simple stimulus, Simple output, Complex stimulus, Bus-functional models, Response monitors, Transaction-level interface.

UNIT -2 **8L+8T+0P=16 Hours**

ARCHITECTING TEST BENCHES:

Test harness, VHDL test harness, Design configuration, Self-checking testbenches, directed stimulus, Random stimulus, defining scenarios, Behavioural models, Managing simulations, Regression.

SKILLS:

- ✓ *Verify the functional properties of the hardware design.*
- ✓ *Write testbenches for functional verification of HDL models.*
- ✓ *Realize impact of HVT on modern designs.*

PRACTICES:

- Examples of random based approach testcases
- Examples of Transaction-level interface
- Implementing Test harness
- Implementation of Regression

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the System Verilog environment of digital systems and analyse.	Analyse	1	1, 2, 4, 5, 9, 10, 12
2	Model a scenario for Verification of a DUT in System Verilog.	Apply	1	1, 2, 5, 9, 10
3	Develop UVM environment at chip level.	Apply	2	1, 2, 3, 5, 9, 10
4	Create test benches for digital systems.	Create	2	1, 2, 5, 9, 10, 12

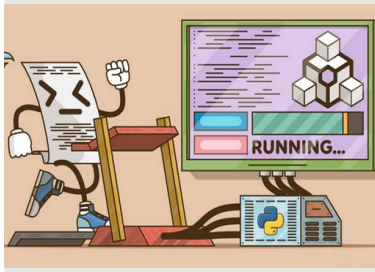
TEXT BOOKS:

1. Stuart Sutherland, Simon Davidmann, Peter Flake, “System Verilog for design: a guide to using System Verilog for hardware design and modeling”, Springer, ISBN 1402075308, 9781402075308, 2004.
2. Stephen Prata, “C++ Primer Plus”, Pearson Education Inc, 2012.

REFERENCE BOOKS:

1 Chris Spear, “System Verilog for Verification: A Guide to Learning the Test bench Language Features”, 2nd edition, Published by Springer, 2008.
2. Srikanth Vijayaraghavan, Meyyappan Ramanathan, “A Practical guide for System Verilog Assertions”, Springer, 2005.
3. Sharon Rosenberg, Kathleen A Meade, “A practical guide to adopting the Universal Verification Methodology”, 2010.

22EC837 PERL AND TCL PROGRAMMING



Source: https://medium.com/@rolla.venkat.reddy/tcl-vs-perl-vs-python-vs-skill-vs-c-how-to-build-my-design-infrastructure-40880bda7652

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Programming Language.

COURSE DESCRIPTION AND OBJECTIVES:

To explain the characteristics and uses of scripting languages. To describe the various PERL concepts used in VLSI design. To learn the concepts of TC.

MODULE - 1

UNIT-1 **8L+8T+0P=16 Hours**

INTRODUCTION TO SCRIPTS AND SCRIPTING USING PERL:

Characteristics and uses of scripting languages, Introduction to PERL, Names and values, Variables and assignment, Scalar expressions, Control structures, Built-in functions, Collections of Data, Working with arrays, Lists and hashes, Simple input and output, Strings, Patterns and regular expressions, Subroutines, Scripts with arguments.

UNIT-2 **8L+8T+0P=16 Hours**

ADVANCED PERL:

Finer points of Looping, Subroutines, Using Pack and Unpack, working with files, Navigating the file system, Type globs, Eval, References, Data structures, Packages, Libraries and modules, Objects, Objects and modules in action, Tied variables, Interfacing to the operating systems, Security issues.

PRACTICES:

- Examples of open-source languages.
- Get started quickly with programming
- Set up a Perl development environment for practicing Perl
- Understanding of variables, variable scopes, and variable interpolation.
- Creating new applications in web browsers
- Create plug-ins and extensions.

MODULE – 2

UNIT-1 **8L+8T+0P=16 Hours**

TCL: The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/output, Procedures, Working with Strings, Patterns, Files and Pipes, Example code.

UNIT-2 **8L+8T+0P=16 Hours**

ADVANCED TCL: The eval, source, exec and up-level commands, Libraries and packages, Namespaces, Trapping errors, Event-driven programs, Making applications 'Internet-aware', 'Nuts- and-bolts' internet programming, Security issues, running untrusted code, The C interface.

PRACTICES:

- Running Tcl
- Simple Text Output

SKILLS:

- ✓ *Apply the knowledge of PERL to write any program.*
- ✓ *Apply the knowledge of TCL to write any program.*
- ✓ *Resolve security issues in internet programming.*

- Assigning values to variables
- Evaluation & Substitutions 1: Grouping arguments with “”
- Textual Comparison - switch
- Evaluation & Substitutions 2: Grouping arguments with {}
- Evaluation & Substitutions 3: Grouping arguments with []
- Results of a command - Math 101

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Interpret typical scripting languages for system ap-plications.	Apply	1	1, 2, 12
2	Develop server-side scripts using Perl and TCL.	Apply	1	1, 2, 5, 12
3	Create software systems using scripting languag-es, including Perl and TCL.	Create	2	1, 2, 3, 5, 12
4	Design websites using advanced TCL.	Create	2	1, 2, 12

TEXT BOOKS:

1. David Barron, “The World of Scripting Languages”, Wiley Student Edition, 2010.
2. Brent Welch, Ken Jones and Jeff Hobbs, “Practical Programming in TCL and TK”, Fourth edition, 2003.

REFERENCE BOOKS:

1. Clif Flynt, “TCL/TK: A Developer’s Guide”, Morgan Kaufmann Series, 2003.
2. John Ousterhout, “TCL and the TK Toolkit”, 2nd Edition, Kindel Edition, 2009.
3. Wojciech Kocjan and Piotr Beltowski, “TCL 8.5 Network Programming book”, Packt Publishing.

22EC838 PYTHON FOR SOFTWARE/ HARDWARE CO-DESIGN

Source: http://daslab.seas.harvard.edu/hw-sw/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Programming Knowledge, Digital Electronics

COURSE DESCRIPTION AND OBJECTIVES:

Understand the Role of Scripting in VLSI Design. Know Basics of Python, Pandas, Numpy and Matplotlib Packages . Know the HDL design libraries MyHDL and Pymtl. Understand designing and implementation of combinational, Sequential circuits using Python, MyHDL and pymtl.

MODULE–1

UNIT-1 **6L+6T+0P=12 Hours**

BASICS OF PYTHON:

Introduction to Python Language-Numbers, Strings, Lists, python control statements-if, for, range function, break and continue statements and else clauses on loops, pass statements, functions, data structures, input and output.

UNIT-2 **10L+10T+0P=20 Hours**

FILE HANDLING AND MODULES:

Numpy- Special arrays, Slicing arrays, Array arithmetic, Boolean operations, Distance metrics, Sorting, Pandas - Introduction, Python pandas - Series, Dataframe, Read and analyze the data, Indexing and selecting data, Statistical functions, Plotting.

PRACTICES:

- Write a program to demonstrate different number datatypes in python.
- Write a program to perform different arithmetic operations on numbers in python.
- Write a program to create, concatenate and print a string and accessing substring from a given string.Evaluating Performance.
- Write a python program to create, append and remove lists in python.
- Write a program to demonstrate working with tuples in python.
- Write a program to demonstrate working with dictionaries in python.
- Write a python program to find largest of three numbers.
- Write a python program to convert temperature to and from Celsius to fahrenheit.
- Write a python program to print prim numbers less than 20.
- Write a python program to find factorial of a number using recursion.
- Write a python program to define a module to find Fibonacci Numbers and import the module to another program.
- Write a python program to perform basic calculator operations using class.
- Write a python program to find the area of rectangle using classes.

MODULE–2

UNIT-1 **8L+8T+0P=16 Hours**

MyHDL:

Introduction to MyHDL, A basic MyHDL simulation, Signals and concurrency, Parameters, ports and hierarchy HARDWARE-ORIENTED TYPES: The intbv class, Bit indexing, Bit slicing, The modbv class, Unsigned and signed representation.

SKILLS:

- ✓ *Program any specific application using Python.*
- ✓ *Design combinational and sequential circuits using MyHDL.*

UNIT-2 **8L+8T+0P=16 Hours**

MYHDL MODELING:

Structural modeling - Introduction, Conditional instantiation, Converting between lists of signals and bit vectors, Inferring the list of instances. RTL MODELING: Introduction, Combinatorial logic, Sequential logic. HIGH LEVEL MODELING: Introduction, Modelling with bus-functional procedure, Modelling memories with built-in types.

PRACTICES:

- Write a MyHDL code for simple combinational circuit.
- Write a MyHDL code for simple sequential circuit.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply basics of Python, Pandas and Numpy modules.	Apply	1	1, 2, 12
2	Develop the solution for a given problem using Py-thon.	Apply	1	1, 2, 4, 5, 12
3	Model the hardware using design libraries MyHDL.	Apply	2	1, 2, 3, 5, 12
4	Design the combinational, Sequential circuits MyHDL.	Create	2	1, 2, 3, 12

TEXT BOOKS:

1. Steve Holden and David Beazley, “Python Web Programming”, New Riders Publications, 2002.
2. J. Decaluwe. “MyHDL: A Python-based Hardware Description Language”, Linux journal, 2004(127):5, 2004.

REFERENCE BOOKS:

1. Programming Python, M.Lutz,SPD.
2. Guide to Programming with Python, M.Dawson, Cengage Learning.
3. IEEE standard for system verilog-unified hardware design, specification, and verification
4. language. IEEE Std 1800-2012 (Revision of IEEE Std 1800-2009), pages 1—1315, Feb 013.
5. The MyHDL Manual. http://docs.myhdl.org/en/latest/manual/index.html, 2014.
6. Altera. Avalon interface specifications. http://www.altera.com/literature/manual/mnl_avalon_
7. spec.pdf, 2014.
8. http://www.myhdl.org/
9. https://github.com/xesscorp/myhdl-resources
10. https://www.fpgarelated.com/showarticle/25.php

22EC839 SYSTEM ON CHIP DESIGN

Source: https://microcontrollerslab.com/system-on-chip-soc-introduction/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Concepts of VLSI Design.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the concepts of integrating all components of any electronic system into a single chip. The objective of the course is to introduce the students to digital, analogue, mixed- signal, and radio-frequency functions to integrate all on a single chip substrate.

MODULE–1

UNIT -1 **8L+8T+0P=16 Hours**

INTRODUCTION TO SOC:

System trade-offs and evolution of ASIC technology, System on chip concepts and methodology, SoC design issues, SoC challenges and components.

UNIT – 2 **8L+8T+0P=16 Hours**

DESIGN METHODOLOGY FOR LOGIC CORES:

SoC design flow, On-chip buses, Design process for hard cores, Soft and firm cores, Designing with hard cores, soft cores, Core and SoC design examples.

PRACTICES:

- Implementation of SoC concepts.
- Simulation of hard cores.
- Simulation of soft cores.

MODULE–2

UNIT – 1 **8L+8T+0P=16 Hours**

DESIGN METHODOLOGY FOR MEMORY AND ANALOG CORES:

Embedded memories, Simulation modes specification of analogue circuits, A to D converters, Phase locked loops, High speed I/O.

UNIT – 2 **8L+8T+0P=16 Hours**

DESIGN VALIDATION:

Core level validation - Test benches, SoC design validation, Hardware /software co-simulation and co-verification; Case study - Validation and testing of SoC. SoC test issues - Testing of digital logic cores, Built in self-test method.

PRACTICES:

- SoC test issues.
- Implementing testbenches
- Simulation of digital logic cores
- Implementation of BIST

SKILLS:

- ✓ *Design and test a SoC system.*
- ✓ *Effective realization of BIST.*
- ✓ *Realize impact of SoC on electronic design.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand and analyse the fundamental concepts, methodologies, design issues of System-on-Chip.	Analyse	1	1, 2, 4, 5, 9, 10, 12
2	Demonstrate testing issues in digital logic cores.	Apply	1	1, 2, 5, 9, 10
3	Apply the knowledge of methods and design issues in hard-core, soft-core process and analogue circuits.	Apply	2	1, 2, 3, 5, 9, 10
4	Analyse the software and hardware simulation and validate it.	Analyse	2	1, 2, 5, 9, 10, 12

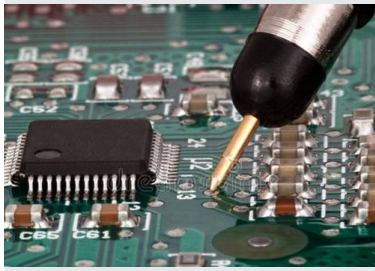
TEXT BOOKS:

1. Rochit Rajsuman, “System-on-a-chip: Design and Test”, 2nd edition, Santa Clara, CA: Artech House, 2000.
2. Prakash Rashinkar, Peter Paterson and Leena Singh, “System-on-a-chip verification: Methodology and Techniques”, 3rd edition, Kluwer Academic Publishers, 2011.

REFERENCE BOOKS:

1. M. Keating, D.Flynn, R.Aitken, A. Gibbons and K. Shi, “Low Power Methodology Manual for System-On-Chip Design Series (Integrated Circuits and Systems)”, 2nd edition, Springer, 2007.
2. L.Balado and E. Lupon, “Validation and test of systems on chip”, Twelth Annual IEEE conference on ASIC/SOC, 1999.
3. A.Manzone, P.Bernardi, M.Grosso, M.Rebaudengo, E.Sanchez and M.S.Reorda “Integrating BIST techniques for on-line SoC testing”, Eleventh IEEE International on line testing symposium, 2005.

22EC840 TESTING OF VLSI CIRCUITS



Source: https://study bullet.com/udemy /introduction-to-testing-of-vlsi-circuits-fault-modeling/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: VLSI Design.

COURSE DESCRIPTION AND OBJECTIVES:

This course imparts knowledge on various types of faults, fault detection techniques and dominance. The objective of this course is to introduce the student to the concepts of test generation for combinational and sequential circuits and other VLSI circuit testing methods like DFT schemes, BIST and BILBO.

MODULE - I

UNIT-1 **8L+8T+0P=16 Hours**

TESTING AND FAULT MODELLING:

Introduction to testing, Faults in digital circuits, Modelling of faults, Logical fault models, Fault detection, Fault location, Fault dominance, Logic simulation, Types of simulation, Delay models, Gate level event, Driven simulation.

UNIT-2 **8L+8T+0P=16 Hours**

CMOS DIGITAL CIRCUITS:

TEST GENERATION: Test generation for combinational logic circuits, Testable combinational logic circuit design, Test generation for sequential circuits, Design of testable sequential circuits.

DESIGN FOR TESTABILITY: Design for testability, Ad-hoc design, Generic scan-based design, Classical scan-based design, System level DFT approaches.

PRACTICES:

- Analyze the stuck-1 and stuck-0 faults for different combinational circuits
- Design test pattern generator for 4 bit.
- Analyze DFT with any example.

MODULE - 2

UNIT-1 **8L+8T+0P=16Hours**

SELF – TEST AND TEST ALGORITHMS:

Built-In self-test, Test pattern generation for BIST, Circular BIST, BIST architectures, Testable memory design, Test algorithms, Test generation for embedded RAMs.

UNIT-2 **8L+8T+0P=16 Hours**

FAULT DIAGNOSIS:

Logical level diagnosis, Diagnosis by UUT reduction, Fault diagnosis for combinational circuits, Self-checking design, System level diagnosis.

PRACTICES:

- Analyze the BIST architecture
- Analyze the Fault models in Combinational circuits
- Analyze the Self checking design
- Design self-checking logic gates
-

SKILLS:

- ✓ *Identify various faults in any circuit.*
- ✓ *Analyse different test patterns for combinational and sequential circuits.*
- ✓ *Design and investigate self-checking circuits.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concept of fault models to identify the faults and fault location.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Analyze the Generation of test patterns for the given combinational, sequential circuits with built in self-test.	Analyse	1	1, 2, 5, 9, 10
3	Test the fault diagnosis by UUT reduction techniques in combinational circuits and systems.	Apply	2	1, 2, 3, 5, 9, 10
4	Develop self-checking designs for fault tolerant systems.	Apply	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:

1. M.Abramovici, M.A.Breuer and A.D. Friedman, “Digital systems and Testable Design”, 2nd edition, Jaico Publishing House, 2012.
2. P.K. Lala, “Fault Tolerant and Fault Testable Hardware Design”, 3rd edition, Academic Press, 2012.

REFERENCE BOOKS:

1. P.K. Lala, “Digital Circuit Testing and Testability”, 2nd edition, Academic Press, 2012.
2. M.L.Bushnell and V.D.Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, 2nd edition, Kluwer Academic Publishers, 2012.
3. A.L.Crouch, “Design Test for Digital IC’s and Embedded Core Systems”, 5th edition, Prentice Hall International, 2009.
4. http://nptel.ac.in/courses/106103016/30.

22EC841 VERIFICATION USING SYSTEM VERILOG

Source: https://icons-for-free.com/SystemVerilog-1324888767028251608/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Digital Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

To expose the students to all aspects of functional verification of digital systems. To introduce verification of hardware designs. To provide a practical approach for verification of designs. To give an introduction to FPGA based verification and Emulation of VLSI systems. To study the basic concepts of system Verilog. To Study the basic concepts of OOPs.

MODULE - 1

UNIT-1 **8L+8T+0P=16 Hours**

SYSTEM VERILOG:

Data Types, Arrays, Structures, Unions, Procedural Blocks, Tasks & Functions, Procedural Statements, Interfaces, Basic OOPs, Randomization, Threads & Inter Process Communication.

UNIT-2 **8L+8T+0P=16 Hours**

SYSTEM VERILOG TEST BENCH:

Advanced OOPs & Test bench guidelines, Advanced Interfaces, A Complete System Verilog Test Bench (SVTB), Functional Coverage in System Verilog.

PRACTICES:

- Examples implementing implication operators
- Repetition operators.
- Functional verification.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

SYSTEM VERILOG ASSERTIONS (SVA)-1:

Introduction to SVA, building blocks, Properties, Boolean expressions, Sequence, Single & Multiple Clock definitions, Implication operators (Overlapping & Non- overlapping), Repetition operators.

UNIT-2 **8L+8T+0P=16 Hours**

SYSTEM VERILOG ASSERTIONS (SVA)-2:

Built-in System functions ($past, $stable, $onehot, $onehot0, $isunknown), Constructs (ended, and, intersect, or, first match, throughout, within, disableiff, expect, matched, if –else), Assertion directives, Nested implication, Formal arguments in property.

PRACTICES:

- Built in system functions.
- Nested implications

SKILLS:

- ✓ *Write a synthesizable more efficient Verilog code and test bench for verification of complex combinational and sequential circuits.*
- ✓ *Analyze various FPGS architectures and technologies to implement the complex designs in FPGA.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the System Verilog environment of digital systems.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Model a scenario for Verification of a DUT in System Verilog.	Apply	1	1, 2, 4, 5, 9, 10, 12
3	Develop UVM environment at chip level.	Apply	2	1, 2, 3, 5, 9, 10
4	Create test benches for digital systems.	Create	2	1, 2, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Stuart Sutherland, Simon Davidmann, Peter Flake, “SystemVerilog for design: a guide to using SystemVerilog for hardware design and modeling”, Springer, ISBN 1402075308, 9781402075308, 2004.
2. Stephen Prata, “C++ Primer Plus”, Pearson Education Inc, 2012.

REFERENCE BOOKS:

1. Janick Bergeron, “Writing testbenches using System Verilog”, Birkhäuser, 2006.
2. Ben Cohen, cohen, Venkataramanan, Kumari, Srinivasan Venkataramanan, AjeethaKumari, “SystemVerilog Assertions Handbook - for Formal and Dynamic Verification”, Vhdlcohen publishing, 2005.

DEPT.
ELECTIVES

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech.

22EC815	-	Android OS and Application Development
22EC816	-	Cognitive Radio Networks
22EC817	-	Embedded System Design Using FPGA
22EC818	-	Introduction to Embedded Systems
22EC819	-	Introduction to Industry 4.0 and Industrial Internet of Things
22EC820	-	Multi-Core Architectures and Programming
22EC821	-	Smart & Virtual Instrumentation
22EC823	-	Wireless Sensor Networks

COURSE CONTENTS

I SEM & II SEM

22EC815 ANDROID OS AND APPLICATION DEVELOPMENT

Source: https://www.getaprogrammer.com.au/a-beginners-guide-to-android-app-development/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Any programming language with Oops concepts.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of the course is that the student will be able to develop android application using Java in Android Studio.

MODULE –1

UNIT-1 **8L+0T+8P=16 Hours**

UNDERSTANDING ANDROID OS:

Android App Creation in Android Studio, Overview of the Android Architecture, The Anatomy of an Android Application, Overview of Android View Binding, Understanding Android Application and Activity Lifecycles.

UNIT-2 **8L+0T+8P=16 Hours**

UNDERSTANDING STATES AND ACTIVITIES:

Handling Android Activity State Changes, Saving and Restoring the State of an Android Activity, Understanding Android Views, View Groups and Layouts, Android Constraint Layout, Android Touch and Multi-touch Event Handling.

Implementing gestures and touch: Detecting Common Gestures Using the Android Gesture Detector Class, Implementing Custom Gesture and Pinch Recognition on Android,

PRACTICES:

- Develop an application that uses GUI components, Font and Colors.
- Develop an application that uses Layout Managers and event listeners.
- Develop a native calculator application.
- Write an application that draws basic graphical primitives on the screen.
- Develop an application that makes use of database.
- Develop an application that makes use of RSS Feed.

MODULE –2

UNIT-1 **8L+0T+8P=16 Hours**

DESIGNING ANDROID COMPONENTS:

Modern Android App Architecture with Jetpack, An Android Jetpack View Model Tutorial, Working with the Floating Action Button and Snackbar, Creating a Tabbed Interface using the TabLayout Component

WORKING WITH INTENTS AND NOTIFICATIONS: Adding Sample Data to a Project, Working with the AppBar and Collapsing Toolbar Layouts, Overview of Android Intents, Android Explicit & Implicit Intents, Android Broadcast Intents and Broadcast Receivers, Overview of Android Services & Notifications, Foldable Devices and Multi-Window Support

UNIT-2 **8L+0T+8P=16 Hours**

ACCESSING STORAGE AND MULTIMEDIA :

An Android Storage Access Framework, Video Playback on Android using the VideoView and MediaController Classes, Making Runtime Permission Requests in Android, Android Audio Recording and Playback using MediaPlayer and MediaRecorder

SKILLS:

- ✓ *Identify the components of the android program*
- ✓ *Develop android application architecture*
- ✓ *Implement oops concepts for android applications.*

CREATING AND TESTING ANDROID APP: Android App Links, Creating, Testing and Uploading an Android App Bundle

PRACTICES:

- Implement an application that implements Multi threading.
- Develop a native application that uses GPS location information.
- Implement an application that writes data to the SD card.
- Implement an application that creates an alert upon receiving a message.
- Write a mobile application that creates alarm clock.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Implement basic states, gestures for Android applications	Create	1	1, 2, 4, 9, 10, 11, 12
2	Identify and design the components for developing android applications	Apply	1	1, 2, 3, 4, 9, 10, 11, 12
3	Display notifications and access storage and multimedia in android OS	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Design an android app for a given need	Create	2	1, 2, 3, 4, 9, 10, 11, 12

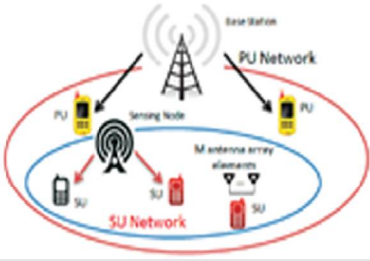
TEXT BOOKS:

1. Smyth, Neil, “Android Studio 4. 2 Development Essentials - Java Edition”, 2021
2. Wei-Meng Lee, “Beginning Android 4 Application Development”, 1st edition, Wiely Publishers, 2011.

REFERENCES BOOKS:

1. Prasanna Kumar Dixit, “Android”, 1st edition, Vikas Publishers, 2014.
2. Jerome (J.F.) DiMarzio, “Android - A programmers Guide”, 1st edition, Tata Mc Graw Hill, 2010.
3. Reto Meier, “Professional Android 4 Application Development”, 1st edition, Wiley Publishers, 2008
4. John Horton, “Android Programming for Beginners”, 1st edition, Pact Publishing, 2015.

22EC816 COGNITIVE RADIO NETWORKS



Source: https://www.mdpi.com/1424-8220/15/7/16105

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Data Communications and Computer Networks.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the fundamental knowledge of cognitive radio networks involving in various operations and scope for research. The primary goal is to provide basic understanding of evolving cognitive radio techniques and their essential functionalities, the basic architecture and standard for cognitive radio, the physical, MAC and Network layer design of cognitive radio and to expose the student to evolving applications and advanced features of cognitive radio.

MODULE - 1

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION TO COGNITIVE RADIO NETWORKS:

Goals, benefits, definitions, and architecture of cognitive radio networks, Life cycle: Spectrum sensing, Analysis, Decision, mobility, Paradigms of Cognitive Radio, overview of IEEE 802.22 standard for broadband wireless access in TV bands.

UNT-2 **8L+0T+8P=16 Hours**

SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS:

Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.

PRACTICES:

- Energy detection and observing the impact of threshold on sensing result.
- Cooperative versus single user detection with different fusion rules.
- Matched filter detection
- Spectrum sharing

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO NETWORKS:

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT-2 **8L+0T+8P=16 Hours**

ADVANCED TOPICS IN COGNITIVE RADIO:

Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, cognitive radio for public safety, cognitive radio for Internet of Things.

SKILLS:

- ✓ *Understanding of cognitive radio techniques*
- ✓ *Able to analyze functionalities, architecture and standard for cognitive radio*
- ✓ *Expose students to advanced features of cognitive radio*

PRACTICES:

- Routing in cognitive radio networks.
- Simulation of ALOHA.
- Simulation of slotted ALOHA.
- Simulation of CSMA.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify the spectrum for cognitive radio network	Analyze	1	1, 2, 4, 9, 10, 11, 12
2	Design and implement algorithms for cognitive radio spectrum sensing and dynamic spectrum access	Create	1	1, 2, 3, 4, 9, 10, 11, 12
3	Apply the knowledge of advanced features of cognitive radio for real world applications	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Analyze and identify the requirements for designing cognitive radio network	Evaluate	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, - Cognitive Radio Communications and Networks‖, Academic Press, Elsevier, 2010.
2. Huseyin Arslan (Ed.), Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2014.

REFERENCE BOOKS:

1. Bruce Fette, —Cognitive Radio Technology‖, Newnes, 2006
2. Kwang-Cheng Chen, Ramjee Prasad, - Cognitive Radio Networks‖, John Wiley and Sons, 2009
3. Ezio Biglieri, Professor Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor, - Principles of Cognitive Radio‖ , Cambridge University Press, 2012.

22EC817 EMBEDDED SYSTEM DESIGN USING FPGA

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Microprocessors and Microcontrollers.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the design and analysis of digital circuits with Verilog HDL. The primary goal is to provide basic understanding of system design. The course enables students to apply their knowledge for the design of digital hardware systems with help of FPGA tools: Understand Digital system design using Verilog HDL, Know FPGA architecture, interconnect and technologies, Understand and implement embedded system on FPGA.

MODULE - I

UNIT-I **6L+0T+6P=12 Hours**

INTRODUCTION TO FPGA ARCHITECTURES AND XILINX VIVADO:

Introducing FPGAs: Exploring the Xilinx Artix-7 and 7 series devices, Combinational logic blocks, Storage, Clocking, I/Os, DSP48E1, ASMBL architecture. Introducing Vivado: Directory structure.

Gate-level Combinational circuit: Introduction, general description, basic lexical elements, data types, four-value system, data type groups, number representation, operators, program skeleton, port declaration, program body, signal declaration, structural description, test bench.

UNIT-II **10L+0T+10P=20 Hours**

RT-LEVEL COMBINATIONAL CIRCUIT:

Introduction, operators, always block for a combinational circuit, If statement, case statement, coding guidelines for an always block, parameter, constant, BCD incrementor.

PRACTICES:

- Setup and test the available FPGA board using the appropriate software tool.
- Design and test up and down counters
- Design and test a Binary Coded Decimal Adder.
- Design a Sequence Detector using Mealy Machine
- Design a Sequence Detector using Moore Machine

MODULE - 2

UNIT-I **6L+0T+6P=12 Hours**

REGULAR SEQUENTIAL CIRCUIT:

Introduction, HDL code of the FF and register, simple design examples, test bench for sequential circuits, square wave generator, PWM and LED dimmer.

UNIT-II **10L+0T+10P=20 Hours**

FSM: Introduction- Mealy and Moore outputs, FSM Representation, FSM code development, Design examples - Rising-edge detector, Debouncing circuit

UART: UART receiving subsystem, UART transmitting subsystem, Overall UART system, Customizing a UART

SKILLS:

- ✓ *Apply knowledge to design of digital hardware systems*
- ✓ *Understand Digital system design*
- ✓ *Understand and implement embedded system on FPGA.*

PRACTICES:

- Generate a square wave signal with FPGA.
- Generate a sinusoidal signal with FPGA.
- Send a series of characters to PC through UART
- Interface a stepper motor FPGA
- Design and test a PWM Circuit, with verification by simulation.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Design and optimize complex combinational and sequential digital circuits.	Apply	1,2	1, 2, 3, 4, 9, 10, 11, 12
2	Model and implement Combinational and sequential digital circuits by Verilog HDL.	Create	1,2	1, 2, 3, 4, 9, 10, 11, 12
3	Design and model digital circuits with Verilog HDL at behavioural, structural, and RTL Levels.	Create	1,2	1, 2, 3, 4, 9, 10, 11, 12
4	Develop test benches to simulate combinational and sequential circuits.	Create	1,2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. Fank Bruno, “FPGA Programming for beginners”, Packt Publishing Limited, 2021, ISBN 978-1-78980-541-3.
2. Pong P. Chu, “FPGA Prototyping by Verilog Examples”, A JOHN WILEY & SONS, INC. PUBLICATION, 2011.

REFERENCE BOOKS:

1. A Verilog HDL primer by J. Bhaskar, Star Galaxy Pub., 2004.
2. Verilog HDL Design Examples by Joseph Cavanagh, CRC Press, 2017.
3. VHDL and FPLDs, by Zoran Salcic, Kluwer,1998.
4. Computers as Components, Principles of Embedded Computing System Design, by Wayne Wolf, Morgan Kauffman, 2001.
5. A VHDL Primer, by Jayaram Bhasker. Prentice Hall, 1998.
6. HDL Chip Design, by Douglas J. Smith, 1999.
7. VHDL Analysis and Modeling of Digital Systems, by Z. Navabi, McGraw-Hill, 1993.

WEB REFERENCES:

1. http://www.ece.rutgers.edu/node/1528.
2. http://www.ece.iastate.edu/~morris/388/syllabus_388x.html.

22EC818 INTRODUCTION TO EMBEDDED SYSTEMS

Source: https://classpert.com/classpertx/courses/making-embedded-systems/cohort

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Computer Architecture and Organization, Microprocessors and Microcontrollers.

COURSE DESCRIPTION AND OBJECTIVES:

The course objective is to study the applications, categories, hardware and software architectures, memory, testing tools in embedded systems, Firmware, Embedded C, operating system functions and various kernel objects and RTOS.

MODULE–1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION:

Basic concepts, Applications and Categories of embedded systems, Hardware architecture, Software architecture of Embedded Systems, Process of generating executable images, Development/testing tools.

UNIT-2 **10L+0T+6P=16 Hours**

PROGRAMMING:

Comparison of Assembly and C languages, C and Embedded C. Programming in C: Arrays, Structures, Loops and Decisions, Pointers, Functions, Embedded C: Header files for Project and Header files for Port.

PRACTICES:

- Programming with Embedded C using any compiler.
- Demonstration/Practical session for creation of header files.
- Program to create loops in Embedded C.
- Program to implement decisions in Embedded C.
- Develop program to implement interrupt function.

MODULE–2

UNIT-1 **6L+0T+6P=12 Hours**

OPERATING SYSTEMS:

Introduction to Operating Systems, Process and threads, Scheduling, Non-preemptive and Preemptive scheduling, Real Time Scheduling.

UNIT-2 **10L+0T+10P=20 Hours**

REAL TIME OPERATING SYSTEMS:

Introduction to Real Time Operating Systems, Shared Data Problem, Semaphores, Priority inversion problem, Inter process/task communication techniques.

PRACTICES:

- Create and schedule a process/task
- Demonstrate shared data problem

SKILLS:

- ✓ *Choose component for Embedded System*
- ✓ *Understand operating system concepts*
- ✓ *Understand*

- Create and use semaphores
- Find schedulability using Gantt charts
- Implement IPC techniques

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify the components of embedded systems and differentiate various embedded systems	Apply	1	1, 2, 3, 4, 9, 10, 11, 12
2	Design embedded systems using standard procedure	Create	1	1, 2, 3, 4, 9, 10, 11, 12
3	Choose necessary component and buses for the embedded system	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Apply the knowledge of operating system functions and various kernel objects	Apply	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. Raj Kamal, “Embedded Systems Architecture, Programming and Design”, 3rd edition, Mc Graw Hill, 2017.
2. Lyla B. Das, “Embedded Systems An Integrated Approach”, Pearson Education, 2013.

REFERENCE BOOKS:

1. Marilyn wolf, “Computers as Components: Principles of Embedded Computer systems design”, 4th edition, Morgan Kaufmann Publishers, 2017.
2. K.V.K.K. Prasad, “Embedded Real time Systems”, Black book, Dreamtech Press, 2003.
3. Daniel W. Lewis, “Fundamentals of Embedded Software: Where C and Assembly Meet”, 1st edition, Pearson, 2001.
4. John Catsoulis, “Designing Embedded Hardware”, 2nd Edition, O’Reilly Media, Inc., 2005.
5. “Getting Started with Arduino: The Open Source Electronics Prototyping Platform”, 3rd edition, Maker Media Inc., 2015.
6. Michail Kölling, “Raspberry PI: A complete guide to start learning RaspberryPi on your own”, Francesco Cammardella Publications, 2020.

22EC819 INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS

Source: https://www.agilevision.io/blog/what-is-iiot-how-it-relates-to-iot-and-industry-4-0-use-cases-and-iiot-platforms-overview

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITES KNOWLEDGE: BASIC KNOWLEDGE OF COMPUTER AND INTERNET

COURSE DESCRIPTION AND OBJECTIVES:

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

MODULE 1

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION:

Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories. Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

UNIT-2 **8L+0T+8P=16 Hours**

CYBERSECURITY IN INDUSTRY 4.0, BASICS OF INDUSTRIAL IOT:

Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems. IIoT-Introduction, Industrial IoT: Business Model and Referece Architerture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

INDUSTRIAL IOT- LAYERS: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I. IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

PRACTICES:

- Acquire data from thermal sensor over Internet
- Acquire data from motion detector over Internet
- Control temperature of a system over internet
- Switch on camera on detection of movement
- Develop architecture for interfacing sensors and actuators over internet
- Develop a secured communication for IIoT devices

MODULE 2

UNIT-1 **8L+0T+8P=16 Hours**

INDUSTRIAL IOT :

Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop. SDN in

SKILLS:

- ✓ *Integrate sensors, communication and computational processing*
- ✓ *Automate system using cloud*
- ✓ *Develop sensor and actuator network for control*

IIoT-Part I, Part II, Data Center Networks, Security and Fog Computing - Cloud Computing in IIoT-Part I, Part II , Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

UNIT-2 **8L+0T+8P=16 Hours**

INDUSTRIAL IOT- APPLICATION DOMAINS:

Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies : Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I Case study - III : Manufacturing Industries - Part II Case study - IV : Student Projects - Part I Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab Case study - VII : Steel Technology Lab.

PRACTICES:

- Interface multiple devices using Edge computing
- Log temperature data continuously in the cloud
- Using facial recognition over cloud control access for a person
- Control a robot over internet
- Monitor robot functionality over internet

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Model the cyber security for IIoT	Apply	1	1, 2, 4, 9, 10, 11, 12
2	Design communication in IIoT	Create	1	1, 2, 3, 4, 9, 10, 11, 12
3	Analyse the IIoT data using machine learning and data science concepts	Analyse	2	1, 2, 3, 4, 9, 10, 11, 12
4	Implement security in various domains of IIoT	Create	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. “Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2016.
2. “Industrial Internet of Things: Cyber manufacturing Systems”by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2016.

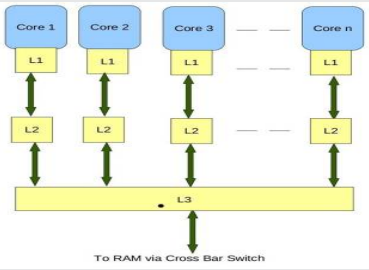
REFERENCES BOOKS:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

22EC820 MULTI-CORE ARCHITECTURES AND PROGRAMMING

Hours Per Week :

L	T	P	C
2	0	2	3



Source: https://www.researchgate.net/publication/269207369_Affect_of_Parallel_Computing_on_Multicore_Processors/figures

PREREQUISITES KNOWLEDGE: C PROGRAMMING

COURSE DESCRIPTION AND OBJECTIVES:

This course is designed to make the students understand the challenges in parallel and multi-threaded programming and learn about the various parallel programming paradigms, and solutions.

MODULE 1

UNIT- 1 **8L+0T+8P=16 Hours**

MULTI-CORE PROCESSORS:

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence.

UNIT-2 **8L+0T+8P=16 Hours**

PARALLEL PROGRAM CHALLENGES:

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

PRACTICES:

- Suppose that a vector processor has a memory system in which it takes 10 cycles to load a single 64-bit word from memory. How many memory banks are needed so that a stream of loads can, on average, require only one cycle per load?
- Does the addition of cache and virtual memory to a von Neumann system change its designation as a SISD system? What about the addition of pipelining? Multiple issue? Hardware multithreading?
- Develop program to implement mutex
- Develop program to implement semaphore
- Implement communication between two parallel programs

MODULE 2

UNIT-1 **8L+0T+8P=16 Hours**

SHARED MEMORY PROGRAMMING WITH OPENMP:

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

UNIT-2 **8L+0T+8P=16 Hours**

DISTRIBUTED MEMORY PROGRAMMING WITH MPI:

MPI program execution – MPI constructs – Libraries – MPI send and receive – Point- to-point and Collective communication – MPI derived datatypes – Performance evaluation

PARALLEL PROGRAM DEVELOPMENT : Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

SKILLS:

- ✓ *Parallel programming*
- ✓ *Shared memory programming using MPI*
- ✓ *Parallel programming using OpenMP*

PRACTICES:

- Write an OpenMP program that uses a Monte Carlo method to estimate π
- Implement gauss elimination using OpenMP
- Implement paralledl merge sort program
- Write an MPI program that computes a tree-structured global sum.
- Write an MPI program that computes a global sum using a butterfly.
- Implement matrix-vector multiplication using a block-column distribution of the matrix

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify their characteristics and challenges of multicore architecture	Analyze	1	1, 2, 4, 9, 10, 11, 12
2	Implement solutions for Parallel programming challenges	Create	1	1, 2, 3, 4, 9, 10, 11, 12
3	Develop programs using OpenMP and MPI.	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Design parallel programming solutions to common problems	Create	2	1, 2, 3, 4, 9, 10, 11, 12

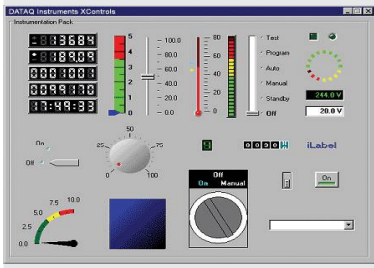
TEXT BOOKS:

1. Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, “Multicore Application Programming for Windows”, Linux, and Oracle Solaris, Pearson, 2011.

REFERENCE BOOKS:

1. Michael J Quinn, Parallel programming in C with MPI and OpenMP, Tata McGraw Hill, 2003.
2. Shameem Akhter and Jason Roberts, Multi-core Programming, Intel Press, 2006.
3. Roman Trobec, Boštjan Slivnik, Patricio Bulić, Borut Robič, Introduction to Parallel Computing: From Algorithms to Programming on State-of-the-Art Platforms, Springer, 2018.

22EC821 SMART & VIRTUAL INSTRUMENTATION



Source: https://www.dataq.com/products/x-controls/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basic understanding of Sensors, any programming language concepts

COURSE DESCRIPTION AND OBJECTIVES:

To familiarize students with the smart and intelligent sensors with VI software. Acquire knowledge on Data Acquisition Systems and network interface concepts. Understand various analysis tools and develop programs for Industrial Applications

MODULE - 1

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION TO VIRTUAL INSTRUMENTATION:

Computers in Instrumentation, Virtual Instrumentation (VI), LabVIEW and VI, Conventional and Graphical Programming, Components of LabVIEW, Owned and Free Labels, Tools and Other Palettes, Arranging Objects, Pop-Up Menus, Color Coding, Code Debugging.

UNIT-2 **8L+0T+8P=16 Hours**

VI PROGRAMMING TECHNIQUES :

VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

DATA ACQUISITION SYSTEM: Measurement and Automation Explorer, The Waveform Data Type, Working in DAQmx, Working in NI-DAQ(Legacy DAQ), Use of Simple VIs, Intermediate VIs.

PRACTICES:

- Introduction to LabVIEW
- Use of NI Elvis
- Use of SubVI
- Formula node
- Shift registers
- Array, Strings
- Function Generator
- DC voltage measurement using DAQ

MODULE – 2

UNIT-1 **8L+0T+8P=16 Hours**

INTERFACING INSTRUMENTS:

GPIB and RS232: RS232C versus GPIB, handshaking, GPIB interfacing, RS232C/RS485 interfacing, Standard commands for programmable instruments, VISA, Instrument interfacing and LabVIEW.

UNIT-2 **8L+0T+8P=16 Hours**

INTERFACING SMART SENSORS:

Introduction, Classification, Smart Sensors, Cogent Sensors, Soft or Virtual Sensors, Self Adaptive Sensors, Self-Validating Sensors, VLSI Sensors, Temperature Compensating Intelligent Sensors. Film sensors (Thick film sensors, this film sensor), MEMS and Nano-Sensors.

SKILLS:

- ✓ *Develop Interface circuitry for sensors*
- ✓ *Acquire real time signals using LabVIEW programming concepts*
- ✓ *Analyse real time signals*

PRACTICES:

- Analog Input and Output Interface
- Frequency Measurement
- Network Interface
- Thermocouple Interface and Celsius to Fahrenheit conversion
- Stepper Motor
- Simulation of Tank Process
- Clusters
- PID controller for DC motor

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the basic concept of smart sensors, virtual instrument.	Analyze	1	1, 2, 4, 9, 10, 11, 12
2	Create a Virtual Instrument using graphical programming	Create	1	1, 2, 3, 4, 9, 10, 11, 12
3	Develop systems for real-time signal acquisition and analysis.	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Apply concepts of network interface for data communication.	Create	2	1, 2, 3, 4, 9, 10, 11, 12
5	Interface physical parameters with computer through data acquisition systems for practical applications	Apply	2	1, 2, 3, 4, 9, 10, 11, 12

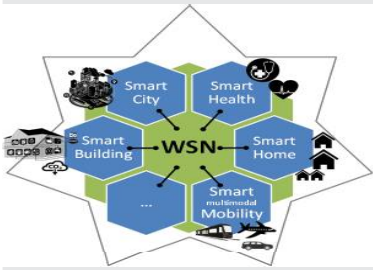
TEXT BOOKS:

1. Dr. Sumathi. S and Prof. Surekha. P, “LabVIEW Based Advanced Instrumentation Systems”, 2nd edition, 2007.
2. Jovitha Jerome, “Virtual Instrumentation using LabVIEW”, PHI Learning Pvt. Ltd, New Delhi, 2010.

REFERENCE BOOKS:

1. Lisa .K, Wells and Jeffrey Travis, “LABVIEW for Everyone”, Prentice Hall, 2009.
2. Skolkoff, “Basic concepts of LABVIEW 4”, PHI, 1998.
3. Gupta. S, Gupta. J.P, “PC Interfacing for Data Acquisition and Process Control”
4. Gary Johnson, “LabVIEW Graphical Programming”, McGraw Hill, 2006.

22EC823 WIRELESS SENSOR NETWORKS



Source: https://www.openaccessgovernment.org/ dependable-secure-trustable-wireless-sensor-networks/27971

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of computer networks.

COURSE DESCRIPTION AND OBJECTIVES:

This course is targeted at understanding and obtaining hands-on experience with the state of the art in such wireless sensor networks which are often composed using relatively inexpensive sensor nodes that have low power consumption, low processing power and bandwidth. Explore the various MAC routing protocols evolved in wireless sensor networks.

MODULE–1

UNIT-I **8 L+0T+8P=16 Hours**

INTRODUCTION:

Introduction to Wireless Networks, Protocol Suites, and Standards, OSI Model and TCP/IP Protocol Suite, Ad-hoc Networks, Comparison of Ad-hoc and Sensor Networks, applications of WSNs, challenges for WSNs, hardware components of wireless sensor node, energy consumption of a sensor nodes, operating system and execution environments and examples of sensor nodes.

UNIT-II **8 L+0T+8P=16 Hours**

NETWORK ARCHITECTURE AND PHYSICAL LAYER:

Sensor network scenarios, optimization goals and figures of merit, design principles for wireless sensor networks, service interfaces for wireless sensor networks, gateway concepts, wireless channel and communication fundamentals, physical layer, and transceiver design considerations in wireless sensor networks.

MODULE-2

UNIT-I **8L+0T+8P=16 Hours**

MAC LAYER PROTOCOLS FOR WIRELESS SENSOR NETWORKS:

Fundamentals of wireless MAC protocols, Low duty cycle protocols and wakeup concepts, contention-based protocols, schedule- based protocols, IEEE 802.15.4 MAC protocols, error control and link layer management.

UNIT-II **8 L+0T+8P=16 Hours**

ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORKS:

The forwarding and routing concept, Gossiping and agent-based unicast forwarding, energy efficient unicast methods, broadcast and multicast methods, geo-graphic routing methods and mobile nodes, TEEN, APTEEN and SPIN protocols.

PRACTICES:

Experiments to be carried out in any network simulator like NETSIM, NS2 and OMNET++ etc.

- Examine the various path loss models available for wireless networks
- Identify the various reasons for hidden node terminal problem in wireless ad-hoc networks.
- Create a scenario where both ad-hoc and wireless sensor network are available and examine the interference problem.

SKILLS:

- ✓ *Able to adapt the wireless sensor network with sensor nodes which have limitations in power consumption, processing power and bandwidth.*
- ✓ *Able to specify the requirements for the hardware and software solutions for energy-efficient sensor network for new applications.*
- ✓ *Able to apply appropriate algorithms to improve existing or to develop new wireless sensor network applications*

- Simulate the MAC routing protocols for wireless sensor networks.
- Simulate the multiple wireless scenarios for throughput performance.
- Analyze performance of the hierarchical routing protocols in various parameters like end-to-end delay, bit error rate and throughput.
- Design a wireless sensor network and observe how the power consumption consumed for the network.
- Examine the importance of channel accessing mechanism helped for getting high throughput in wireless networks.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the various solutions involved for designing WSN	Analyze	1	1, 2, 4, 9, 10, 11, 12
2	To identify the Wireless Sensor Network node architecture and real time nodes.	Apply	1	1, 2, 3, 4, 9, 10, 11, 12
3	Analyze the performance of Medium Access Control protocols for power consumption, fairness, channel utilization and control packet overhead.	Analyze	2	1, 2, 3, 4, 9, 10, 11, 12
4	Evaluate the performance of routing protocols for wireless sensor network.	Evaluate	2	1, 2, 3, 4, 9, 10, 11, 12

TEXTBOOKS:

1. Holger Karl, Andreas Willig “Protocols and Architecture for Wireless Sensor Networks” John Wiley and Sons, Ltd, 2007
2. Feng Zhao and Leonides Guibas, “Wireless Sensor Networks”, Elsevier Publication–2002.

REFERENCEBOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004.
2. Kazem sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks: Technology, Protocols and Application” John Wiley, 2007.
3. C.K Toh, “Ad-Hoc Mobile Wireless Networks: Protocols and Systems” 1st edition, Pearson, 2007.

DEPT.
ELECTIVES

ELECTRONICS AND COMMUNICATION ENGINEERING

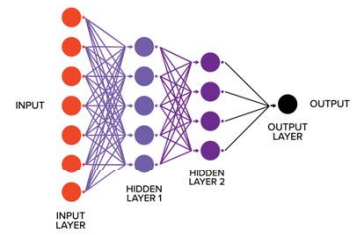
B.Tech.

- 22EC801 - Deep Learning and ANN
- 22EC802 - Digital Image Processing
- 22EC803 - Human Machine Interaction
- 22EC804 - Introduction to Artificial Intelligence
- 22EC805 - Machine Learning and Data Science
- 22EC806 - Programming With Python
- 22EC807 - Statistical Analysis & Data Analytics
- 22EC808 - Time Series Data Analysis Using Python

COURSE CONTENTS

I SEM & II SEM

22EC801 DEEP LEARNING AND ANN



Source: https://i0.wp.com/smartboost.com/wp-content/uploads/2020/07/Deep-Learning-vs-Neural-Network.ai-03-1024x576.png

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Basics of probability theory, linear algebra and calculus. Programming skills (Python will be used throughout the course)

COURSE DESCRIPTION AND OBJECTIVES:

The main goal of this course is to help students to introduce the fundamental techniques and principles of Neural Networks, to study the different models in ANN and their applications and to familiarize deep learning concepts with Convolutional Neural Network case studies.

MODULE –1

UNIT-1 **8L+8T+0P=16 Hours**

FUNDAMENTALS OF NEURAL NETWORKS:

Model of Biological and Artificial Neuron – Neural Network Architectures – Learning Methods – Taxonomy Of Neural Network Architectures – Applications

FEED FORWARD NEURAL NETWORKS: Perceptron Models, Limitations of the Perceptron Model, Back propagation Algorithm

UNIT-2 **8L+8T+0P=16 Hours**

ANN ARCHITECTURES:

Associative Memory, Exponential BAM – Associative Memory for Real Coded Pattern Pairs – Applications

Adaptive Resonance Theory – Introduction – ART 1 – ART2 – Applications – Neural Networks Based On Competition – Kohenen Self Organizing Maps – Learning Vector Quantization – Counter Propagation Networks – Industrial Applications.

PRACTICES:

- Programming with Python:
- Programming skills in Python.
- Implementation of Learning Rules
- Implementation of Logic function using Perceptron

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

DEEP LEARNING : Deep Feed Forward network, Regularizations, Training deep models, Dropouts, Training Deep Neural Networks using Back Propagation-Setup and initialization issues, vanishing and exploding Gradient problems, Gradient- Descent Strategies

UNIT-2 **8L+8T+0P=16 Hours**

CONVOLUTIONAL NEURAL NETWORK : Convolutional Neural Network, Basic structure of Convolutional Network, Case studies: Alex net, VGG Net, Google Net, Applications of CNN– Object Detection, Content based image Retrieval.

SKILLS:

- ✓ *Understand techniques and principles of Neural Networks*
- ✓ *Analyze the concepts of ANN and their applications*
- ✓ *Familiarize deep learning concepts*

PRACTICES:

- Programming with Python
- Implementation and performance comparison of various nets in Keras and TF API.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Explain the basic concepts in Neural Networks and applications	Apply	1,2	1, 2, 4, 5, 9,10, 12
2	Discuss feed forward networks and their training issues.	Apply	1	1, 2, 5, 9,10, 12
3	Distinguish different types of ANN architectures	Evaluate	2	1, 2, 3, 4, 5, 9,10, 12
4	Explain the deep learning concepts using Back Propagation Network.	Analyze	2	1, 2, 3, 4, 5, 9,10, 12
5	Discuss Convolutional Neural Network models to Object detection and Image Retrieval	Analyze	2	1, 2, 3, 4, 5, 9,10, 12

TEXT BOOKS:

1. CharuC.Aggarwal “Neural Networks and Deep learning” Springer International Publishing, 2018
2. Satish Kumar, “Neural Networks, A Classroom Approach”, Tata McGraw -Hill, 2007.
3. Simon Haykin, “Neural Networks, A Comprehensive Foundation”, 2nd Edition, Addison Wesley Longman, 2001.

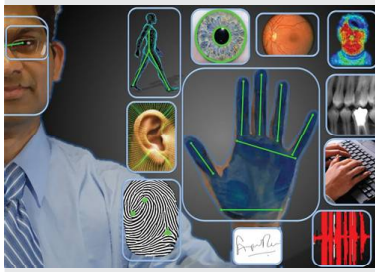
REFERENCES BOOKS:

1. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006
2. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000.

ONLINE RESOURCES

1. Michael Nielsen, “Neural Networks and Deep Learning”, Determination Press, 2015. http://neuralnetworksanddeeplearning.com

22EC802 DIGITAL IMAGE PROCESSING



Source: https://www.youtube.com/watch?v=UhDIL-tLT2U

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Signals and Systems, Digital Signal Processing.

COURSE DESCRIPTION AND OBJECTIVES:

Image processing is the basis of all digital media technology and is an active area of research over a wide range of applications such as compression and medical image analysis. The course features an introduction to digital image processing algorithms that form the core of digital media technology.

MODULE - 1

UNIT-1 **6L+0T+6P=12 Hours**

FUNDAMENTALS:

Basic steps of image processing system, Sampling and quantization of an Image, Basic relationship between pixels, Image Transforms - 2D Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT).

UNIT-2 **10L+0T+10P=20 Hours**

IMAGE ENHANCEMENT:

Spatial domain methods: Point processing- Intensity transformations, Histogram processing, Image subtraction, Image averaging. Spatial filtering- Smoothing filters, Sharpening filters. Frequency domain methods: Low pass filtering, High pass filtering, Homomorphic filter.

PRACTICES:

- Read two images and perform arithmetic operations like addition, subtraction, multiplication and division.
- Resizing, cropping and exporting images.
- Find and plot the spectrum of image using FFT.
- Find & sketch the histogram for image and histogram processing.
- Enhance the images by using spatial filters.
- Enhance the images by using frequency domain filters.
- Display of bit planes of an Image

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

IMAGE SEGMENTATION:

Point Detection, Line Detection, Edge Detection using Gradient and Laplacian Filters, Hough Transform, Thresholding: Global, Local and Adaptive, Region Based Segmentation: Region Growing Algorithm, Region Split and Merge Algorithm.

UNIT-2 **8L+0T+8P=16 Hours**

REPRESENTATION, DESCRIPTION AND RECOGNITION:

Representation- chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors-simple. Recognition: Pattern and Pattern classes.

SKILLS:

- ✓ *Demonstrate how digital images are acquired, stored and relationship between pixels*
- ✓ *Distinguish the various concepts and mathematical transforms for image processing.*
- ✓ *Identify and apply these techniques to solve real-world image processing problems and propose solutions for the same.*

PRACTICES:

- Detecting the points, lines and edges of an image.
- Perform segmentation of an image using Otsu's method.
- Polygonal approximation
- Skeleton of an image
- Pattern recognition

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand and apply the fundamentals of image processing techniques.	Apply	1,2	1, 2, 4, 5, 9, 10, 12
2	Apply enhancement, segmentation and compression techniques to 2D images.	Apply	1	1, 2, 5, 9, 10
3	Analyze and represent an image using transform techniques.	Analyze	1, 2	1, 2, 5, 9, 10
4	Interpret image in various data formats by applying image transformation processing techniques for different applications.	Apply	2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Rafael E. Gonzaleze and Richard E. Woods, "Digital Image Processing", 4th edition, Pearson, 2018.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2002.

REFERENCE BOOKS:

1. J. C. Russ. The Image Processing Handbook. CRC, Boca Raton, FL, 4th edn., 2002
2. W. K. Pratt. Digital image processing, PIKS Inside. Wiley, New York, 3rd, edn., 2001.
3. Arsath Natheem "Digital Image Processing using MATLAB: ZERO to HERO Practical Approach with Source Code", Independent Publishing, 2021.
4. Rafael Gonzalez, Richard Woods, Stevens Eddins, "Digital Image Processing Using MATLAB", 3rd edition, Gatesmark Publishing, 2020.

22EC803 HUMAN MACHINE INTERACTION

Source: https://dribbble.com/tags/human_computer_interaction

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of AI, Logical reasoning.

COURSE DESCRIPTION AND OBJECTIVES:

The main goal of this course is to help students to learn the foundation of human machine interaction. Understand the importance of human psychology in designing good interfaces. Aware of mobile interaction design and its usage in day -to –day activities. Understand various design technologies to meet user requirements and encourage to indulge into research in Machine Interaction Design.

MODULE - I

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION:

Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields.

The psychopathology of everyday things – complexity of modern devices; human-cantered design; fundamental principles of interaction; Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error;

UNIT-2 **10L+0T+10P=20 Hours**

GOAL DIRECTED DESIGN:

Goal directed design, Implementation models and mental models; Beginners, experts and intermediates – designing for different experience levels; Understanding users; Modeling users – personas and goals

PRACTICES:

- Study of GUIs for Human Machine Interaction
- Modelling physical parameters of machine
- Study various implementation modeling

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

GRAPHICAL USER INTERFACE:

Benefits of a good UI; Popularity of graphics; Concept of direct manipulation; Advantages and disadvantages; Characteristics of GUI; Characteristics of Web UI; General design principles.

UNIT-2 **10L+0T+10P=20 Hours**

DESIGN GUIDELINES:

Perception, Gesalt principles, visual structure, reading is unnatural, colour, vision, memory, six behavioural patterns, recognition and recall, learning, factors affecting learning, time.

Interaction Styles and Communication: Menus, Windows, Device based controls, screen-based controls, Colours.

SKILLS:

- ✓ *Understanding the Human machine Interaction environment.*
- ✓ *Various GUI's, modelling, guidelines for machine interaction.*
- ✓ *Design styles for Modelling Human aspects.*

PRACTICES:

- Identifying different visual structures.
- Study different behavioural patterns,
- Study the device boards implementing for human machine interaction.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify User Interface (UI) design principles and analyze effective user-friendly interfaces	Apply	1,2	1, 2, 4, 5, 9,10, 12
2	Apply Interactive Design process in real world applications.	Apply	2	1, 2, 5, 9,10, 12
3	Evaluate UI design and justify the same.	Apply	1	1, 2, 5, 9, 10,
4	Create application for social and technical tasks.	Analyze	2	1, 2, 3, 4, 5, 9,10, 12

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction, 3rdEdition, Pearson Education, 2004.
2. Wilbert O. Galitz, The Essential Guide to User Interface Design, Wiley publication, 2009.

REFERENCE BOOKS:

1. Rogers Sharp Preece, Interaction Design: Beyond Human Computer Interaction, Wiley.
2. Guy A. Boy, The Handbook of Human Machine Interaction, Ashgate publishing Ltd.
3. Kalbande, Kanade, Iyer,Galitzs Human Machine Interaction, Wiley Publications.
4. Jeff Johnson, Designing with the mind in mind, Morgan Kaufmann Publication.
5. Donald A. Normann, Design of everyday things, Basic Books; Reprint edition 2002.
6. Brian Fling, Mobile Design and Development, First Edition, O Reilly Media Inc., 2009.

22EC804 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Source: https://www.documentarytube.com/articles/a-few-words-about-artificial-intelligence-what-is-it

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Data structure, Logical reasoning.

COURSE DESCRIPTION AND OBJECTIVES:

The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence. Emphasis will be placed on the teaching the fundamentals, to impart the concepts and principles that underlie modern AI algorithms, learn foundational topics, including heuristic search, logical reasoning and planning, Formalise a given problem in the language/framework of different AI methods and to enable the students to understand the basic principles of Artificial Intelligence in various applications.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE:

Introduction, A.I. Representation, Non-AI &AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT-2 **10L+10T+0P=20 Hours**

UNINFORMED SEARCH:

Uninformed Search Strategies Formulation of real-world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Contingency problems.

PRACTICES:

- Implement Breadth First Search
- Implement Depth First Search
- Depth Limited Search
- Bidirectional Search

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

INFORMED SEARCH:

Informed Search Strategies Generate& test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cut-offs, Waiting for Quiescence.

UNIT-2 **10L+10T+0P=20 Hours**

LOGIC AND KNOWLEDGE REPRESENTATION:

First-Order Logic: Representation, Syntax and Semantics of First-Order Logic, Knowledge Engineering in First-Order Logic.

Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

Knowledge Representation: Ontological Engineering, Categories and Objects, Events.

SKILLS:

- ✓ *Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.*
- ✓ *Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.*
- ✓ *Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.*

PRACTICES:

- Hill Climbing,
- Best First Search,
- A* and AO*
- Minimax Search,
- Alpha-Beta
- Forward Chaining
- Backward Chaining
- Case Study: Classical Planning, Planning and Acting in the Real World.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand and apply the concepts of state space representation for problem solving	Apply	1,2	1, 2, 4, 5, 9,10, 12
2	Apply appropriate informed search algorithms for any AI problem.	Apply	2	1, 2, 5, 9,10, 12
3	Apply appropriate uninformed search algorithms for any AI problem.	Apply	1	1, 2, 5, 9, 10,
4	Analyse and apply knowledge representation to solve problem using first order logic.	Analyze	2	1, 2, 3, 4, 5, 9,10, 12

TEXT BOOKS:

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill, 2010.
2. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Education, 4th Global edition, 2021.

REFERENCE BOOKS:

1. E. Charniak and D. McDermott, “Introduction to Artificial Intelligence”, Pearson Education, 2002.
2. Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall of India, 1990.
3. E. Rich, K. Knight, S. B. Nair, “Artificial Intelligence”, 3rd edition, McGraw Hill Education, 2017.
4. J. Pearl, “Causality: Models, Reasoning and Inference”, Cambridge University Press, 2nd edition, 2018.
5. D. Koller, N. Friedman, “Probabilistic Graphical Models: Principles and Techniques”, MIT Press, 2009.

22EC805 MACHINE LEARNING AND DATA SCIENCE

Source: https://www.mygreatlearning.com/blog/difference-data-science-machine-learning-ai/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITES KNOWLEDGE: Probability and Linear Algebra.

COURSE DESCRIPTION AND OBJECTIVES:

The primary objective of this course is to comprehensive the concept of data science and machine learning. Emphasis will be placed on the teaching the fundamentals to learn different linear regression methods used in machine learning, to learn Classification models used in machine learning.

MODULE 1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION:

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.

Machine Learning Foundations – Overview – Design of a Learning System – Types of Machine Learning – Supervised Learning and Unsupervised Learning – Mathematical Foundations of Machine Learning – Applications of Machine Learning.

UNIT-2 **10L+10T+0P=20 Hours**

UNSUPERVISED LEARNING:

Introduction- Expectation maximum algorithm, Empirical distribution and density estimation, clustering

PRACTICES:

- Apply EM algorithm to cluster a set of data stored in a .CSV file,
- Density estimation,
- Implementation of K-Means Clustering

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

REGRESSION:

Introduction-linear regression, linear models and nonlinear regression models.

UNIT-2 **10L+10T+0P=20 Hours**

CLASSIFICATION:

Classification metrics, classification via Bayes rule, logistic regression, SoftMax, K nearest neighbour and SVM.

PRACTICES:

- Implementation of regression models
- Implementation of Logistic Regression
- Implementation of KNN classifier
- Implementation of SVM

SKILLS:

- ✓ *Build clustering methods*
- ✓ *Build classification techniques*
- ✓ *Generate an ability to build regression models for solving real life problems.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand and apply the concepts of data science and machine learning for real time problems.	Apply	1,2	1, 2, 4, 5, 9,10, 12
2	Identify types of suitable machine learning techniques.	Apply	1	1, 2, 5, 9,10, 12
3	Apply, build, fit and develop regression models for real time problems.	Evaluate	2	1, 2, 3, 4, 5, 9,10, 12
4	Apply and analyze the classification models using SVM and K-nearest neighbour.	Analyze	2	1, 2, 3, 4, 5, 9,10, 12

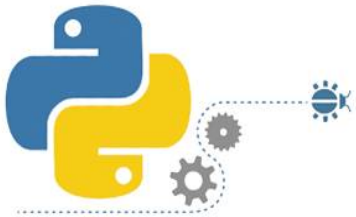
TEXT BOOKS:

1. Dirk P. Kroese, Zdravko Botev, Thomas Taimre, and Radislav Vaisman, “Data Science and Machine Learning Mathematical and Statistical Methods”, 1st edition, Chapman and Hall/CRC, 2019.
2. Daniel D. Gutierrez, “Machine Learning and Data Science: An Introduction to Statistical Learning Methods with R”, First edition, 2015.

REFERENCES BOOKS:

1. Douglas Montgomery, Elizabeth A. Peck, and G. Geoffrey Vining, “Introduction to Linear Regression Analysis”, 5th edition, Wiley publication, 2013.
2. Tom M. Mitchell, “Machine Learning”, First edition, McGraw Hill Education, 2017.
3. Frank Kane, “Hands-On Data Science and Python Machine Learning: Perform data mining and machine learning efficiently using Python and Spark”, Packt Publishing Limited, 2017.

22EC806 PROGRAMMING WITH PYTHON



Source: https://www.dlf.pt/ddetail/hohmooJ_python-read-png-image-language-computer-python-programing/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITES KNOWLEDGE: Data structure, Basics of communications.

COURSE DESCRIPTION AND OBJECTIVES:

Python is a language with a simple syntax, and a powerful set of libraries. It is an interpreted language, with a rich programming environment. While it is easy for beginners to learn, it is widely used in many scientific areas for data exploration. This course is an introduction to the Python programming language for students without prior programming experience. We cover data types, control flow, Functions, Arrays and Modules.

MODULE 1

UNIT-1 **6L+0T+6P=12 Hours**

BASICS OF PYTHON:

Basics of Python: Python Installation and Working of it, get familiar with python variables and data types, Operator understanding and its usage, detail study of python blocks.

UNIT-2 **10L+0T+10P=20 Hours**

CONTROL FLOW:

If, if-elif-else, for, while, break, continue, pass Data Structures Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions.

PRACTICES:

- Perform any 5 built-in functions by taking any list.
- Create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenate tuples.
- Count the number of vowels in a string using sets
- Display all prime numbers within an interval of 20 and 50.
- Create an adder, by providing value for lambda

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

FUNCTIONS:

Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, Command Line Arguments.

UNIT-2 **10L+0T+10P=20 Hours**

ARRAYS AND MODULES:

Creating Arrays, Using arrays and scalars, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output

Modules- Creating modules, import statement, from import statement, name spacing,

SKILLS:

- ✓ *Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.*
- ✓ *Demonstrate proficiency in handling Strings.*
- ✓ *Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.*

PRACTICES:

- Define a function for finding maximum of three numbers using default arguments.
- Add, transpose and multiply two matrices using numpy.
- Generate basic signals: Sinusoidal and Complex exponential signals.
- Analyse basic operations on Signals: Time shifting, Time Reversal, Amplitude scaling and Time scaling.
- Plot the probability density function of a. normal or Gaussian distribution. b. Exponential distribution
- Compute energy and power of defined signals.
- Compute Auto correlation and cross correlation of signals.
- Analyse the implications of sampling theorem at variable sampling rates for a sine wave input signal.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Interpret the fundamental Python syntax and semantics	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Apply Python control flow statements for problem solving	Apply	1	1, 2, 3, 4, 5, 9, 10, 12
3	Apply the concepts of lists, dictionaries, tuples and sets to create and manipulate Python programs	Apply	1, 2	1, 2, 3, 4, 5, 9, 10, 12
4	Analyse the operations involving arrays and modules.	Analyze	2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Vamsi Kurama, Python Programming: A Modern Approach, Pearson, 2018.
2. Mark Lutz, “Learning Python”, 5th Edition, Orielly Media, 2013.

REFERENCE BOOKS:

1. Allen Downey, “Think Python: How to Think Like a Computer Scientist”, Green Tea Press- Orielly, 2016.
2. Zed A. Shaw, “Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code”, Addison-Wesley Professional, 2017.
3. James Herron, “Python Programming For Beginners”, Kindle Edition, 2021.

22EC807 STATISTICAL ANALYSIS & DATA ANALYTICS

Source: https://www.freepik.com/premium-vector/statistical-analysis-diagram-data-analytics-websites-mobile-sites_20172518.htm

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Data structure, Basics of communications.

COURSE DESCRIPTION AND OBJECTIVES:

The main goal of this course is to help students to get exposed to big data and analytics. Learn the different ways of Data Analysis using different statistical tools and to be familiar with data streams and visualization. To understand and learn the mining and clustering.

MODULE - 1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION TO BIG DATA:

Introduction– Challenges of conventional systems, Data Collection, organization and presentation. Measure of central tendency, mean, median and mode. Range, deviation and Variation. Statical Concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT-2 **10L+10T+0P=20 Hours**

DATA ANALYSIS:

Regression modelling, single and Multivariate analysis, Bayesian modelling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION TO STREAMS CONCEPTS:

Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window - Realtime Analytics Platform(RTAP) applications - case studies - real time sentiment analysis, stock market predictions

UNIT-2 **10L+10T+0P=20 Hours**

CLUSTERING AND VISUALIZATION:

Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-Euclidean space – Clustering for streams and Parallelism, Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications.

PRACTICES:

- Perform any 5 built-in functions by taking any list.
- Create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenate tuples.
- Count the number of vowels in a string using sets
- Display all prime numbers within an interval of 20 and 50.
- Create an adder, by providing value for lambda

SKILLS:

- ✓ *Able to learn the different ways of Data Analysis*
- ✓ *Understand the concepts of mining and clustering*
- ✓ *Familiarization of data streams*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the statistical analysis methods.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Compare and contrast various soft computing frameworks	Apply	1	1, 2, 3, 4, 5, 9, 10, 12
3	Design distributed file systems.	Apply	1, 2	1, 2, 3, 4, 5, 9, 10, 12
4	Apply Stream data model. Use visualisation techniques	Analyze	2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

REFERENCE BOOKS:

1. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O" Reilly, 2011.
3. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.

22EC808 TIME SERIES DATA ANALYSIS USING PYTHON

Hours Per Week :

L	T	P	C
2	0	2	3

Source: https://www.linkedin.com/pulse/new-python-time-series-forecasting-course-jose-marcial-portilla/

PREREQUISITE KNOWLEDGE: Basics of python.

COURSE DESCRIPTION AND OBJECTIVES:

The main goal of this course is to help students to understand importance and formats of time series data, learn pre-process & visualize time series data, implement common data processing and visualisation techniques for time series data in python and apply ML/ DL techniques to real life data.

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION TO TIME SERIES:

First examples, definitions of trends, seasonality and noise, Stationary processes, definition and examples, autocovariance, autocorrelation. Linear Filtering: Definitions and the Theorem of Filtering, Convolutions and compositions, causal processes, NumPy and Pandas: Data Indexing, Visualisation, Time resampling, shifting, rolling and expanding, Analysis with stat models.

UNIT-2 **8L+0T+8P=16 Hours**

FORECASTING MODELS :

Introduction to stationary and non-stationary models like AR, MA, ARMA, ARIMA, ARCH and GARCH, Applications and Examples

PRACTICES:

- Implement Breadth First Search
- Implement Depth First Search
- Depth Limited Search
- Bidirectional Search

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

ML FOR TIME SERIES DATA :

Random Forest for Identifying Important Time Periods, “Prophetic” Time Series Forecasting, Prophet For Predicting Values for a Future Time Frame

UNIT-2 **8L+0T+8P=16 Hours**

LOGIC AND KNOWLEDGE REPRESENTATION :

Deep Learning for Time series data: Perceptron, Nueral net, CNN, Multivariate time series with Recurrent Neural Network, LSTMs and GRU.

PRACTICES:

- Implement Prophetic time series random forest
- Implement Multivariate time series with Recurrent Neural Network
- Implement LSTMs and GRU Bidirectional Search

SKILLS:

- ✓ *Understanding the importance and formats of time series data.*
- ✓ *Learn the pre-process & visualize time series data.*
- ✓ *Python programming concepts for time series data.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the statistical analysis to time series data.	Apply	1,2	1, 2, 4, 5, 9,10, 12
2	Understand about several time series models ranging from stationary autoregressive and moving average models to cointegration models	Apply	2	1, 2, 5, 9,10, 12
3	Use Visualisation techniques. Estimate, forecast, and simulate these models using statistical libraries in Python.	Apply	1	1, 2, 5, 9, 10,
4	Design ML and DL frameworks for Time series data	Analyze	2	1, 2, 3, 4, 5, 9,10, 12

TEXTBOOKS:

1. Box, G.E.P., G.M. Jenkins and G.C. Reinsel. n Time Series Analysis, Forecasting, and Control, 3rd ed. Englewood Cliffs, NJ: Prentice Hall, 2014.
2. Fuller, W.A. Introduction to Statistical Time Series, 2nd ed. New York: Wiley, 2009.

REFERENCEBOOKS:

1. Robert H. Shumway and David S. Stoffer Time Series Analysis and Its Applications With R Examples, Springer, 2016.
2. J. Cryer, K.-S. Chan. Time Series Analysis – With Applications in R, Springer texts in Statistics.
3. Avishek Pal and PKS Prakash, Practical Time Series Analysis, Birmingham - Mumbai, 2017.
4. Chan, N.H. (2002). Time Series: Applications to Finance. New York: Wiley. (Links to an external site.) (Links to an external site.)

DEPT.
ELECTIVES

ELECTRONICS AND COMMUNICATION ENGINEERING

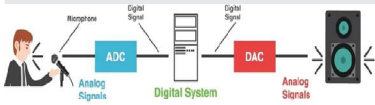
B.Tech.

22EC809	-	Advanced Digital Signal Processing
22EC810	-	Cellular and Mobile Communications
22EC811	-	Fundamentals of Radar Signal Processing
22EC812	-	Multirate Digital Signal Processing
22EC813	-	Optical Fiber Communications
22EC814	-	Satellite Communications

COURSE CONTENTS

I SEM & II SEM

22EC809 ADVANCED DIGITAL SIGNAL PROCESSING



Source: https://www.allaboutcircuits.com/technical-articles/an-introduction-to-digital-signal-processing/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Signals and Systems, PTSP & Digital Signal Processing.

COURSE DESCRIPTION AND OBJECTIVES:

This course will examine a number of advanced topics in one-dimensional digital signal processing, with emphasis on optimal signal processing techniques. Topics will include stationary and non-stationary random signals, analysis & characterization of discrete-time random processes, spectral estimation, linear prediction, adaptive filters and their applications to communication engineering.

MODULE –1

UNIT-1 **6L+6T+0P=12 Hours**

DISCRETE-TIME RANDOM SIGNALS:

Random variables - ensemble averages a review, random processes - ensemble averages, autocorrelation and autocovariance properties and matrices, white noise, filtering random processes, spectral factorization, special types of random processes - AR, MA, ARMA.

UNIT-2 **10L+10T+0P=20 Hours**

SPECTRUM ESTIMATION:

Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram - performance analysis. Bartlett's method, Welch's method, Blackman-Tukey method. Performance comparison. Parametric methods - autoregressive (AR) spectrum estimation - autocorrelation method, Prony's method, solution using Levinson Durbin recursion.

PRACTICES:

- Design AR, MA, ARMA model
- Power spectrum using Welch's method
- Power spectrum using Bartlett's method
- Spectral estimation using Levinson Durbin recursion

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

LINEAR ESTIMATION AND PREDICTION:

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter.

UNIT-2 **8L+8T+0P=16 Hours**

ADAPTIVE FILTERS:

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noise cancellation, channel equalization.

PRACTICES:

- FIR filter design

SKILLS:

- ✓ *Process non-stationary signals using adaptive algorithms.*
- ✓ *Design adaptive system for signal filtering and tracking applications.*
- ✓ *Demonstrate appropriate spectrum estimation techniques for a given random process*

- IIR filter design
- Adaptive filtering using LMS Algorithm.
- System identification and channel equalization using different LMS algorithm.
- Design an adaptive filter to extract a desired signal from noise corrupted signal by cancelling the noise.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Learn and apply the concepts of special random processes in practical applications.	Apply	1,2	1, 2, 4, 5, 9, 10, 12
2	Choose appropriate spectrum estimation techniques for a given random process.	Apply	1	1, 2, 5, 9, 10
3	Apply optimum filters appropriately for a given communication application.	Apply	1, 2	1, 2, 5, 9, 10
4	Apply and analyse the appropriate adaptive algorithm for processing non-stationary signals.	Analyze	2	1, 2, 3, 4, 5, 9, 10, 12

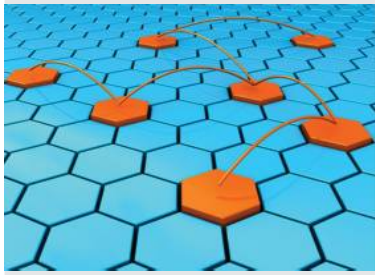
TEXT BOOKS:

1. Monson H. Hayes, “Statistical digital signal processing and modeling”, John Wiley and Sons Inc. New York, Indian reprint, 2008.
2. J.G.Proakis & D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4th Edition, Pearson, 2006.

REFERENCES BOOKS:

1. Sophoncles J. Orfanidis, “Optimum signal processing”, 2nd edition McGraw Hill, 2007.
2. Jian Wang, Barmak Honarvar Shakibaei Asli, “Advanced Digital Signal Processing”, Scitus Academics, 2019.
3. Vaseghi Saeed V, “Advanced Digital Signal Processing and Noise Reduction John Wiley and Sons Ltd, 2008.

22EC810 CELLULAR AND MOBILE COMMUNICATIONS



Source: https://www.tnuda.org.il/en/physics-radiation/radio-frequency-rf-radiation/cellular-communication-network-technologies

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Electromagnetic Waves and Transmission Lines; Digital Communications; Antennas and Wave Propagation.

COURSE DESCRIPTION AND OBJECTIVES:

This course will provide the basics to the students for applying math and engineering concepts in the analysis and design of mobile communication systems. The main objective is to have an understanding of digital cellular systems (GSM, CDMA), 3G, 4G LTE and 5G systems, PANs like WLAN, Bluetooth technologies and Zigbee.

MODULE - 1

UNIT-1 **8L + 8T+ 0P = 16 Hours**

INTRODUCTION TO WIRELESS COMMUNICATIONS & MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION:

Evolution of Mobile Radio Communications, Mobile radiotelephony in USA and around the world, Examples of wireless Communication Systems – Paging, Cordless Telephone systems and Cellular Telephone systems,

Trends in Wireless and Personnel Communications. FDMA, TDMA, Spread Spectrum Multiple access, Orthogonal Frequency Division Multiplexing (OFDM), SDMA, Packet radio, Packet radio protocols, CSMA protocols, Reservation Protocols

UNIT-2 **8L + 8T+ 0P = 16 Hours**

THE CELLULAR CONCEPT – SYSTEM DESIGN FUNDAMENTALS:

Introduction, Frequency reuse, Channel Assignment strategies, Handoff Strategies – Prioritizing Handoffs, Practical Handoff Considerations, Interference and System Capacity – Co-channel Interference and System.

Capacity, Channel Planning for Wireless Systems, Adjacent Channel Interference, Power Control for Reducing Interference, Improving Coverage and Capacity in Cellular Systems – Cell Splitting, Sectoring, Repeaters for Range Extension, A Microcell Zone Concept.

PRACTICES:

- Determine number of cells, cell frequencies for Guntur/Tenali for 2G/3G and 4G networks of various operators.
- Identify the Handoff strategies used by mobile operators in Guntur region.
- Identification of frequency band of a given Mobile Operator.
- Determine the maximum number of users at guest house of VFSTRU, Convocation Hall during a meeting, H-Block and A Block.

MODULE 2

UNIT I **8L+8T+0P-=16 Hours**

CELLULAR WIRELESS NETWORKS:

First Generation Analogue System, Second Generation (2G) TDMA Systems, 2G CDMA Systems, 3G Systems, Introduction to LTE, Purpose Motivation and approach to 4G, LTE Architecture, Evolved Packet Core, LTE Resource Management, LTE Channel Structure and Protocols, LTE RAN, LTE Advanced, Introduction to 5G Cellular communications

SKILLS:

- ✓ *Determine cell size and number of cells and cell locations for a given topological area.*
- ✓ *Finalize the frequency allocation for various cells with maximum reuse.*
- ✓ *Identify the handoff strategies.*
- ✓ *Estimate system capacity for minimum C/I.*
- ✓ *Suggest methods to improve the signal coverage.*
- ✓ *Choose proper accessing techniques for various generations of cellular communications.*

UNIT II **8L+8T+0P=16 Hours**

WIRELESS PERSONAL AREA NETWORKS:

WLAN Overview, IEEE 802 Protocol architecture, IEEE 802.11 Architecture and services, IEEE 802.11 Medium access control, IEEE 802.11 Physical layer, Gigabit WiFi, other IEEE 802.11 standards. Bluetooth motivation and overview, Bluetooth specifications, Bluetooth High Speed and Bluetooth Smart, IEEE 802.15 standards, ZigBee

PRACTICES:

- Simulate of 2G/3G/4G Networks using matlab
- Determine the data speeds for 3G and 4G at various locations and times.
- Determine the speed of Wifi and Bluetooth Communication Links
- Identify the Frequency bands used by Wifi and Bleutooth devices in VFSTR at various places

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Familiarity with basic wireless access techniques for mobile communication	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Understanding of the radio conditions like interference fading etc. in the mobile environment, and the basic design concepts of cellular systems	Apply	1	1, 2, 5, 9, 10
3	Knowledge about different generations of cellular technologies evolution from 1G to 5G	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Basic design concepts of Personnel Area Networks such as WLAN, Bluetooth and Zigbee	Analyze	2	1, 2, 5, 9, 10, 12
5	Evaluate various Cellular Technologies and personal area networks for various real life use cases.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Theodore. S. Rapport, “Wireless Communications”, 2nd edition, Pearson education, 2002.
2. Cory Beard, William Stallings, “Wireless Communication Networks and Systems”, 1st Edition, Pearson education, 2016

REFERENCE BOOKS:

1. W.C.Y. Lee, “Mobile Cellular Telecommunications”, 3rd edition, McGraw Hill, 2006.
2. William Stallings, “Wireless Communications and Networks”, 2nd Edition, Pearson education, 2005
3. Ajay.R.Mishra, “Advanced Cellular Network Planning And Optimisation”, John Wiley & Sons Ltd, 2007.

22EC811 FUNDAMENTALS OF RADAR SIGNAL PROCESSING

Source: https://www.raytheonmissilesanddefense.com /what-we-do/land-warfare/sensors/sentinel-radar

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Signal Processing.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to develop a novel signal processing algorithms for processing of Radar signals for identification Targets, moving targets and separation of clutters.

MODULE - I

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION TO RADAR SYSTEMS:

History and Applications of Radar, Basic Radar Functions, Elements of a Pulsed Radar, Reviews of Selected Signal Processing Concepts and Operations, A Previews of Basic Radar Signal Processing, Radar Literature .

Signal Models : Components of a radar Signal, Amplitude Models, Clutter Noise Model and Signal-to-Noise Ratio, Jamming Frequency Models: The Doppler Shift, Spatial Models, Spectral Model.

UNIT-2 **10L+0T+10P=20 Hours**

SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS:

Domains and Criteria for sampling Radar Signals, Sampling in the Fast Time Dimension, Sampling in Slow Time: Selecting the Pulse Repetition Interval, Sampling the Doppler Spectrum, Sampling in the Spatial and Angle Dimensions Quantization, I/O Imbalance and Digital I/O.

Radar Waveforms: Introduction, The waveform matched Filter, Matched Filtering of Moving Targets, The Ambiguity Function, The Pulse Burst Waveform, Frequency– Modulated Pulse compression waveforms, Range Side Lobe Control for FM Waveforms, The Stepped Frequency Waveform, Phase-Modulated Pulse Compression Waveforms, Costas Frequency Codes.

PRACTICES:

- Simulation of basic CW Radar
- Simulation of pulsed Radar
- Radar signal processing for Target identification
- Radar signal processing for Target identification and Tracking
- Radar signal processing for clutter identification
- Radar signal processing for clutter removal
- Doppler processing
- Radar signal processing using matched filtering
- Pulse compression techniques.

MODULE 2

UNIT-1 **6L+0T+6P=12 Hours**

DOPPLER PROCESSING:

Alternate Forms of the Doppler Spectrum, Moving Target Indication (MIT), Pulse Doppler Processing, Pulse Pair Processing, Additional Doppler Processing Issue, clutter mapping and the moving target Detector, MTI for moving platforms.

SKILLS:

- ✓ *Design and simulate a CW radar for target detection*
- ✓ *Design and simulate a pulse Doppler radar for target detection*
- ✓ *Design and simulate a MTI radar for target detection*
- ✓ *Choose the desired threshold for the detection of radar signals in the presence of clutter*

UNIT – 2 **10L+0T+10P=20 Hours**

DETECTION FUNDAMENTALS:

Radar Detection as Hypothesis Testing, Threshold Detection in Coherent Systems, Threshold Detection of Radar Signals, Binary Integration.

PRACTICES:

- Simulation of MTI radar
- Pulse doppler processing
- Clutter seperation in MTI radar signal processing
- Radar detection and testing
- Coherent radar detection
- Threshold detection methods

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the various radars and Apply techniques for target identification	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Identify the radar for proper target identification based on situation or environment	Apply	1, 2	1, 2, 5, 9, 10
3	Analyse the radar signals for separating target and clutter	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Inspect threshold detection methods	Analyze	2	1, 2, 5, 9, 10, 12
5	Evaluate the performance of various radars	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

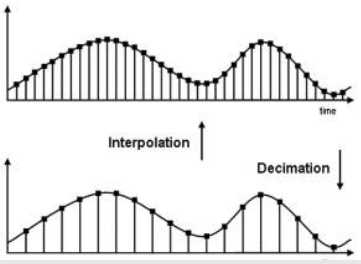
TEXT BOOKS:

1. Fundamentals of Radar Signal Processing, Mark A Richards, 2nd edition McGraw-Hill, 2014.
2. Signal Processing in RADAR SYSTEMS, Vyacheslav Tuzlukov, CRC Press, 2017.

REFERENCE BOOKS:

1. Radar Signal Analysis and Processing using MATLAB, Bassem R Mahafza, CRC Press, 2010.
2. Topics in Radar Signal Processing, Graham Weinberg, Intechopen, 2018.
3. Digital Signal Processing Techniques and Applications in Radar Image Processing, Bu-chin wang, Wiley, 2008

22EC812 MULTIRATE DIGITAL SIGNAL PROCESSING



Source: https://www.mathworks.com/help/dsp/ug/overview-of-multirate-filters.html

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Signals and Systems, Digital Signal.

COURSE DESCRIPTION AND OBJECTIVES:

The course focuses on multirate signal processing which is the basic to modern signal processing. Topics include sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques, multirate implementation of ADC and DAC converters.

MODULE-1

REVIEW OF DSP FUNDAMENTALS:

Sampling of continuous-time signals and the sampling theorem, The Fourier-transform and z-transform of discrete-time signals, Discrete Fourier transform, Design of IIR and FIR filters, Spectral analysis of signals.

UNIT-2 **10L+10T+0P=20 Hours**

FUNDAMENTALS OF MULTIRATE DSP:

Up sampling, down sampling, interpolation, decimation, Resampling with rational factor, Polyphase decomposition, Multi-stage Interpolation and Decimation systems.

PRACTICES:

- Sampling of continuous-time signals
- Study the time-dependence property of the down/up-sampling operation on an sequence
- Study the spectral characteristics of the down/up-sampled and decimated / interpolated signals
- Polyphase decomposition
- Design FIR filters for the two-stage decimator.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

DESIGN OF FILTER BANKS:

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter.

UNIT-2 **8L+8T+0P=16 Hours**

APPLICATIONS:

Oversampling A/D and D/A converters, Introduction to wavelets and its relation to multirate filter banks.

PRACTICES:

- Adaptive noise-removal
- Signal separation with wiener filter
- Wiener filter estimation based on Wiener-Hopf equations for signal separation or denoising
- Design two channel filter bank
- Oversampling A-to-D and D-to-A converters with multistage noise shaping modulators

SKILLS:

- ✓ *Demonstrate multirate sampling and its mechanism.*
- ✓ *Implement adaptive filters for given applications*
- ✓ *Develop methods for decimating, interpolating and changing the sampling rate of the signal and to analyze the effect of sampling rate changes.*
- ✓ *Design of multi-channel filter banks to decompose a signal into sub bands and synthesize a full band signal from the sub band components and to learn the principles of polyphase filtering.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze discrete-time signals in transform domain.	Analyze	1,2	1, 2, 4, 5, 9, 10, 12
2	Design of digital filters	Apply	1	1, 2, 5, 9, 10
3	Design of multi-channel filter banks	Apply	1, 2	1, 2, 5, 9, 10
4	Apply the wavelets and its application to multirate filter banks	Analyze	2	1, 2, 3, 4, 5, 9, 10, 12

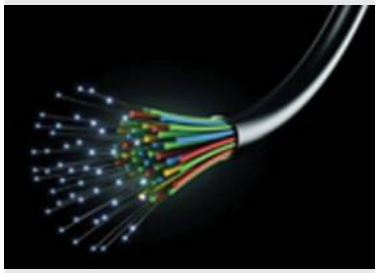
TEXT BOOKS:

1. Oppenheim, R. Schafer, “Discrete-time signal processing,” Pearson, 2014.
2. Norbert Fliege, “Multirate digital signal processing: multirate systems, filter banks, wavelets,” Wiley, 1999.

REFERENCE BOOKS:

1. Sophoncles J. Orfanidis, “Optimum signal processing”, 2nd edition McGraw Hill, 2007.
2. J. Proakis and D. Manolakis, “Digital Signal Processing: Principles, algorithms and applications,”Pearson, 2006.
3. P. P. Vaidyanathan, “Multirate systems and filter banks”, Prentice Hall Inc. 1993.
4. L. C. Ludeman, “Fundamentals of digital signal processing,” John Wiley and Sons, 1986.
5. Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia,Wavelet Transforms Introduction to Theory and Application.1998
6. Nirdosh Bhatnagar, Introduction to wavelet, CRC Press 2020
7. C. Sidney Burrus et al., “Computer-Based Exercises for Signal Processing using MATLAB, “Prentice-Hall, 1994. T. Krauss et al.,” Signal processing TOOLBOX,” The math Works Inc., 1993.

22EC813 OPTICAL FIBER COMMUNICATIONS



Source: http://www.wiretechworld.com/the-future-of-optical-fibres/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITES KNOWLEDGE: Basics of Data Communications.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers fundamental knowledge on optical components such as optical fibers, sources, detectors etc. The objective of this course is to enable the student to understand the basics of optical laws, optical fibre structures, wave guides and signal degradation mechanism in optical communication

UNIT-1 **6L+6T+0P=12 Hours**

OVERVIEW OF OPTICAL FIBER COMMUNICATION:

Overview Of Optical Fiber Communication: The general system, Advantages of optical fiber communications, Fiber materials, Optical fiber wave guides - Introduction, Total internal reflection, Acceptance angle, Numerical aperture, Skew rays, V-number, Step index fibers, Graded index fibers.

UNIT-2 **10L+10T+0P=20 Hours**

SIGNAL DEGRADATION IN OPTICAL FIBERS:

Signal Degradation In Optical Fibers: Signal distortion in optical fibers- Attenuation, Absorption, Scattering and bending losses, Core and cladding losses, Information capacity determination, Group delay.

Types of dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion; Overall fiber dispersion in multi-mode and Single mode fibers, Pulse broadening

PRACTICES:

- Advantages of optical fiber communications.
- Fiber materials
- Optical fiber wave guides
- Ray theory transmission
- Total internal reflection.
- Acceptance angle
- Numerical aperture
- Skew rays
- V-number
- Signal distortion in optical fibers.
- Core and cladding losses
- Group delay
- Overall fiber dispersion

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

OPTICAL FIBER CONNECTORS : Optical Fiber Connectors: Connector types, Single mode fiber connectors, Connector return loss, Fiber splicing - Splicing techniques, Fiber alignment and joint loss.

SKILLS:

- ✓ *Choose the type and size of fibre and mode of operation for the given application.*
- ✓ *Estimate the loss and the delay in the fibre link.*
- ✓ *Choose the technique for fibre joint.*
- ✓ *Identify the type of source and detector suitable for specific application and estimate its performance.*
- ✓ *Estimate and evaluate the link budget.*

UNIT-2 **8L+8T+0P=16 Hours**

OPTICAL FIBER SOURCES AND DETECTORS:

Optical Sources: LEDs, Structures, Materials, Quantum efficiency, Injection laser diodes- modes, Threshold conditions.

Optical Detectors: Physical principles of PIN and APD, Comparison of photo detectors, Point to- point links, System considerations, Link power budget, Rise time budget.

PRACTICES:

- Single mode fiber connectors.
- Fiber splicing - Splicing techniques
- Fiber alignment and joint loss.
- LEDs, Structures.
- Quantum efficiency.
- Modulation, Power bandwidth product.
- Injection laser diodes- modes.
- Threshold conditions
- Physical principles of PIN and APD.
- Comparison of photo detectors
- Optical system design-Considerations.
- Point to- point links.
- System considerations.
- Rise time budget.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Illustrate the significance of optical communication and fundamental operating principles.	Apply	1	1, 2, 12
2	Demonstrate the signal distortion phenomena through various parameters like losses and pulse broadening	Apply	1	1, 2, 5, 12
3	Understand the principles and Analyze efficiencies of various optical sources.	Analyze	1	1, 2, 3, 5, 12
4	Investigate the characteristics of different optical connectors.	Analyze	2	1, 2, 12
5	Differentiate various optical detectors.	Analyze	2	1, 2

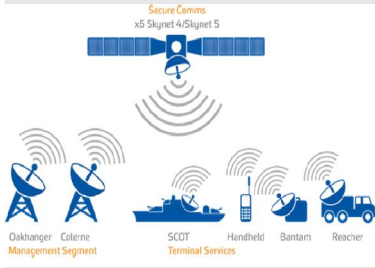
TEXT BOOKS:

1. Gerd Keiser, “Optical Fiber Communications”, 4th edition, McGraw-Hill International, 2015.
2. John M. Senior, “Optical Fiber Communications”, 3rd edition, PHI, 2013.

REFERENCES BOOKS:

1. S. C. Gupta, “Text Book on Optical Fibre Communication and its Applications”, 3rd edition, PHI, 2005.
2. Govind P. Agarwal, “Fiber Optic Communication Systems”, 3rd edition, John Wiley, 2004.
3. Joseph C. Palais, “Fiber Optic Communications”, 4th edition, Pearson Education, 2004.

22EC814 SATELLITE COMMUNICATIONS



Source: https://ekendraonline.com/satellite/geosynchronous-communication-satellite-merits-demerits/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITES KNOWLEDGE: Electromagnetic Waves and Transmission Lines; Digital Communications; Antennas and Wave Propagation.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the fundamentals of satellite communications, its sub-systems, signals and noise associated with satellite communications and transmission concepts. The objective is to introduce the mechanisms of satellites and satellite launchers and also to study the design and operation issues of satellite systems.

MODULE 1

UNIT-1 **8L+8T+0P=16 Hours**

INTRODUCTION AND ORBITAL MECHANICS AND LAUNCHERS:

Origin of satellite communications, Historical back-ground, Basic concepts of satellite communications, Frequency allocations for satellite services, Applications, Orbital mechanics, Look angle determination, Orbital perturbations, Orbit determination, Launches and launch vehicles, Orbital effects in communication systems performance.

MULTIPLE ACCESS: Frequency division multiple access (FDMA) Intermediation, Calculation of C/N, Time division multiple access (TDMA) frame structure and examples, Satellite switched TDMA on board processing, Code division multiple access (CDMA), Spread spectrum transmission and reception.

UNIT-2 **8L+8T+0P=16 Hours**

SATELLITE SUBSYSTEMS:

Attitude and orbit control system, Telemetry, Tracking, Command and monitoring, Power systems, Communication subsystems, Satellite antenna equipment reliability and space qualification.

PRACTICES:

- Study and analyse the polar, GEO, MEO and LEO satellite orbital parameters
- Analyse the satellite orbits and different launching vehicles used for launching those satellites
- Study various applications of Satellite and types of satellites used
- Analyse the various mechanisms of Altitude and Orbital control mechanisms
- Analyse the TTC &M used for Indian Satellite systems
- Study various Power systems used for satellites
- Study the various space qualification standards used for various mechanical, electrical and electronic Components

MODULE 2

UNIT – 1 **8L+8T+0P=16 Hours**

SATELLITE LINK DESIGN:

Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.

SKILLS:

- ✓ *Recognize the different bands used in satellites.*
- ✓ *Identify the orbital distances.*
- ✓ *Choose the orbit for the given applications.*
- ✓ *Identify the frequency allocation of TT and C.*
- ✓ *Find the launch vehicles for a given satellite.*
- ✓ *Determine uplink and downlink frequencies and the transmitter and receiver powers required to meet the specified CNR (BER).*
- ✓ *Estimate satellite performance and life span.*
- ✓ *Design link budget for a satellite system*
- ✓ *Understand different applications of GPS.*

UNIT – 2 **8L+8T+0P=16 Hours**

LEO AND GEO-STATIONARY SATELLITE SYSTEMS:

Orbit consideration, Coverage and frequency considerations, Delay and throughput considerations.

SATELLITE NAVIGATION & THE GLOBAL POSITIONING SYSTEM:

Radio and satellite navigation, GPS position location principles, GPS receivers and codes, Satellite signal acquisition, GPS navigation message, GPS receiver operation, GPS course acquisition (C/A), Differential GPS, Applications of GPS, Introduction to other Positioning Systems – GLONASS (Russia), Galileo (EU), IRNSS or NavIC (India).

PRACTICES:

- Design a downlink for a communication satellite with given specifications
- Design a Uplink for a communication satellite with given specifications
- Design a satellite Link for a given C/N
- Study and analyse the GPS satellite Constellations
- Study and analyse the GPS operation and A-GPS
- Study and compare other positioning systems GLONASS (Russia), Galileo (EU), IRNSS or NavIC (India) with GPS systems

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Summarize different types of satellite orbits and systems.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Compare various multiple access techniques.	Analyze	1	1, 2, 5, 9, 10
3	Analyze the link budget of a satellite system and satellite links for specified system.	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Compare different types of satellites based on their location.	Evaluate	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, “Satellite Communications”, 2nd edition, Wiley Publications, 2003.
2. Gerard Maral and Michel Bousquet, “Satillite Communication Systems”, 5th edition, Wiley Publications, 2009.

REFERENCE BOOKS:

1. M. Richharia, “Satellite Communications: Design Principles”, 2nd edition, BS Publications, 2003.
2. Dennis Roddy, “Satellite Communications”, 2nd edition, McGraw Hill, 1996.
3. Wilbur L. Pritchard, Robert A. Nelson and Henri G.Suyderhoud, “Satellite Communications Engineering”, 2nd edition, Pearson Publications, 2003.
4. V. S. Bagad, “Satellite Communications”, 1st edition, Technical Publications, 2009.

DEPT.
ELECTIVES

ELECTRONICS AND COMMUNICATION ENGINEERING

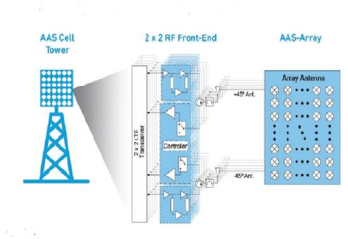
B.Tech.

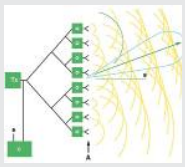
22EC824	-	Advanced Antenna Arrays
22EC825	-	Advanced Antennas for Modern Wireless Communication
22EC826	-	Computational Electromagnetics
22EC827	-	Microwave Measurements
22EC828	-	MIMO Antennas for Wireless Communication Theory and Design
22EC829	-	Radar System Design
22EC830	-	RF Devices and Active Circuits
22EC831	-	RF Passive Circuits
22EC832	-	RFIC and Microwave MEMS
22EC833	-	Smart Antenna

COURSE CONTENTS

I SEM & II SEM

22EC824 ADVANCED ANTENNA ARRAYS





Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Antenna Theory.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers advanced antenna theory both linear and planar array structure. The objective of this course is to make the student familiarize with the array antenna analysis and synthesis.

MODULE –1

UNIT-1 **8L+0T+8P=16 Hours**

LINEAR ARRAY ANALYSIS LINEAR ARRAY ANALYSIS:

Introduction, pattern, Formulas for Arrays with Arbitrary element Positions, Linear Arrays, Schelkunoff's Unit Circle Representations.

UNIT-2 **8L+0T+8P=16 HOURS**

LINER ARRAY SYNTHESIS:

Introduction, Sum and difference patterns, Dolph- chebyshev Synthesis of sum patterns, Sum pattern beam width of linear arrays, A relation between beam width and directivity for linear arrays, Taylor Synthesis of sum patterns, sum pattern with arbitrary side lobe topography, discretization of continuous line source distribution, Bayliss synthesis of difference patterns, difference patterns with arbitrary side lobe topology.

PRACTICES:

Design and verify the following Antenna array using Simulation Software (HFSS/MATLAB).

- Generate Liner array antenna using MATLAB software.
- Calculation of side lobe suppression using HFSS.
- Generation of Dolph- chebyshev Synthesis using MATLAB software
- Generation of Taylor Synthesis using MATLAB software.
- Generation of Bayliss synthesis using MATLAB software

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

PLANAR ARRAYS ANALYSIS AND SYNTHESIS:

Analysis and synthesis: Introduction, rectangular grid arrays, circular Taylor patterns, modified circular Taylor patterns, sampling generalized Taylor distributions-rectangular grid arrays, circular grid arrays, rectangular grid arrays with rectangular boundaries, Discretizing technique for rectangular grid arrays, circular bayliss patterns.

UNIT-2 **8L+0T+8P=16 Hours**

CIRCULAR PLANAR ARRAYS AND ADAPTIVE ARRAYS:

Circular Planar Arrays: Taylor Circular Array Synthesis, Bayliss Difference Patterns for Circular Arrays, Methods of Pattern Optimization/Adaptive Arrays, Pattern Optimization

Adaptive Arrays: Generalized S/N Optimization for Sidelobe Cancelers, Phased and Multiple-Beam

SKILLS:

- ✓ *Understanding the basic theory of Linear array.*
- ✓ *Analysis of Liner array synthesis.*
- ✓ *Know the basic concept and analysis of planar array and synthesis.*
- ✓ *Focus on circular and adaptive arrays.*

Arrays, Operation as Sidelobe Canceler, Fully Adaptive Phased or Multiple-Beam Arrays, Wideband Adaptive Control.

PRACTICES:

Design and verify the following Antenna array using Simulation Software (HFSS/MATLAB).

- Generate circular Taylor using MATLAB software.
- Generation of circular grid arrays using HFSS.
- Generation of Bayliss Difference Patterns for Circular Arrays MATLAB software
- Generation of Adaptive Arrays using MATLAB software.
- Generation of Multiple-Beam Arrays using MATLAB software

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze working concepts of linear array antenna.	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Analysis of linear array synthesis.	Analyze	1	1, 2, 4,5, 9, 10,12
3	Analysis of Planar array and Synthesis	Analyze	2	1, 2,4,5, 9, 10,12
4	Analyze Circular and Adaptive array	Analyze	2	1, 2,3,4,5, 9, 10, 12

TEXT BOOKS:

1. Antenna Theory and Design, R.S. Elliott, Wiley India, 2006.
2. Antenna for All Application, J.D.Krauss, R.J.Marhefka and Ahmad.S.Khan Tata McGraw Hill Publishing Company Ltd, 3rd edition, 2006

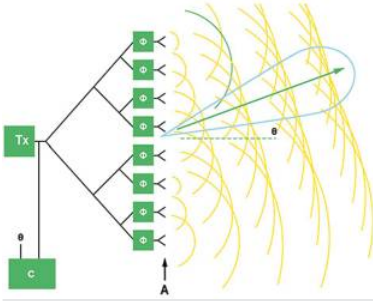
REFERENCES BOOKS:

1. Mailloux, R.J., Phased array antenna handbook. Artech house, 2017.
2. Constantain A Balanis, “Antenna Theory: Analysis and Design”, 4th edition, Wiley Publishers, 2015.
3. Randy L. Haupt, “Antenna Arrays: A Computational Approach”, Wiley, 2010.

22EC825 ADVANCED ANTENNAS FOR MODERN WIRELESS COMMUNICATION

Hours Per Week :

L	T	P	C
2	0	2	3



Source: https://www.avnet.com/wps/portal/abacus/solutions/ markets/communications/5g-solutions/5g-beamforming/

PREREQUISITE KNOWLEDGE: Antenna Theory.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of this course is to introduce the concepts and fundamentals of microstrip antennas basic concept, different structure like, metamaterial, reconfigurable antenna, DRA antenna and design aspects.

MODULE - 1

UNIT-1 **8L+0T+8P=16 Hours**

MICROSTRIP ANTENNAS:

Origin of microstrip radiators, microstrip antenna analysis methods, Rectangular micro-strip antennas-common feed methods, TM10 and TM01 modes, return loss, radiation pattern, quarter wave rectangular micro-strip antenna, single feed and dual fed circular polarized rectangular microwave antenna design, impedance and axial ratio bandwidth, efficiency. Circular micro strip antenna properties, directivity, input impedance bandwidth, gain, radiation pattern and efficiency, radiation modesTM11 bipolar mode, TM21 quadrapolar mode, TM02 unipolar mode, cross polarization.

UNIT-2 **8L+0T+8P=16 Hours**

METAMATERIALS:

The concept of Metamaterials: Basic Electromagnetic and Optical properties, Basic structures, potential applications, Governing equations for Metamaterials, Brief overview of computational electromagnetics. Definition of Metamaterials and Left-Handed (LH) MTMs

PRACTICES:

Design and verify the following MIMO antenna using Simulation Software (HFSS/ADS/MATLAB).

- Analysis of TM10 and TM01 mode in RMA
- Design analysis of circular patch antenna
- Analysis of Co and Cross polarization.
- Design of metamaterial antenna for wireless application.
- Analysis of metamaterial unit cell properties.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

RECONFIGURABLE ANTENNA:

Frequency reconfiguration methods: PIN diodes, Varactor Diodes, Liquid crystals, Graphene, Frequency reconfigurable slot antennas : Varactor loaded slot antenna, MIMO reconfigurable slot antenna, Different reconfigurable antennas and their applications

UNIT-2 **8L+0T+8P=16 Hours**

PRINTED ANTENNAS DEISGN:

Basic concepts of CPW-Coplanar Waveguide antennas, DRA-Dielectric Resonator Antennas, Micro

SKILLS:

- ✓ *Understanding the basic theory of patch antenna*
- ✓ *Covers the antenna characteristics*
- ✓ *Addresses the different structure of printed antenna*
- ✓ *Focus on wireless application antennas.*

strip antenna with DGS, Design structures of different antennas and applications of different antennas.

PRACTICES:

Design and verify the following MIMO antenna using Simulation Software (HFSS/ADS/MATLAB).

- Analysis design aspects of THz Antenna
- Design reconfigurable antenna for switching application.
- Design CPW antenna for Zigbee applications.
- Design DRA antenna for high gain applications.
- Design DGS antenna for bandwidth enhancement.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the basic rectangular and circular antenna	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Analyze concept of metamaterial antenna.	Analyze	1	1, 2, 4,5, 9, 10,12
3	Analyze design of reconfigurable antenna.	Analyze	2	1, 2,4,5, 9, 10,12
4	Study of different structure printed Antennas	Analyze	2	1, 2,3,4,5, 9, 10, 12

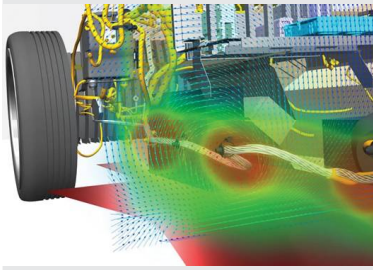
TEXT BOOKS:

1. Randy Bancraft, “Microstrip and Printed Antenna Design”,2nd Edition, Prentice-Hall of India, 2010.
2. Ramesh Garg, Prakash Bhartia, InderBaul and ApisakIttipiboon, “Microstrip Antenna Design Handbook”, Artech House, 2001.

REFERENCE BOOKS:

1. Constantain A Balanis, “Antenna Theory: Analysis and Design”, 4th edition, Wiley Publishers, 2015.
2. Jichun Li, Yunqinghuang , “Time Domain Finite Element Methods for Maxwell’s equations in Metamaterials”, 2013.
3. Jennifer T. Bernhard ,”Reconfigurable antennas”. 2007.
4. Girish Kumar & KP Ray ,”Broadband microstrip antenna”, 2003.

22EC826 COMPUTATIONAL ELECTROMAGNETIC



Source: https://semiengineering.com/the-foundations-of-computational-electromagnetics/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Electromagnetic Theory.

COURSE DESCRIPTION AND OBJECTIVES:

To understand the concepts of computational electromagnetics, to enable analysis of numerical stability and dispersion.

MODULE - I

UNIT-1 **8L+8T+0P=16 Hours**

TIME DOMAIN TECHNIQUES:

Introduction: The Rise of Partial Differential Equation Methods , Interdisciplinary Impact of Emerging Time-Domain PDE Solvers, History of Space-Grid Time-Domain Techniques for Maxwell's Equations , General Characteristics of Space-Grid Time-Domain Approaches :Classes of FD-TD and FV-TD Algorithms , Predictive Dynamic Range , Scaling to Very Large Problem Sizes : Algorithm Scaling Factors , Computer Architecture Scaling Factors , Defense Applications, Dual-Use Electromagnetics Technology.

UNIT-2 **8L+8T+0P=16 Hours**

ONE DIMENSIONAL SCALAR WAVE EQUATION:

Propagating-Wave Solutions , Finite Differences , Finite-Difference Approximation of the Scalar Wave Equation , Dispersion Relations for the One-Dimensional Wave Equation , Numerical Phase Velocity, Numerical Group Velocity, Numerical Stability: The Time Eigenvalue Problem, The Space Eigenvalue Problem, Enforcement of Stability.

PRACTICES:

- Validation of time domain techniques using Maxwell equations.
- Verify FD-TD and FV-TD algorithms
- Calculation of Algorithms scaling factor.
- Analyzes of one-dimensional scalar wave equation.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

INTRODUCTION TO MAXWELL'S' EQUATIONS AND THE YEE ALGORITHM:

Maxwell's Equations in Three Dimensions , Reduction to Two Dimensions : TM Mode, TE Mode , Reduction to One Dimension :TM Mode , TE Mode, Equivalence to the Wave Equation in One Dimension , Yee Algorithm.

UNIT-2 **8L+8T+0P=16 Hours**

NUMERICAL STABILITY:

Basic-Stability Analysis Procedure, TM Mode, Time Eigenvalue Problem, Space Eigenvalue Problem, Enforcement of Stability, Extension to the Full Three-Dimensional Yee Algorithm, Generalized Stability Problem: Boundary Conditions, Variable and Unstructured Meshing, Lossy, Dispersive, Nonlinear, and Gain Materials

Numerical Dispersion: Basic Procedure, Substitution of Traveling-Wave Trial Solution, Extension to

SKILLS:

- ✓ *Understanding the basic theory of computational electromagnetics*
- ✓ *Analysis of one dimensional scalar wave equation.*
- ✓ *Understanding the three dimensions reduction to two dimensions.*
- ✓ *Focus on Numerical dispersion.*

the Full Three-Dimensional Yee Algorithm, Comparison with the Ideal Dispersion Case, Reduction to the Ideal Dispersion Case for Special Grid Conditions, Dispersion-Optimized Basic Yee Algorithm, Dispersion-Optimized Yee Algorithm with Fourth-Order Accurate Spatial Central Differences: Formulation, Example, Pros and Cons

PRACTICES:

- Analyses of stability factor in TM Modes.
- Analyses of stability factor in TE Modes.
- Analyses of Yee algorithms.
- Analysis of Numerical dispersion.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply fundaments and overview of Partial Differential Equation and Time-Domain Methods	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Analyze one-dimensional scalar wave equation	Analyze	1	1, 2, 4,5, 9, 10,12
3	Analyze concept of Maxwell's' Equations and Yee Algorithm	Analyze	2	1, 2,4,5, 9, 10,12
4	Analyze Numerical stability schemes and Numerical Dispersion	Analyze	2	1, 2,3,4,5, 9, 10, 12

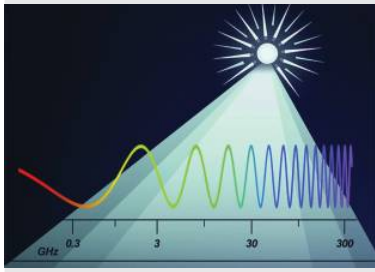
TEXT BOOKS:

1. Antenna Theory and Design, R.S. Elliott, Prantice Hall of India, Wiley, 2006.
2. Taflove, A. and Hagness, S.C., Computational Electrodynamics, Artech House (2006).

REFERENCE BOOKS:

1. Sullivan, D.M., Electromagnetic Simulation Using the FDTD Method, IEEE Computer Society Press (2000).
2. Thomas Rylander, "Computational Electromagnetics", Springer, 2012.
3. Anders Bondeson, Thomas Rylander, Pär Ingelström, "Computational Electromagnetics", Springer, 2005.

22EC827 MICROWAVE MEASUREMENTS



Source: https://onlinelibrary.wiley.com/doi/full/10.1002/lpor.201600019

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Electromagnetics and Microwave Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course which covers advanced topics in microwave measurements such as power spectrum and introduction to state-of-the-art microwave test equipment (Network Analyzer, Spectrum Analyzer, etc.), methods for measuring the dielectric constant of materials,

MODULE-1

UNIT-1 **8L+8T+0P=16 Hours**

INTRODUCTION TO MICROWAVE MEASUREMENTS:

Microwave frequency bands, tuned detectors, slotted line carriage, TE-TM mode field distribution in rectangular waveguide. power measurement: high power measurement, low power measurement, medium power measurement, very low power measurement, testing performance of microwave amplifier. VSWR measurement: direct method, double minima method, attenuation measurement, waveguide parameters measurement.

UNIT-2 **8L+8T+0P=16 Hours**

DIELECTRIC CONSTANT, FREQUENCY, AND IMPEDANCE MEASUREMENTS:

Dielectric constant measurement: two-point method, cavity perturbation method, infinite sample method. Frequency measurement: cavity wavemeter, slotted line method, heterodyne frequency meter, phase shift measurement Impedance measurement: slotted line method, impedance measurement of reactive discontinuity.

PRACTICES:

Design and verify the following measurement using Simulation Software and Hardware (HFSS/VNA).

- S parameter estimation of antenna using ADS and VNA.
- VSWR estimation of antenna using ADS and VNA.
- Simulation of various dielectric properties using HFSS.
- Measurement of impedance using VNA.
- Measurement of filter using VNA.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

NETWORK ANALYZER:

Definition of network analyzer, concept of Vector Network Analyzer (VNA), basic block diagram of Vector Network Analyzer, errors and need for calibration, calibration technique, application of Vector Network Analyzer. Scalar Network Analyzer (SNA), difference between VNA and SNA, basic block diagram of Scalar Network Analyzer.

UNIT-2 **8L+8T+0P=16 Hours**

SPECTRUM ANALYZER:

SKILLS:

- ✓ *Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.*
- ✓ *Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.*
- ✓ *Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.*

Introduction, basic block diagram of a Spectrum Analyzer, functions and applications of a Spectrum Analyzer, errors, difference between vector network analyzer and spectrum analyzer.

PRACTICES:

Design and verify the following measurement using Simulation Software and Hardware (HFSS/VNA).

- Estimation of impedance bandwidth using VNA.
- Simulation and measurement error calculation using HFSS and VNA.
- Analyze of various calibration in VNA.
- Analyze of various calibration in spectrum analyzer.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	The measurements of microwave components and verify the performance parameters.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	The measurements of dielectric Constant, frequency, and Impedance.	Apply	1, 2	1, 2, 5, 9, 10
3	Study and analyze the network analyzer erformance.	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Study and analyze the spectrum analyzer performance.	Analyze	2	1, 2, 5, 9, 10, 12

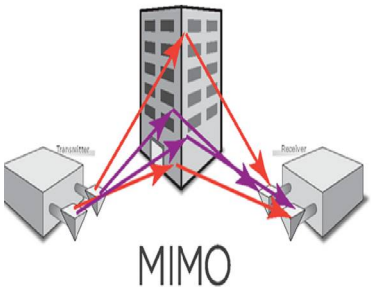
TEXT BOOKS:

1. Sushrut Das. “Microwave Engineering”, India: Oxford University Press, 2014.
2. Edwards, Derek Frederick Alfred. “Electronic Measurement Techniques”, United Kingdom, Butterworths, 2014.

REFERENCE BOOKS:

1. G.H. Bryant, “Principles of Microwave Measurements”. United Kingdom, P. Peregrinus Limited, 1993.
2. D.M. Pozar, “Microwave Engineering”. Italy, Wiley, 2012.
3. Handbook of Microwave Measurements. United States, Polytechnic Press of the Polytechnic Institute of Brooklyn, 1963.

22EC828 MIMO ANTENNAS FOR WIRELESS COMMUNICATION-THEORY AND DESIGN



Source: http://daslab.seas.harvard.edu/hw-sw/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITES KNOWLEDGE: Antenna Theory.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers to investigate diversity and mutual coupling effects on MIMO antenna designs for Wireless applications. Diversity techniques in MIMO antennas leading to the performance improvement ratings are demonstrated and deliberated. The improved MIMO antenna structures are investigated and presented in this subject including part of massive MIMO to provide the important aspects of emerging technology.

MODULE 1

UNIT-1 **8L+0T+8P=16 Hours**

MIMO THEORY:

Introduction, Wireless Channel Limitations, Fading, Large Scale Fading, Small Scale Fading, Effect of Interference on Channel Capacity, Co-Channel Interference and Capacity, Adjacent Channel Interference and Capacity, Power and Interference, Approaches to Improve Capacity, Cell Splitting, Sector Forming, Repeaters ,Microcell Zones, Applications of MIMO, Functions of MIMO, Types of MIMO.

UNIT-2 **8L+0T+8P=16 Hours**

MIMO ANTENNA PERFORMANCE CRITERIA :

Introduction, Performance Criteria of MIMO Antenna, Reflection Coefficient and VSWR, Transmitted and Reflected Powers, Transmission Coefficient, Envelope Correlation Coefficient (ECC), Total Active Reflection Coefficient (TARC), Channel Capacity, Mean Effective Gain (MEG),Spectral Efficiency, MIMO Mode.

PRACTICES:

Design and verify the following MIMO antenna using Simulation Software (HFSS/ADS/MATLAB).

- Verify MIMO signals using MATLAB.
- Design SISO antenna using HFSS.
- Design of Bluetooth 1x2 MIMO Antenna and verify the MIMO characteristics using HFSS
- Design of Zigbee 2x2 MIMO Antenna and verify the MIMO characteristics using HFSS
- Design of GSM 2x2 MIMO Antenna and verify the MIMO characteristics using HFSS

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

5G MASSIVE MIMO TECHNOLOGY:

Introduction, Massive MIMO, Channel Estimation in Massive MIMO, Spatial Diversity/Multiplexing, Beam forming, Beam forming Types, Advantages of massive MIMO.

UNIT-2 **8L+0T+8P=16 Hours**

MUTUAL COUPLING REDUCTION TECHNIQUES IN MIMO DESIGNS:

Diversity Techniques, Space Diversity, Polarization Diversity, Pattern Diversity. Parasitic Element/

SKILLS:

- ✓ *Understanding the basic theory of MIMO*
- ✓ *Covers effects of ECC, MEG, TARC, and equivalent circuit.*
- ✓ *Addresses the coupling and diversity aspects of antenna design problem for MIMO systems.*
- ✓ *Focus on the MIMO antenna designs for the real time applications.*

Structure Approach, Neutralization Line Approach, Slit and Slot Etching Approach, Coupling/Decoupling Structure Approach, Metamaterials Approach, Shorting Pins/Posts, Feeding Technique, Ground Branches/Utilization, MIMO Antenna Miniaturization Techniques.

PRACTICES:

Design and verify the following MIMO antenna using Simulation Software (HFSS/ADS/MATLAB).

- Design 5G MIMO antenna using HFSS
- Design of Diversity antenna using HFSS.
- Design of space diversity Antenna using HFSS
- Design of mutual coupling reduction antenna using HFSS
- Design of compact MIMO using HFSS

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze Theory of MIMO.	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Analyze MIMO Antenna performance Criteria.	Analyze	1	1, 2, 4,5, 9, 10,12
3	Understand 5G Massive MIMO Technology.	Understand	2	1, 2,4,5, 9, 10,12
4	Analyze Mutual Coupling Reduction Techniques in MIMO Designs.	Analyze	2	1, 2,3,4,5, 9, 10, 12

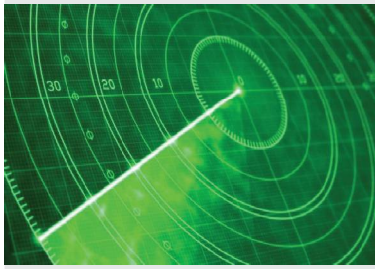
TEXT BOOKS:

1. Malviya, L., Panigrahi, R.K. and Kartikeyan, M.V., MIMO Antennas for Wireless Communication: Theory and Design. CRC Press, 2020.
2. Mohammad S. Sharawi , “Printed MIMO Antenna Engineering”, Artech House, Boston, 2014.

REFERENCES BOOKS:

1. Bird, T.S. ed., Mutual Coupling Between Antennas. New York: Wiley, 2021.
2. Rod Waterhouse, “Printed Antennas for Wireless Communications”, Wiley, 2008.
3. Anil Pandey, “Practical Microstrip and Printed Antenna Design”, Artech House, 2019.

22EC829 RADAR SYSTEM DESIGN



Source: https://www.linkedin.com/pulse/radar-systems-design-engineering-course-charles-alexi-1e/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITES KNOWLEDGE: Signals and Systems, Communication Systems and Probability and statistics, Microwave Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

To understand the basic subunits of a RADAR system with respect to their functions. To derive the basic radar equation and its dependence on various parameters, study CW radar system and its application along with FMCW radar system for altimeter applications, study Doppler Effect and its applications with respect to pulsed Doppler radar, to understand moving target indicator and to study its application, study and understand the effect of noise on radar signal detection and study the various types of Radar Receivers and Transmitter system.

MODULE 1

UNIT-1 **8L+0T+8P=16 Hours**

RADAR INTRODUCTION:

Introduction: Introduction Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Related Problems.

Radar Equation : Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment).

UNIT-2 **8L+0T+8P=16 Hours**

CW,FM,MTI AND DOPPLER RADAR:

CW and Frequency Modulated Radar : Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar.

MTI and Pulse Doppler Radar : Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler Radar.

PRACTICES:

Design and verify the following Radar systems design using Simulation Software (Advanced Designed System/MATLAB).

- Design a general Radar systems design using ADS software.
- Compute the received power with the help of radar range equation using MATLAB.
- Design an Isolator using ADS software.
- Design a CW and Pulsed Doppler Radar using ADS software.
- Compute the MTI radar Parameters with the help of MATLAB software

SKILLS:

- ✓ *Understanding the basic theory of Radar and basic equations.*
- ✓ *Analysis of CW, FM, MTI and Doppler Radar .*
- ✓ *Know the basic concept and analysis of tracking radar.*
- ✓ *Study and analysis of Radar receiver.*

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

TRACKING RADAR AND DETECTION:

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse. Target Reflection Characteristics and Angular Accuracy. Tracking in Range, Acquisition and Scanning Patterns. Comparison of Trackers.

Detection of Radar Signals in Noise : Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise.

UNIT-2 **8L+0T+8P=16 Hours**

CIRCULAR PLANAR ARRAYS AND ADAPTIVE ARRAYS:

Radar Receivers: Noise Figure and Noise Temperature. Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Series versus Parallel Feeds, Applications, Advantages and Limitations.

PRACTICES:

Design and verify the following Radar systems design using Simulation Software (Advanced Designed System/MATLAB).

- Design of monopulse tracking Radar using ADS software.
- Compute the characteristics of matched filter receiver using MATLAB.
- Design of phased array antenna using ADS software.
- Design of Circulator and Duplexer using ADS software.
- Design of Beam Steering Network and Series/Parallel Feeding using ADS Software.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze basic principle of RADAR System, equation and calculation of Transmitter power.	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Analyze the working principle of CW and Frequency Modulated Radar, MTI and Pulse Doppler Radar.	Analyze	1	1, 2, 4,5, 9, 10,12
3	Analyze Tracking Radar principle	Analyze	2	1, 2,4,5, 9, 10,12
4	Analyze the basic principle of Receiver and also extraction of signal in Noise, Calculate Noise Figure and Noise Temperature in Radar Receivers.	Analyze	2	1, 2,3,4,5, 9, 10, 12

TEXT BOOKS:

1. Introduction to Radar Systems – Merrill I. Skolnik, SECOND EDITION, McGraw-Hill, 2010.
2. Byron Edde, “Radar: Principles, Technologies, Applications”, Pearson Education, 2009.

REFERENCE BOOKS:

1. Byron Edde “Radar Principles Technology Applications”, Pearson Education, 2004.

22EC830 RF DEVICES AND ACTIVE CIRCUITS

Source: https://www.apitech.com/products/rf-solutions/amplifiers/low-noise-amplifiers/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Microwave Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers basic information on the RF circuit design. This makes that student able to design linear and non-linear RF circuits and familiar with RF CAD software (ADS).

MODULE - 1

UNIT-1 **8L+0T+8P=16 Hours**

ACTIVE RF COMPONENTS:

RF diodes- applications of diodes- switch, modulator, attenuator, phase shifter, detector. BJTs, FETs, MOSFETS, MESFETS, HEMTs, HBT, Device Models, Device Characterization, Device technologies.

UNIT-2 **8L+0T+8P=16 Hours**

RFAMPLIFIERS:

BJT and FET Biasing, Impedance matching, Small Signal Amplifier Design, Large signal amplifier design, Multistage amplifier design.

PRACTICES:

Design and verify the following RF Devices and Active Circuit using Simulation Software (ADS/HFSS/ MATLAB).

- Design of phased shifter using ADS.
- Design of reconfigurable switch using ADS.
- Design of reconfigurable based RF diode using ADS
- Design of small signal Amplifier using ADS.
- Design of large signal Amplifier using ADS.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

MIXERS:

Mixer characteristics: Image frequency, conversion loss, noise figure; Devices for mixers: p-n junctions, Schottky barrier diode, FETs; Diode mixers: Small-signal characteristics of diode, single-ended mixer, large-signal model, switching model; FET Mixers: Single-ended mixer, other FET mixers; Balanced mixers; Image reject mixers.

UNIT-2 **8L+0T+8P=16 Hours**

OSCILLATORS AND FREQUENCY SYNTHESIZERS:

General analysis of RF oscillators, transistor oscillators, voltage-controlled oscillators, dielectric resonator oscillators, frequency synthesis methods, analysis of first and second order phase-locked loop, oscillator noise and its effect on receiver performance.

SKILLS:

- ✓ *Perform RF components design*
- ✓ *Design of Low power RF amplifier*
- ✓ *Design of mixer circuits.*
- ✓ *Design of oscillator.*

PRACTICES:

Design and verify the following RF Devices and Active Circuit using Simulation Software (ADS/HFSS/ MATLAB).

- Design of mixer using ADS.
- Design of FET mixer using ADS.
- Design of single end mixer using ADS.
- Design of VCO ADS.
- Design of PLL using ADS

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Model and characterise RF devices	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Design and analyse small signal and large signal amplifiers	Analyse	1	1, 2, 3, 5, 9, 10
3	Analyse single ended and balanced Mixers	Analyse	2	1, 2, 3, 5, 9, 10
4	Implement frequency synthesizer for a RF communication system	Evaluate	2	1, 2, 3, 4, 5, 9, 10, 12

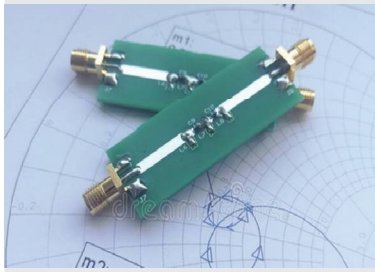
TEXT BOOKS:

1. Reinhold Ludwig, Pavel Bretchko, “RF Circuit Design: Theory and Applications”, Prentice Hall, Year: 2000, ISBN: 0130953237.
2. Bahl I and Bhartia P, “Microwave Solid State Circuit Design”, John Wiley & Sons, 2nd Edition, 2003.

REFERENCE BOOKS:

1. Gonzalez, Guillermo, Microwave transistor amplifiers: analysis and design, Prentice hall , 1997.
2. Andrei Grebennikov, RF and Microwave Transistor Oscillator Design, Wiley , 1 edition.
3. Chang K, Bahl I and Nair V, “RF and Microwave Circuit and Component Design forWireless Systems”, Wiley Inter science. 2002.

22EC831 RF PASSIVE CIRCUITS



Source: https://www.dreamstime.com/photos-images/microstrip.html

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Microwave Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course helps to understand the basics of RF passive components and circuits. This makes that student able to use smith chart and design RF passive circuits with RF CAD software (ADS).

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION:

Radio frequency and Microwave circuit applications, Radio frequency waves, RF and Microwave circuit design considerations, Introduction to component basics, Microstrip line, Formulation and properties of S-parameters, Smith chart Concepts.

UNIT-2 **8L+0T+8P=16 Hours**

IMPEDANCE MATCHING NETWORKS:

Goal of impedance matching, Components for matching, Design of Matching Networks - Matching network design using Lumped elements- RC, RL, RLC circuits, Design of Matching Networks using Distributed Elements- Transmission lines, Microstrip lines, Stubs.

PRACTICES:

Design and verify the following RF Passive Circuit using Simulation Software (HFSS/MATLAB).

- Study the Smith chart.
- Design of Microstrip line using HFSS.
- Design of impedance matching circuit using ADS
- Design of Stubs using HFSS
- Design of Matching network design using Lumped elements- RC, RL, RLC using ADS

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

RF PASSIVE DEVICES:

Couplers and power dividers - Basic properties, Types, Power combining efficiency, Wilkinson Power divider- equal and unequal types, 90° Hybrids, Branch line couplers, N-way combiners, Corporate structures, Spatial combining,

Phase shifters – Types, Transmission line type, Reflection types phase shifters.

UNIT-2 **8L+0T+8P=16 Hours**

RESONATORS AND FILTERS:

RF resonators and filters - Basic Resonator types, transmission line resonators, Resonant waveguide cavities, Excitation of resonators.

RF filters: Basic filter configurations, Special Filter Realizations, Filter Implementation, Coupled Filter

SKILLS:

- ✓ *Perform RF components design*
- ✓ *Design of Low power RF amplifier*
- ✓ *Design of mixer circuits.*
- ✓ *Design of oscillator.*

PRACTICES:

Design and verify the following RF Passive Circuit using Simulation Software (HFSS/MATLAB).

- Generate of Wilkinson Power divider using HFSS software.
- Design of 90° Hybrids, Branch line couplers using HFSS.
- Design of Branch line couplers using HFSS
- Design of phase shifter using ADS
- Design of RF filter using ADS

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Design impedance matching networks using smith chart	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Realize impedance networks using microstrip lines	Evaluate	1	1, 2, 3, 5, 9, 10
3	Analyse different RF components- couplers, power dividers, phase shifters, resonators and filters.	Analyse	2	1, 2, 3, 5, 9, 10
4	Implement a RF communication system using different passive components	Evaluate	2	1, 2, 3, 4, 5, 9, 10, 12

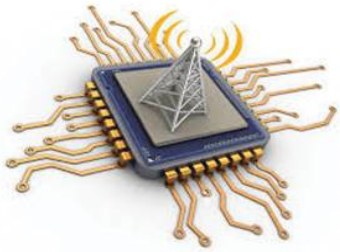
TEXTBOOKS:

1. D M Pozar, Microwave Engineering, John Wiley & Sons, 2011.
2. Chang K, Bahl I and Nair V, “RF and Microwave Circuit and Component Design for Wireless Systems”, Wiley Inter science. 2002

REFERENCEBOOKS:

1. Gonzalez, Guillermo, Microwave transistor amplifiers: analysis and design, Prentice Hall, 1997.
2. Reinhold Ludwig, Pavel Bretchko, “RF Circuit Design: Theory and Applications”, Prentice Hall, Year: 2000, ISBN: 0130953237.
3. Samuel Y Liao, “Microwave Devices and Circuits”, 3rd edition, Pearson Education, 2003.

22EC832 RFIC AND MICROWAVE MEMS



Source: https://www.asicnorth.com/offerings/design-services/rf-design/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Microwave Engineering, RF devices and active circuits, passive circuits, VLSI.

COURSE DESCRIPTION AND OBJECTIVES:

To learn about the concept of RFIC design basics, RF transceiver architectures, front-end amplifiers and RF Mixers. RF MEMS, RF Switches and Filter and phase shifter.

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

BASIC COMPONENTS IN RF DESIGN:

General considerations, non-linearity and its effects, Noise concepts in RF, Sensitivity, Dynamic range, Receiver Architectures, Transmitter Architectures, OOK transceivers

UNIT-2 **8L+0T+8P=16 Hours**

LNA AND MIXERS:

Input matching, basic LNA topologies, Gain switching, Advance LNA topologies, Mixer Noise Figures, Single-balanced and Double-balanced Mixers, Passive down conversion Mixers, Active down conversion Mixers.

PRACTICES:

Design and verify the following using Simulation Software (ADS).

- Perform DC and AC analysis for basic structure (CS, CG, CD) topologies.
- Perform s-parameter and Linearity analysis for (CS, CG, CD) topologies.
- Design a MMIC LNA in blue-tooth frequency range using Keysights ADS tool
- Design a double-balanced Mixer.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION:

RF MEMS for microwave applications, MEMS technology and fabrication, mechanical modelling of MEMS devices, MEMS materials and fabrication techniques.

UNIT-2 **8L+0T+8P=16 Hours**

TIMING ANALYSIS:

MEMS Switches: Introduction to MEMS switches; Capacitive shunt and series switches: Physical description, circuit model and electromagnetic modelling; Techniques of MEMS switch fabrication and packaging; Design of MEMS switches.

PRACTICES:

Design and verify the following using Simulation Software (COMSOL/ ADS).

- Design RF MEMS for RFID applications

SKILLS:

- ✓ *Understand the concepts of cascading, cascading, down conversion and up conversion in RFIC design*
- ✓ *Identify various improved Mixer topologies.*
- ✓ *Understand the concepts of MEMS phase shifters and tunable microwave surfaces.*
- ✓ *Understand passive and active MMIC elements*

- Design of RF MEMS shunt Switches
- Design of RF MEMS series Switches.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic of RF passive and active circuits and Design a RF front end amplifier with MMIC technology.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Analyse a novel topology in design of LNA's and RF Mixers.	Analyse	1	1, 2, 5, 9, 10
3	Design and analyses of RF MEMS for Microwave Applications	Apply	2	1, 2, 3, 5, 9, 10
4	Design and analyses of RF Switches.	Analyse	2	1, 2, 5, 9, 10, 12

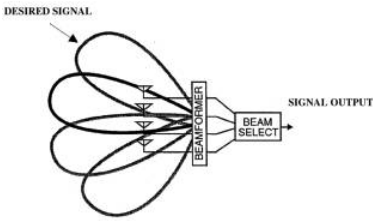
TEXTBOOKS:

1. Behzad Razavi, "RF Microelctronics", Pearson, second edition, 2014.
2. Varadan, V.K., Vinoy, K.J. and Jose, K.J., "RF MEMS and their Applications", John Wiley & Sons. 2003.

REFERENCEBOOKS:

1. Rebeiz, G.M., "MEMS: Theory Design and Technology", John Wiley & Sons. 1999.
2. De Los Santos, H.J, "RF MEMS Circuit Design for Wireless Communications", Artech House. 1999
3. Trimmer, W., "Micromechanics & MEMS", IEEE Press. 1996 5. Madou, M., "Fundamentals of Microfabrication", CRC Press. 1997
4. Sze, S.M., "Semiconductor Sensors", John Wiley & Sons. 1994.

22EC833 SMART ANTENNA



Source: https://www.circuitstoday.com/smart-antennas

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Signals and Systems, Communication Systems and Antenna Theory, Microwave Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

To know the basic concepts on antenna, the performance of an antenna array, Learning self adaptive procedure to extract the desired signal and design of smart antenna system. To gain an understanding and experience with smart antenna environments, algorithms and implementation.

MODULE–1

UNIT-1 **8L+8T+0P=16 Hours**

SMART ANTENNAS:

Introduction, Need for Smart Antennas, Overview, Smart Antenna Configurations.

UNIT-2 **8L+8T+0P=16 Hours**

DOA ESTIMATION FUNDAMENTALS:

Introduction, Conventional Direction Of Arrivals (DOA) Estimation Methods, Conventional Beam forming Methods.

PRACTICES:

Design and verify the following smart Antenna designs using Simulation Software (HFSS/CST/ANSYS).

- Basic Microstrip Patch Smart Antenna Designs.
- DGS based Smart Antenna Designs.
- Fractal based Smart Antenna Designs.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

BEAM FORMING FUNDAMENTALS:

Classical Beam former, Statistically Optimum Beamforming Weight Vectors, Maximum SNR Beam former, Multiple Sidelobe Canceller and Maximum.

UNIT-2 **8L+8T+0P=16 Hours**

INTEGRATION AND SIMULATION OF SMART ANTENNAS:

Overview, Antenna Design, Mutual Coupling, Adaptive Signal Processing Algorithms, DOA, Adaptive Beam forming, Beam forming and Diversity Combining for Rayleigh-Fading, Channel.

PRACTICES:

Design and verify the following smart Antenna designs using Simulation Software (HFSS/CST/ANSYS).

- Smart Antenna Designs based on MIMO Concept.
- Adaptive Beam forming based MIMO Antenna
- Artificial Intelligence in DGS based Smart Antenna Designs

SKILLS:

- ✓ *Gain an understanding and experience with smart antenna environments and implementation.*
- ✓ *Know, how technology promote 5G wireless communication systems.*
- ✓ *Change the beam forming direction according to the needs.*
- ✓ *Identify the need of Artificial Intelligence in Smart Antenna designs.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the fundamental concepts of Smart Antennas and its Applications.	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Analyze Direction Of Arrivals in Smart Antenna.	Analyze	1	1, 2, 4,5, 9, 10,12
3	Apply the concepts on Beam forming Algorithms.	Apply	2	1, 2,4,5, 9, 10,12
4	Evaluate the requirements for the design and implementation of smart antenna systems.	Evaluate	2	1, 2,3,4,5, 9, 10, 12

TEXTBOOKS:

1. Constantine A. Balanis & Panayiotis I. Ioannides, “Introduction to Smart Antennas”, Morgan & Claypool Publishers’ series-2010
2. Joseph C. Liberti Jr., Theodore S Rappaport, “Smart Antennas for Wireless CommunicationsIS-95 and Third Generation CDMA Applications”, PTR – PH publishers, 1st Edition, 2014.

REFERENCEBOOKS:

1. T.S Rappaport, “Smart Antennas Adaptive Arrays Algorithms and Wireless Position Location”, IEEE press 1998, PTR – PH publishers 1999.
2. Lal Chand Godara, “Smart Antennas”, CRC Press, LLC-2004.
3. T. K Sarkar, Micheal C. Wicks, “Smart Antenna”, 1st edition, Wiley, 2003.

HONOURS

ELECTRONICS AND COMMUNICATION ENGINEERING

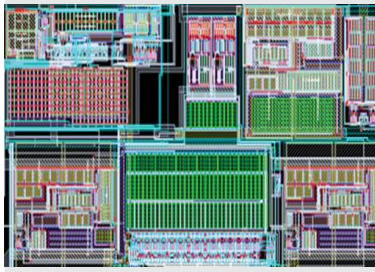
B.Tech.

- 22EC975 - Analog IC Design
- 22EC976 - ASIC Design
- 22EC977 - Digital IC Design
- 22EC978 - Low Power VLSI Design

COURSE CONTENTS

I SEM & II SEM

22EC975 ANALOG IC DESIGN



Source: https://www.microwavejournal.com/articles/36289-x-fab-introduces-analog-mixed-signal-reference-design-kit-for-siemens-tanner-ic-design-tools

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Analog Circuits, VLSI Design.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the analysis and design of analog integrated circuits starting from basic building blocks to different implementations of the amplifiers in CMOS technology.

MODULE –1

UNIT-1 **12L+8T+0P=20 Hours**

MOSFET:

CMOS device fundamentals: Basic MOS models, device capacitances, parasitic resistances, substrate models, transconductance, output resistance, frequency dependence of device parameters.

UNIT-2 **12L+8T+0P=20 Hours**

SINGLE STAGE AMPLIFIERS:

Current Mirrors and Single stage amplifiers: CMOS current mirror, Common source amplifier, common drain amplifier or source follower, Common gate amplifier, Source degenerated current mirror, High output impedance current mirrors; Casode current mirror, Wilson current mirror, Cascode gain stage , MOS differential pair, Differential Amplifiers

PRACTICES:

Design and simulate the following analog circuits.

- Verify the characteristics of nMOS and pMOS Transistor
- Common Source, Common Drain and Common gate Amplifiers
- Current Mirror and Cascoded Current Mirror
- Differential Amplifier

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

FREQUENCY RESPONSE OF AMPLIFIERS:

Frequency Response of Amplifiers: Miller effect, Common Source amplifier, Source follower amplifier, Common gate amplifier, Cascode gain stage, BandGap references

UNIT-2 **12L+8T+0P=20 Hours**

CMOS OPERATIONAL AMPLIFIER:

CMOS Operational Amplifiers: Classification of Op Amps, Design of Op Amps, Compensation of Op Amps, Performance parameters, Design of two-stage Op Amps, Gain boosting, common mode feedback, Input range, slew rate, Power supply rejection, Noise in Op Amps, Stability and frequency Compensation, Buffered Op-amps, High speed / Frequency Op-amps, Differential output op-amps, low noise and low voltage op-amps.

SKILLS:

- ✓ *Identify and analyze various Current mirror circuits.*
- ✓ *Design of differential amplifier.*
- ✓ *Analyze the frequency response.*

PRACTICES:

Design and simulate the following analog circuits.

- CMOS Op-amp single Stage
- Two stage operational amplifier
- Folded cascode amplifier

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Design basic building blocks of analog ICs.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Design optimal single stage amplifiers for various applications	Apply	1	1, 2, 5, 9, 10
3	Analyze the frequency response of amplifiers	Analyze	2	1, 2, 3, 5, 9, 10
4	Develop a procedure for optimal compensation of op-amp against process, supply and temperature variations	Apply	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:

1. BehzadRazavi, “Design of Analog CMOS integrated circuits”, McGraw-Hill International edition, 2001.
2. D. A. Johns and Martin, Analog Integrated Circuit Design, John Wiley,1997.

REFERENCES BOOKS:

1. R Gregorian and G C Temes, Analog MOS Integrated Circuits for Signal Processing, John Wiley,1986.
2. R L Geiger, P E Allen and N R Strader, VLSI Design Techniques for Analog &Digital Circuits, McGraw Hill,1990.
3. Gray, Wooley, Brodersen, “Analog MOS Integrated circuits”, IEEE press,1989.
4. Alan B. Grebene, “Bipolar and MOS Analog Integrated Circuit Design”, Wiley, 2002.

22EC976 ASIC DESIGN

Source: https://www.sondrel.com/blog/why-thinking-about-software-and-security-is-so-important-right-at-the-start-of-an-asic-design

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: VLSI Design.

COURSE DESCRIPTION AND OBJECTIVES:

To prepare the student to be an entry-level industrial standard ASIC or FPGA designer. To give the student an understanding of issues and tools related to ASIC/FPGA design and implementation. To give the student an understanding of basics of System on Chip and platform based design.

MODULE - 1

UNIT-1 **12L+8T+0P=20 Hours**

BASICS OF ASIC:

Types of ASICs, VLSI Design flow, Programmable ASICs - Antifuse, SRAM, EPROM, EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable interconnects. Latest Version - FPGAs and CPLDs and Soft-core processors.

UNIT-2 **12L+8T+0P=20 Hours**

TRADE OFF ISSUES AT SYSTEM LEVEL:

Optimization with regard to speed, area and power, asynchronous and low power system design. ASIC physical design issues, System Partitioning, Power Dissipation, and Partitioning Methods.

PRACTICES

- Design SRAM Cell.
- Analyse different ROM memories.
- Design memories using different power reduction techniques.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

ASIC DESIGNING:

ASIC floor planning, Placement and Routing.

UNIT-2 **12L+8T+0P=20 Hours**

HIGH PERFORMANCE ALGORITHMS FOR ASICS AS CASE STUDIES:

High performance algorithms for ASICS as case studies – Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC, USB controllers, OMAP

PRACTICES:

- Analyze different floor planning techniques.
- Analyze different placement techniques to optimize area.
- Analyze different routing techniques to optimize speed.

SKILLS:

- ✓ *Determine cell size and number of cells and cell locations for a given topological area.*
- ✓ *Finalize the frequency allocation for various cells with maximum reuse.*
- ✓ *Identify the handoff strategies.*
- ✓ *Estimate system capacity for minimum C/I.*
- ✓ *Suggest methods to improve the signal coverage.*
- ✓ *Choose proper accessing techniques for various generations of cellular communications.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Develop VLSI tool-flow and FPGA architecture.	Apply	1	1, 2, 12
2	Identify the issues involved in ASIC design, including technology choice, design management, tool-flow, verification, debug and test, as well as the impact of technology scaling on ASIC design.	Apply	1	1, 2, 4, 5, 12
3	Develop the algorithms used for ASIC construction.	Apply	2	1, 2, 3, 5, 12
4	Design high performance algorithms available for ASICs IC.	Create	2	1, 2, 3, 12

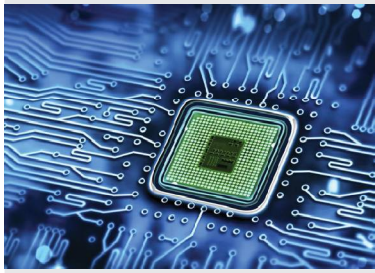
TEXT BOOKS:

1. M.J.S. Smith,"ApplicationSpecific Integrated Circuits", Pearson, 2003
2. H.Gerez, "Algorithms for VLSI Design Automation", John Wiley,1999.

REFERENCE BOOKS:

1. J..M.Rabaey, A. Chandrakasan, and B.Nikolic, "Digital Integrated
2. D.A.Hodges,"AnalysisandDesignofDigitalIntegratedCircuits(3/e)",MGH2004.
3. Hoi-Jun Yoo, KangminLeeandJun Kyong Kim, "Low-Power NoC for High-Performance SoC Design", CRC Press,2008.

22EC977 DIGITAL IC DESIGN



Source: https://www.easytechjunkie.com/what-is-a-digital-integrated-circuit.htm

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Digital Electronics, VLSI Design.

COURSE DESCRIPTION AND OBJECTIVES:

This course imparts knowledge on various types of faults, fault detection techniques and dominance. The objective of this course is to introduce the student to the concepts of test generation for combinational and sequential circuits and other VLSI circuit testing methods like DFT schemes, BIST and BILBO.

MODULE - I

UNIT-1 **12L+8T+0P=20 Hours**

CMOS INVERTER:

CMOS Inverter: Introduction to MOS transistor, V-I Characteristics, Electrical Parameters, Static behavior, switching Threshold, Noise Margins, Robustness revisited, Dynamic behavior: Computing the capacitances, propagation delay, propagation delay from a design perspective, power, energy and energy delay.

UNIT-2 **12L+8T+0P=20 Hours**

CMOS COMBINATIONAL CIRCUITS:

Combinational Logic Design: Introduction, Static CMOS Design: Complementary CMOS, ratioed logic, pass transistor logic dynamic CMOS Design: Dynamic logic, speed and power dissipation of dynamic logic, signal integrity issues in Dynamic design, cascading dynamic gates.

PRACTICES :

- Design of Inverter and all logic gates
- Design and Simulation of Full adder
- Design and Simulation of Serial Binary Adder, Carry Look Ahead Adder.
- Design of pseudo logic gates
- Design of DCVSL logic gates

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

CMOD SEQUENTIAL DESIGN:

Sequential Logic Design: Introduction, static latches and registers: The Bi-stability principle, multiplexer based latches, master-slave edge-Triggered register, low-voltage static latches, Static SR Flip-flop, dynamic latches and registers, dynamic transmission, Gate Edge - triggered registers, CMOS NORA-CMOS True single - phase clocked register (TSPCER).

UNIT-2 **12L+8T+0P=20 Hours**

TIMING ANALYSIS:

Timing Issues in Digital Circuits: Introduction, Timing classification of digital systems,

synchronous design, Self-Timed circuit design, synchronizers and arbiters.

SKILLS:

- ✓ *Identify various cmos logics to design combinational circuits.*
- ✓ *Design CMOS based sequential circuits.*
- ✓ *Analyze the timing constraints in the VLSI designs.*

PRACTICES:

- Design of flip flops: SR, D, JK, T
- Design of edge triggered registers
- Design of D flipflop using TSPCER

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Design CMOS inverters with specified noise margin and propagation delay.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Implement efficient techniques at combinational circuit level for improving power and speed of digital circuits	Apply	1	1, 2, 5, 9, 10
3	Design CMOS sequential circuits	Apply	2	1, 2, 3, 5, 9, 10
4	Analyse timing constraints in VLSI systems.	Analyse	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:

1. Jan M. Rabaey, AnanthaChandrakasan and Borivoje Nikolic., Digital Integrated Circuits: A Design Perspective, Second Edition, Pearson Education India, 2003
2. Ken Martin, Digital Integrated Circuit Design, Oxford University Press, 1st edition, 1999.

REFERENCE BOOKS:

1. Neil H. E. Weste and D. M. Harris, CMOS VLSI Design, Third Edition, 2010. 2. Sung-Mo Kang, CMOS Digital Integrated Circuits, 3rd Edition, McGraw-Hill, 2003.
2. IEEE Trans Electron Devices, IEEE J.Solid State Circuits, and other National and International Conferences and Symposia.

22EC978 LOW POWER VLSI DESIGN

Source: https://www.indiamart.com/nano-scientific-research/low-power-vlsi-ieee-projects.html

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: VLSI Design.

COURSE DESCRIPTION AND OBJECTIVES:

To understand the critical requirements and implementation of Low-power VLSI circuits. The course also covers critical issue related to continuous scaling of microelectronic circuits.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

FUNDAMENTALS OF LOW POWER VLSI DESIGN:

Need for Low Power Circuit Design: Sources of Power Dissipation: Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation

Short Channel Effects: Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT-2 **12L+8T+0P=20 Hours**

ACHIEVING LOW POWER:

For achieving low power: Switching activity reduction, algorithmic optimization, architecture optimization, logic optimization, circuit optimization.

Architectural Level Approach: Pipelining and Parallel Processing Approaches.

Different logic styles: Static and dynamic logic, Clock gating, reducing glitching through path balancing, input reordering.

Low-Power Design Approaches: VTCMOS circuits, MTCMOS circuits, Transistor stacking, power gating, Dynamic threshold CMOS.

PRACTICES:

- Use of Clock Gating for reducing Dynamic power.
- Apply frequency Scaling and voltage Scaling for reducing Dynamic power.
- Verify the techniques involved in verifying the Power Gating

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

LOW POWER DESIGN TECHNIQUES:

Low-Voltage Low-Power Adders, Low-Voltage Low-Power Multipliers, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low- Voltage Low-Power Logic Styles.

UNIT-2 **12L+8T+0P=20 Hours**

LOW-VOLTAGE LOW-POWER MEMORIES:

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

SKILLS:

- ✓ *Apply the different approaches to attain Low power design.*
- ✓ *Apply the different logic designs to attain Low power design.*
- ✓ *Resolve the sluggish issues in memories.*

PRACTICES:

- Reduce the power in high-end systems
- Analyze the Performance characteristics of chip using multi-voltage.
- Analyze the Power Gating and compare it with other techniques.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Acquires knowledge about the second order effects of MOS transistor characteristics.	Apply	1	1, 2, 12
2	Analyze various CMOS low power design techniques.	Analyze	1	1, 2, 5, 12
3	Design and implementation of computational structures for low power applications.	Create	2	1, 2, 3, 5, 12
4	Analyze memories with efficient architectures to improve power.	Analyze	2	1, 2, 12

TEXT BOOKS:

1. Kiat-Seng Yeo, Kaushik Roy, “Low-Voltage, Low-Power VLSI Subsystems”, TMH Professional Engineering, 2005.
2. Anantha P. Chandrakasan, and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publications, 2012.

REFERENCE BOOKS:

1. Kaushik Roy, Sharat C. Prasad, “Low Power CMOS VLSI Circuit Design”, John Wiley & Sons, 2000.
2. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, Kluwer Academic Press, 2002.
3. Rabaey, and Pedram, Low Power Design Methodologies, Kluwer Academic,1997.
4. Philip Allen, and Douglas Holberg, CMOS Analog Circuit Design, Oxford University Press.

HONOURS

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech.

22EC961	-	ADHOC Sensor Networks
22EC962	-	Cloud Computing for IoT Systems
22EC963	-	Embedded System Design Using FPGA
22EC964	-	Embedded Systems
22EC965	-	Introduction to Internet Of Things
22EC966	-	IoT Architecture
22EC967	-	IoT Design
22EC968	-	IoT Security
22EC969	-	Sensors and Actuators for IoT

COURSE CONTENTS

I SEM & II SEM

22EC961 ADHOC SENSOR NETWORKS

Source: https://www.brainkart.com/subject/Ad-hoc-and-Wireless-Sensor-Networks_363/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of computer networks.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed at offering fundamental concepts of wireless ad-hoc networks and wireless sensor networks. Explore the various routing protocols and their importance for designing of energy efficient and reliable wireless networks.

MODULE –1

UNIT-1 **12L+0T+8P=20 Hours**

ADHOC NETWORKS:

Introduction to Ad Hoc Networks - Characteristics of MANETs, Applications of MANETs and Challenges of MANETs. Routing in MANETs - Criteria for classification, Taxonomy of MANET routing algorithms, Topology based routing algorithms-Proactive: DSDV; Reactive: DSR, AODV; Hybrid: ZRP; Position-based routing algorithms-Location Services-DREAM.

UNIT-2 **12L+0T+8P=20 Hours**

DATA TRANSMISSION SCHEMES:

Broadcast Storm Problem, Rebroadcasting Schemes-Simple-flooding, Probability-based Methods, Area-based Methods, Neighbor Knowledge-based: SBA, Multipoint Relaying, AHBP. Multicasting: Tree-based: AMRIS, MAODV; Mesh-based: ODMRP, CAMP; Hybrid: AM Route, MCEDAR.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

SENSOR NETWORKS- INTRODUCTION & ARCHITECTURES:

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT-2 **12L+0T+8P=20 Hours**

SENSOR NETWORK PLATFORMS AND TOOLS:

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

PRACTICES:

Experiments to be carried out in any network simulator like NETSIM, NS2 and OMNET++ etc.

- Examine the various path loss models available for wireless networks
- Identify the various reasons for hidden node terminal problem in wireless ad-hoc networks.
- Create a scenario where both ad-hoc and wireless sensor network are available and examine the interference problem.

SKILLS:

- ✓ *Identify the various issues and their solutions in for designing wireless networks*
- ✓ *Implement routing algorithms for ad-hoc and sensor networks.*
- ✓ *Design an energy efficient wireless sensor network for various applications.*

- Analyze how the application-level throughput changes as a function of nominal bitrate in an 802.11g network.
- Simulate the multiple wireless scenarios for throughput performance.
- Analyze performance of the MANET routing protocols in various parameters like end-to-end delay, bit error rate and throughput.
- Design a wireless sensor network and observe how the power consumption consumed for the network.
- Examine the importance of channel accessing mechanism helped for getting high throughput in wireless networks.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Realize concepts, network architectures and applications of ad hoc and wireless sensor networks	Create	1	1, 2, 4, 9, 10, 11, 12
2	Analyze the protocol design issues of ad hoc and sensor networks	Analyze	1	1, 2, 3, 4, 9, 10, 11, 12
3	Design routing protocols for ad hoc systems.	Create	2	1, 2, 3, 4, 9, 10, 11, 12
4	Evaluate the QoS related performance measurements of ad hoc and sensor networks	Evaluate	2	1, 2, 3, 4, 9, 10, 11, 12

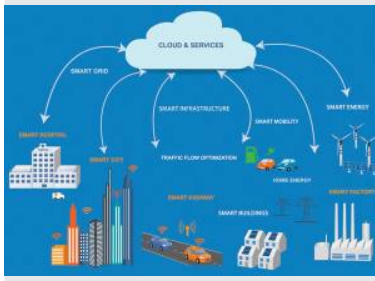
TEXT BOOKS:

1. Carlos Corderio Dharma P. Aggarwal, “Ad-Hoc and Sensor Networks – Theory and Applications”, World Scientific Publications, March 2011.
2. Feng Zhao and Leonides Guibas, “Wireless Sensor Networks”, Elsevier Publication–2002

REFERENCES BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004.
2. Kazem sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks: Technology, Protocols and Application” John Wiley, 2007.
3. C.K Toh, “Ad-Hoc Mobile Wireless Networks: Protocols and Systems” 1st edition, Pearson, 2007.

22EC962 CLOUD COMPUTING FOR IOT SYSTEMS



Source: https://iotdesignpro.com/articles/iot-and-cloud-computing

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers skills on IoT edge usage and networking techniques of cloud. The objective of the course is to enable the students to design and develop cloud services for IoT systems.

MODULE - 1

UNIT-1 **12L+0T+8P=20 Hours**

FUNDAMENTALS OF IOT SYSTEM:

IoT system architecture and design approaches, IoT standards, Ubiquitous computing and internet of things, IoT communication requirements - IoT network design fundamentals.

UNIT-2 **12L+0T+8P=20 Hours**

NETWORKING TO CLOUD:

Networking - SSH, Sockets, Network libraries, and web services, Retrieving data from real-world sensors, Working with cloud – Publishing data, Setting up IoT analytics at cloud.

PRACTICES:

- Sending an SMS and Email using cloud services.
- Interface any sensor and upload the data to Thing speak cloud.
- Counting the number of people who entered the room and store the data in the cloud using SSH.
- Door lock system using Blynk cloud services.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

IOT EDGE TO CLOUD PROTOCOLS:

MQTT, MQTT – SN, CoAP, HTTP, RestFul API, AMQP, Significance of gateway design, Characteristics, Protocol bridging, Implementations, Edge analytics at devices and gateways.

UNIT-2 **12L+0T+8P=20 Hours**

DATA ANALYTICS IN IOT:

Overview of existing cloud platforms-Azure/Watson/AWS, Data ingestion and complex event processing, IoT for predictive analytics and maintenance, Smart medical data sensing, and applications in health care.

PRACTICES:

- Make Raspberry pi as MQTT broker and control the ESP8266 NodeMCU as publisher and
- subscriber.
- Setting up Raspberry Pi server and writing data into it using Django.
- Image capturing and updating to the cloud using Raspberry pi.
- Live video streaming using cloud services.

SKILLS:

- ✓ *Use various sensors and actuators for IoT applications.*
- ✓ *Interface programming on I/O devices.*
- ✓ *Develop applications for the Internet of things.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify different components of an IoT system and their purpose.	Apply	1	1, 2,3
2	Able to identify appropriate protocols to interpret the data from an IoT system.	Apply	1	1, 2,3,5,12
3	Able to implement various networking protocols for IoT applications.	Apply	1	1, 2, 3, 5,12
4	Explore edge and cloud computing platforms for IoT.	Apply	2	1, 2
5	Evaluate various data analytics tools and machine learning algorithms.	Apply	2	1, 2, 3, 5

TEXT BOOKS:

1. Perry Lea, “Internet of Things for Architects”, 1st edition, Packt Publishing, 2018.
2. Subhas Chandra Mukhopadhyay, “Internet of Things Challenges and opportunities”, Springer, 2015.

REFERENCE BOOKS:

1. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013,
2. Samuel Greengard, “The Internet of Things (Essential Knowledge)”, MIT Press, 2015.
3. Timothy Chou,. Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020.

22EC963 EMBEDDED SYSTEM DESIGN USING FPGA

Source: https://synective.se/services/machine-learning/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Computer Architecture and Organization, Microprocessors and Microcontrollers.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the design and analysis of digital circuits with Verilog HDL. The primary goal is to provide basic understanding of system design. The course enables students to apply their knowledge for the design of digital hardware systems with help of FPGA tools like Digital system design using Verilog HDL, know FPGA architecture, interconnect and technologies, understand and implement embedded system on FPGA.

MODULE - I

UNIT-I **12L+0T+8P=20 Hours**

INTRODUCTION TO FPGA ARCHITECTURES AND XILINX VIVADO:

Introducing FPGAs: Exploring the Xilinx Artix-7 and 7 series devices, Combinational logic blocks, Storage, Clocking, I/Os, DSP48E1, ASMBL architecture.

Introducing Vivado: Directory structure.

Gate-level Combinational circuit
general description, basic lexical elements, data types, four-value system, data type groups, number representation, operators, program skeleton, port declaration, program body, signal declaration, structural description, testbench.

UNIT-II **12L+0T+8P=20 Hours**

RT-LEVEL COMBINATIONAL CIRCUIT:

Introduction, operators, always block for a combinational circuit, If statement, case statement, coding guidelines for an always block, parameter, constant, BCD incrementor.

PRACTICES:

- Setup and test the available FPGA board using the appropriate software tool.
- Design and test up and down counters
- Design and test a Binary Coded Decimal Adder.
- Design a Sequence Detector using Mealy Machine
- Design a Sequence Detector using Moore Machine

MODULE-2

UNIT-I **12L+0T+8P=20 Hours**

REGULAR SEQUENTIAL CIRCUIT:

Introduction, HDL code of the FF and register, simple design examples, test bench for sequential circuits, square wave generator, PWM and LED dimmer.

SKILLS:

- ✓ *Identify various cmos logics to design combinational circuits.*
- ✓ *Design CMOS based sequential circuits.*
- ✓ *Analyze the timing constraints in the VLSI designs.*

UNIT-II **12L+0T+8P=20 Hours**

FSM:

Introduction- Mealy and Moore outputs, FSM Representation, FSM code development, Design examples - Rising-edge detector, Debouncing circuit

UART:

UART receiving subsystem, UART transmitting subsystem, Overall UART system, Customizing a UART

PRACTICES:

- Generate a square wave signal with FPGA.
- Generate a sinusoidal signal with FPGA.
- Send a series of characters to PC through UART
- Interface a stepper motor FPGA

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Design and optimize complex combinational and sequential digital circuits.	Apply	1,2	1, 2, 3, 4, 9, 10, 11, 12
2	Model and implement Combinational and sequential digital circuits by Verilog HDL.	Create	1,2	1, 2, 3, 4, 9, 10, 11, 12
3	Design and model digital circuits with Verilog HDL at behavioural, structural, and RTL Levels.	Create	1,2	1, 2, 3, 4, 9, 10, 11, 12
4	Develop test benches to simulate combinational and sequential circuits.	Create	1,2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. FPGA Programming for beginners by Fank Bruno, Packt Publishing Limited, 2021, ISBN 978-1-78980-541-3.
2. FPGA Prototyping By Verilog Examples, by Pong P. Chu, A JOHN WILEY & SONS, INC., PUBLICATION, 2008

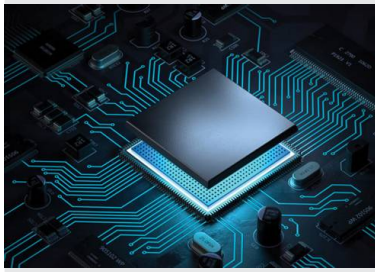
REFERENCE BOOKS:

1. A Verilog HDL primer by J. Bhaskar, Star Galaxy Pub., 2004.
2. Verilog HDL Design Examples by Joseph Cavanagh, CRC Press, 2017.
3. VHDL and FPLDs, by Zoran Salcic, Kluwer,1998.
4. Computers as Components, Principles of Embedded Computing System Design, by Wayne Wolf, Morgan Kauffman, 2001.
5. A VHDL Primer, by Jayaram Bhasker. Prentice Hall, 1998.
6. HDL Chip Design, by Douglas J. Smith, 1999.
7. VHDL Analysis and Modeling of Digital Systems, by Z. Navabi, McGraw-Hill, 1993.

WEB REFERENCES

1. http://www.ece.rutgers.edu/node/1528
2. http://www.ece.iastate.edu/~morris/388/syllabus_388x.html

22EC964 EMBEDDED SYSTEMS



Source: https://www.itpro.com/hardware/30317/what-is-an-embedded-system

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Computer Architecture and Organization, Microprocessors and Microcontrollers.

COURSE DESCRIPTION AND OBJECTIVES:

The course objective is to study the applications, categories, hardware and software architectures, memory, testing tools in embedded systems, Firmware, Embedded C, operating system functions and various kernel objects and RTOS.

MODULE-1

UNIT-1 **12L+0T+8P=20 Hours**

INTRODUCTION:

Basic concepts, Applications and Categories of embedded systems, Hardware architecture, Software architecture of Embedded Systems, Process of generating executable images, Development/testing tools.

UNIT-2 **12L+0T+8P=20 Hours**

PROGRAMMING:

Comparison of Assembly and C languages, C and Embedded C.

Programming in C: Arrays, Structures, Loops and Decisions, Pointers, Functions,

Embedded C: Header files for Project and Header files for Port.

PRACTICES:

- Programming with Embedded C using any compiler.
- Demonstration/Practical session for creation of header files.
- Program to create loops in Embedded C
- Program to implement decisions in Embedded C
- Develop program to implement interrupt function

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

OPERATING SYSTEMS:

Introduction to Operating Systems, Process and threads, Scheduling, Non-preemptive and Preemptive scheduling, Real Time Scheduling.

UNIT-2 **12L+0T+8P=20 Hours**

REAL TIME OPERATING SYSTEMS:

Introduction to Real Time Operating Systems, Shared Data Problem, Semaphores, Priority inversion problem, Inter process/task communication techniques.

SKILLS:

- ✓ *Choose component for Embedded System.*
- ✓ *Understand operating system concepts. Understand .*

PRACTICES:

- Create and schedule a process/task
- Demonstrate shared data problem
- Create and use semaphores
- Find schedulability using Gantt charts
- Implement IPC techniques

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify the components of embedded systems and differentiate various embedded systems	Apply	1	1, 2, 3, 4, 9, 10, 11, 12
2	Design embedded systems using standard procedure	Create	1	1, 2, 3, 4, 9, 10, 11, 12
3	Choose necessary component and buses for the embedded system	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Apply the knowledge of operating system functions and various kernel objects	Apply	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. Raj Kamal, “Embedded Systems Architecture, Programming and Design”, 3rd edition, Mc Graw Hill, 2017.
2. Embedded Systems An Integrated Approach, Lyla B. Das, Pearson Education, 2013

REFERENCE BOOKS:

1. Marilyn wolf, “Computers as Components: Principles of Embedded Computer systems design”, 4th edition, Morgan Kaufmann Publishers, 2017.
2. Dr. K.V.K.K. Prasad, “Embedded Real time Systems”, Black book, Dreamtech Press, 2003.
3. Daniel W. Lewis, “Fundamentals of Embedded Software: Where C and Assembly Meet”, 1st edition, Pearson, 2001.
4. John Catsoulis, “Designing Embedded Hardware”, 2nd Edition, O’Reilly Media, Inc., 2005.
5. “Getting Started with Arduino: The Open Source Electronics Prototyping Platform”, 3rd edition, Maker Media Inc., 2015.
6. Michail Kölling, “Raspberry PI: A complete guide to start learning RaspberryPi on your own”, Francesco Cammardella Publications, 2020.

22EC965 INTRODUCTION TO INTERNET OF THINGS

Source: https://www.zephyrnetworks.com/everything-you-need-to-know-about-iot-devices-and-why-you-should-implement-them-in-your-business/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of C-programming

COURSE DESCRIPTION AND OBJECTIVES:

This course offers skills on interconnection and integration of the physical world and the cyberspace. The objective of the course is to enable the students to design and develop IoT systems for real-world problems.

MODULE-1

UNIT-1 **12L+0T+8P=20 Hours**

IOT INTRODUCTION & CONCEPTS:

Introduction: Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and deployment.

UNIT-2 **12L+0T+8P=20 Hours**

PROTOTYPING & APPLICATIONS:

Prototyping Embedded Devices: Electronics, Embedded Computing Basics, Arduino, ESP8266, Raspberry Pi.

Domain Specific Applications of IoT: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

PRACTICES:

- Familiarization with Arduino boards and ESP8266.
- Interfacing of LED and switch with Arduino boards and ESP8266.
- Traffic Light control using Arduino board and ESP8266.
- Interfacing DHT11 sensor with Arduino board and ESP8266.
- Interfacing of ultrasonic sensor with Arduino board and ESP8266.
- Interfacing of PIR sensor with Arduino board and ESP8266.
- DC motor control using L293D motor driver and Arduino board.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

INTERNET PRINCIPLES & M2M:

Internet Principles: Internet communications: An overview, IP addresses, MAC addresses, TCP and UDP ports, Application layer protocols; Python packages of interest for IoT.

M2M: Introduction to M2M, M2M architecture, Difference between IoT and M2M, SDN and NFV for IoT.

UNIT-2 **12L+0T+8P=20 Hours**

IOT DESIGN:

IoT Design: IoT Design Methodology, Python Web Application Framework, Django, Designing a REST full web API.

Case Studies: Home Automation, Smart Cities, Environment, Agriculture, Productivity Applications.

SKILLS:

- ✓ *Use various sensors and actuators for IoT applications.*
- ✓ *Interface programming on I/O devices.*
- ✓ *Develop applications for the Internet of things.*

PRACTICES:

(Both practices and/ or Tutorials should be included in this section only. The list should quantify the T+P hours in this module)

- Familiarization with Raspberry pi.
- Interfacing of LED and switch with Raspberry pi.
- Interfacing PIR sensor with Raspberry pi.
- Interfacing DHT11 sensor with Raspberry pi.
- Interfacing of ultrasonic sensor with Raspberry pi.
- Interfacing of Picam with Raspberry pi.
- Sending email with Raspberry pi.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Interface sensors with various embedded devices.	Apply	1	1, 2,5,12
2	Design the framework necessary for IoT applications	Apply	1	1, 2, 5, 12
3	Develop prototypes for IoT devices	Apply	1	1, 2, 3, 5, 12
4	Assess various internet principles and M2M technologies.	Apply	2	1, 2, 12
5	Classify various advanced IoT applications and case studies.	Apply	2	1, 2

TEXT BOOKS:

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things A Hands-On- Approach”, 2014.
2. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013,

REFERENCE BOOKS:

1. Perry Lea, “Internet of Things for Architects”, 1st edition, Packt Publishing, 2018.
2. Samuel Greengard, “The Internet of Things (Essential Knowledge)”, MIT Press, 2015.
3. Timothy Chou,. Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020.

22EC966 IOT ARCHITECTURE

Source: https://www.intigia.com/technologies/industrial-iot/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the Architecture of IoT, basic concepts of IoT architectures and IoT Levels. The Course emphasizes the constraints, requirements, and architectures of hardware and software components for IoT systems. By the end of the course, a student will be able to: (1) Develop IoT solutions based on popular hardware/software platforms to address real-life problems (2) Evaluate the cost, power, and performance trade-offs associated with IoT solutions.

MODULE-1

UNIT-1 **12L+0T+8P=20 Hours**

IOT REFERENCE MODELS:

Introduction: Introduction to IoT, Applications of IoT, Use cases of IoT, The IoT Architectural Reference Model as Enabler, IoT in Practice: Examples: IoT in Logistics and Health, IoT Reference Model: Domain, information, functional & communication models.

UNIT-2 **12L+0T+8P=20 Hours**

IOT ARCHITECTURE AND PROTOCOLS:

IoT Reference Architecture: Architecture, Functional, information, deployment and operation views; SOA based Architecture, API-based Architecture, OPENIoT Architecture for IoT/Cloud Convergence.

Application Protocols for IoT: UPnP, CoAP, MQTT, XMPP. SCADA, WebSocket; IP-based protocols: 6LoWPAN, RPL; Authentication Protocols; IEEE 802.15.4.

Case study: Cloud-Based Smart-Facilities Management, Healthcare, Environment Monitoring System.

PRACTICES:

- Implementation of home automation system using relay module.
- Implementation of traffic signal control using 6LoWPAN.
- Implementation of railway gate control by stepper motors.
- Direction and speed control of DC Motor.
- Familiarization with Arduino/Raspberry pi .
- To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn on led for 1sec after every 2 seconds.
- Write a program on Arduino/Raspberry Pi to publish temperature data to the MQTT broker.
- Write a program on Arduino/Raspberry Pi to subscribe to the MQTT broker for temperature data and print it.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

IIOT REFERENCE ARCHITECTURE:

IIoT Architecture: The IIC Internet Reference Architecture, Industrial Internet Architecture Framework (IIAF), Architectural Topology, The Three-Tier Topology, Connectivity, Key System Characteristics, Data Management.

SKILLS:

- ✓ *Understand the specifications and how well different components work together for IoT Boards.*
- ✓ *Learn different data and number representations.*
- ✓ *Design ALU and Control unit.*
- ✓ *Identify the types of IoT application protocols and their uses.*
- ✓ *To enable the students to take up the real-time industry as well as interdisciplinary projects.*

UNIT-2 **12L+0T+8P=20 Hours**

DESIGNING INDUSTRIAL INTERNET SYSTEMS:

The Concept of the IIoT, The Proximity Network, WSN Edge Node, Legacy Industrial Protocols, Modern Communication Protocols, Wireless, Communication Technologies, Proximity Network Communication Protocols, Gateways Examining the Access Network Technology and Protocols - The Access Network, Access, Networks Connecting Remote Edge Networks

PRACTICES:

- Identify the industrial Sensors
- Interfacing raspberry pi with Boilers
- Implementation of scrolling belt using raspberry pi.
- implementation of the network using raspberry pi.
- To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to the smartphone using Bluetooth.
- To interface node MCU with Arduino/Raspberry Pi and write a program to send sensor data to the smartphone using Blynk Application/Cloud.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Build the IoT Design with sensors and actuators and analyse the levels of Arduino programming language.	Apply	1	1, 2, 12
2	Make use of sensors for collection data from the physical medium	Apply	1	1, 2, 5, 12
3	Apply the physical layer issues, analyse Medium Access Control Protocols/IoT Protocols	Apply	1	1, 2, 3, 5, 12
4	Categorize various topologies and Data management tools	Analyze	2	1, 2, 12
5	Comprehend network and transport layer characteristics and protocols and implement conventional protocols	Analyze	2	1, 2

TEXT BOOKS:

1. Giacomo Veneri; Antonio Capasso, “Hands-on Industrial Internet of Things : create a powerful Industrial IoT infrastructure using Industry 4.0”, ,Packt Publishing, 2018
2. Vijay Madisetti, ArshdeepBahga,” Internet of Things A Hands-On- Approach”,2014

REFERENCE BOOKS:

1. Bassi, Alessandro, et al, “Enabling things to talk”, Springer-Verlag Berlin An, 2016.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017
3. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.
4. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016
5. Alasdair Gilchrist,“Industry 4.0: The Industrial Internet of Things” by, ISBN: 978-1-4842-2046-7, APRESS, 2016.

22EC967 IOT DESIGN

Source: https://1nce.com/en/blog/iot-device-design/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT.

COURSE DESCRIPTION AND OBJECTIVES:

This course emphasis on the design principles for developing an IoT product in the market. The objective of the course is to enable the students to understand the design principles while prototyping the IoT devices.

MODULE-1

UNIT-1 **12L+0T+8P=20 Hours**

DESIGN PRINCIPLES FOR CONNECTED DEVICES:

Introduction, Design Principles for Connected Devices, Calm and Ambient Technology, Magic as Metaphor, Privacy, Web Thinking for Connected Devices, Affordances.

UNIT-2 **12L+0T+8P=20 Hours**

PROTOTYPING EMBEDDED DEVICES:

Thinking About Prototyping: Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Open Source versus Closed Source, Tapping into the Community.

Prototyping Embedded Devices: Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp, Other Notable Platforms

PRACTICES:

- Sense the available networks using Arduino.
- Detect the vibration of an object using Arduino.
- Connect with the available wi-fi using Arduino.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

PROTOTYPING ONLINE COMPONENTS:

Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols

Techniques for Writing Embedded Code: Memory Management, Performance and Battery Life, Libraries, Debugging

UNIT-2 **12L+0T+8P=20 Hours**

FROM PROTOTYPE TO REALITY:

Business Models, Lean Startups, Moving to Manufacture, Designing Kits, Designing Printed circuit boards, Manufacturing Printed Circuit Boards, Ethics, Privacy, Control.

SKILLS:

- ✓ *Design prototypes for IoT applications.*
- ✓ *Able to understand the design principle for IoT.*
- ✓ *Interface I/O devices with APIs.*

PRACTICES:

- Data Logging with Raspberry pi and Thing speak.
- Turn your smartphone into an IoT device.
- Interfacing Arduino with any cloud platform.
- Measure any physical quantity and tweet when it crossed the threshold limit.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the design principles for connected devices.	Apply	1	1, 2,3,5
2	Able to design the framework necessary for IoT applications	Apply	1	1, 2,3,5, 12
3	Develop prototypes for IoT devices	Apply	1	1, 2, 3, 5, 12
4	Develop APIs for IoT applications.	Apply	2	1, 2, 3,12
5	Design business models for IoT.	Apply	2	1, 2, 3

TEXT BOOKS:

1. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013.
2. Kamal R. Internet of Things, McGraw Hill, 2017.

REFERENCE BOOKS:

1. Perry Lea, “Internet of Things for Architects”, 1st edition, Packt Publishing, 2018.
2. Samuel Greengard, “The Internet of Things (Essential Knowledge)”, MIT Press, 2015.
3. Timothy Chou,. Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020.

22EC968 IOT SECURITY

Source: https://www.speranzainc.com/communication-security-in-iot/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to Internet of Things.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the methodologies of Cyber Physical systems and the basic Trust models of IoT. The course explores on different threads on IoT applications and provides privacy preservation for real time data using Attack detection techniques, Encryption, Hash Function, Elliptic curves, Signature Algorithms, Consensus Algorithms and Secured Access Protocols.

MODULE-1

UNIT-1 **12L+0T+8P=20 Hours**

CYBER PHYSICAL SYSTEMS & THREADS:

Introduction to IoT –Cyber Physical Systems: IoT and cyber-physicalsystems, IoT security (vulnerabilities, attacks, and countermeasures), security engineering for IoT development, IoT security lifecycle.

IoT as Interconnection of Threats: Network Robustness of Internet of Things- Sybil Attack Detection in Vehicular Networks- Malware Propagation and Control in Internet of Things- Solution-Based Analysis of Attack Vectors on Smart Home Systems

UNIT-2 **12L+0T+8P=20 Hours**

CRYPTO FOUNDATIONS & BLOCK CHAIN:

Crypto Foundations: Block ciphers, message integrity, authenticated encryption, hash functions, Merkle trees, elliptic curves, public-key crypto (PKI), signature algorithms

Block Chain: Crypto-currencies, Bitcoin P2P network, distributed consensus, incentives and proof-of-work, mining, script and smart contracts, wallets: hot and cold storage, anonymity, altcoins.

PRACTICES:

- Implement Block Cipher Encryption.
- Analyze Attacks on smart Home
- Vulnerabilities on IoT devices.
- Implement attacks on IoT.
- Evaluate Cyber-physical systems.
- Design smart contract for real time IoT applications.
- Implement Consensus Algorithm for IoT.
- Implement Sybil Attack Detection.
- Implement Malware Control in Internet of Things.
- Implement elliptic curve cryptography.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

PRIVACY PRESERVATION & TRUST MODELS:

Privacy Preservation for IoT: Privacy Preservation Data Dissemination- Privacy Preservation Data Dissemination- Social Features for Location Privacy Enhancement in Internet of Vehicles- Lightweight

SKILLS:

- ✓ *Understands the state-of-the-art methodologies in Cyber Physical system. 2.*
- ✓ *Knowledge on Model threats and countermeasures.*
- ✓ *Explores the Privacy Preservation and Trust Models in Internet of Things (IoT).*
- ✓ *Designs Internet of Things Security in the real world scenarios.*

and Robust Schemes for Privacy Protection in Key Personal IoT Applications: Mobile WBSN and Participatory Sensing

Trust Models for IoT: Authentication in IoT- Computational Security for the IoT- Privacy-Preserving Time Series Data Aggregation- Secure Path Generation Scheme for Real-Time Green Internet of Things- Security Protocols for IoT Access Networks- Framework for Privacy and Trust in IoT- Policy-Based Approach for Informed Consent in Internet of Things

UNIT-2 **12L+0T+8P=20 Hours**

INTERNET OF THINGS SECURITY:

Security and Impact of the Internet of Things (IoT) on Mobile Networks- Networking Function Security- IoT Networking Protocols, Secure IoT Lower Layers, Secure IoT Higher Layers, Secure Communication Links in IoTs, Back-end Security -Secure Resource Management, Secure IoT Databases, Security Products-Existing Test bed on Security and Privacy of IoTs, Commercialized Products.

PRACTICES:

- Implement IoT Networking protocols.
- Implement authorized login for IoT database.
- Secured IoT Access Networks.
- Security implementation at Lower Layers.
- Security implementation at Higher Layers.
- Design light weight security applications.
- Design policy for IoT data Approach.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify the areas of cyber security for the Internet of Things.	Analyze	1	1, 2
2	Assess different Internet of Things technologies and their applications.	Analyze	1	1, 2, 12
3	Model IoT to business	Apply	1	1, 2, 3, 5
4	Customize real time data for IoT applications.	Apply	2	1, 2, 12
5	Solve IoT security problems using light weight cryptography	Analyze	2	1, 2, 3, 5
6	Build security systems using elementary blocks	Apply	2	1, 2, 3, 5

TEXT BOOKS:

1. Hu, Fei. Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations, 1 st edition,CRC Press, 2016.
2. Russell, Brian, and Drew Van Duren. Practical Internet of Things Security, 1 st edition, Packt Publishing Ltd, 2016.

REFERENCE BOOKS:

1. Whitehouse O. Security of things: An implementers' guide to cyber-security for internet of things devices and beyond, 1 st edition, NCC Group, 2014
2. DaCosta, Francis, and Byron Henderson. Rethinking the Internet of Things: a scalable approach to connecting everything, 1 st edition, Springer Nature, 2013.
3. Patel Chintan, Nishant Dosji. Internet of Things Security Challenges, Advances and Analysis, 1st Edition, Auerbach, 2018.

22EC969 SENSORS AND ACTUATORS FOR IOT

Source: https://parasam.me/2016/05/19/iot-internet-of-things-a-short-series-of-observations-pt-2-sensors-actuators-infrastructure/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT or Embedded Systems.

COURSE DESCRIPTION AND OBJECTIVES:

Explore IoT smart sensor and actuator solutions. Compare types and technical requirements and protocols across market industries. Develop solutions for IoT using various sensors and actuators.

MODULE-1

UNIT-1 **12L+0T+8P=20 Hours**

INTRODUCTION TO SENSORS & ACTUATORS:

Definitions, Classification of sensors and Actuators, General Requirement for interfacing, Units.

Input output characteristics, Transfer function, Range, Span, input and Output full scale, resolution and dynamic range, accuracy, errors, and repeatability, sensitivity and sensitivity analysis, hysteresis, nonlinearity, and saturation, Frequency response, response time, and bandwidth, Calibration, excitation, deadband, reliability.

UNIT-2 **12L+0T+8P=20 Hours**

PRINCIPLES OF SENSORS:

Principles of sensing (Basics) : Capacitance, Magnetism, Resistance, Induction, Piezoelectric effect, Hall effects, Thermoelectric Effects

Ultrasonic Detectors, Optoelectronic Motion Detectors, Optical Presence Sensors, Pressure-Gradient Sensors, 2-D Pointing Devices, Gesture Sensing (3-D Pointing), Tactile Sensors

PRACTICES:

- Find the input characteristics of capacitive sensors
- Measure the range, sensitivity hysteresis, nonlinearity of temperature sensors
- Measure the frequency response of temperature sensor
- Measure the range of optical sensors and calibrate its use for displacement measurement.
- Calibrate a hall effect sensor
- Measure the displacement range, linearity, frequency response of piezoelectric sensor
- Measure the sensitivity of resistance sensors and establish their input characteristics
- Establish sensitivity, range, linearity and frequency response of tactile sensors.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

INTERFACING ELECTRONICS FOR SENSORS:

Signal Conditioners: Input Characteristics, Amplifiers, Operational Amplifiers, Voltage Follower, Charge- and Current-to-Voltage Converters, Light-to-Voltage Converters, Capacitance-to-Voltage Converters, Closed-Loop Capacitance-to-Voltage Converters

Data Acquisition: Data Acquisition, Sensor Classification, Units of Measurements

Analog-to-Digital Converters: Basic Concepts, Digital to analog converters, V/F Converters, PWM Converters, R/F Converters, Successive-Approximation Converter, Resolution Extension, ADC Interface

SKILLS:

- ✓ *Analyze characteristics of various sensors.*
- ✓ *Choose sensors based on application.*
- ✓ *Design interfacing circuitry for sensors and actuators.*

UNIT-2 **12L+0T+8P=20 Hours**

ACTUATORS & INTERFACING:

Thermal actuators, Optical actuators, Capacitive actuators, Magnetic actuators, magnetrostrictive actuators, Acoustic actuators, Electromagnetic actuators (DC, Stepper motors) and their control principles

Interfacing to microprocessor/microcontrollers. Microprocessor as general-purpose controller, General requirements for interfacing sensors and actuators. Interfacing examples

PRACTICES:

- Develop signal conditioning circuit for low level signals along with noise removal
- Develop a digital circuit for amplification of the capacitive sensor and establish various characteristics.
- Develop a digital circuit for measuring the optical sensitivity of optical sensor
- Control the rotation of stepper motor to precise angle without any sensors
- Tracking object by controlling servo motor precisely.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify sensors for selection of a specific physical parameter	Apply	1	1, 2, 12
2	Interface the sensor with different data acquisition systems	Create	2	1, 2, 5, 12
3	Control various actuators	Apply	2	1, 2, 3, 5, 12
4	Design a signal conditioner for the given sensor	Create	2	1, 2, 12
5	Select a sensor for a given application based on its principle of operation	Evaluate	1	1, 2

TEXT BOOKS:

1. Nathan Ida, Senosrs, Actuators, and Their Interfaces-A Multideisciplinary introduction, 2nd Edition, IET London UK, 2020
2. Jacob Fraden, Handbook of Modern Sensors Physics, Designs, and Applications, Fifth Edition, Springer, 2016

REFERENCE BOOKS:

1. John G. Webster, The Measurement Instrumentation and Sensors, CRC Press, 1999
2. Francisco André Corrêa Alegria, Sensors and Actuators, World Scientific Publichisng Co. Pvt. Ltd., 2022.
3. Ammar Rayes, Samer Salam, “Internet of Things from Hype to Reality”, Springer, 2022.

HONOURS

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech.

- 22EC951 - Advanced Deep Learning and Computer Vision
- 22EC952 - Applied Data Science With Python
- 22EC954 - Reinforcement Learning in Python

COURSE CONTENTS

I SEM & II SEM

22EC951 ADVANCED DEEP LEARNING AND COMPUTER VISION

Source: https://www.biostat.wisc.edu/~yli/bmi826_cs838_19fall/

Hours Per Week :

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Machine Learning and Computer Vision/Image Processing, Statistics and Linear Algebra.

COURSE DESCRIPTION AND OBJECTIVES:

This course will introduce the learner to the basics of computer vision and implementation of advanced topics like object detection, segmentation and recognition using deep learning techniques. The course will introduce pretrained nets, GANs and transformer models.

MODULE –1

UNIT-1 **8L+0T+16P=20 Hours**

FUNDAMENTALS:

Introduction to Image Formation, Capture and Representation; Linear Filtering, Correlation, Convolution; Visual Features and Representations: Edge, Blobs, Corner Detection; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP, etc.; Visual Matching: Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow

UNIT-2 **8L+0T+16P=20 Hours**

CONVOLUTIONAL NEURAL NETWORKS:

Convolutional Neural Networks (CNNs): Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, Inception Nets, ResNets, DenseNets

PRACTICES:

- Perform the feature detection using SIFT, SURF; HoG, LBP feature descriptors
- Perform the feature matching using RANSAC
- Implement a Pyramid Matching
- Implement classification using CNN

MODULE-2

UNIT-1 **8L+0T+16P=20 Hours**

CNNS FOR RECOGNITION, VERIFICATION, DETECTION, SEGMENTATION:

CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO, SSD, RetinaNet; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN

UNIT-2 **8L+0T+16P=20 Hours**

ATTENTION MODELS:

Introduction to Attention Models in Vision; Vision and Language: Image Captioning, Visual QA, Visual Dialog; Spatial Transformers; Transformer Networks; Deep Generative Models: Review of Deep Generative Models: GANs.

PRACTICES/ TUTORIALS:

- Object detection using R-CNN and Yolo

SKILLS:

- ✓ *Handle Feature descriptors.*
- ✓ *Design and implementation of various problems using CNN, GAN and transformer models.*

- Object recognition using YoLo.
- Detect cations in pictures
- Generate the object where the ground truth is not available using GAN
- Generate applications using Transformer.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of fundamentals of image formation and feature extraction	Apply	1,2	1, 2, 3, 4, 5, 9,10, 12
2	Integrate machine learning libraries and mathematical and statistical tools with modern technologies.	Apply	1	1, 2, 3, 4, 5, 9,10, 12
3	Apply techniques for the implementation of object detection and segmentation	Apply	2	1, 2, 3, 4, 5, 9,10, 12
4	Build the concept to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models	Apply	1, 2	1, 2, 3, 4, 5, 9,10, 12
5	Analyze the problems using GAN models and transformer models.	Evaluate	2	1, 2, 3, 4, 5, 9,10, 12

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016
2. Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.

REFERENCES BOOKS:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, 2010.
2. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.
3. Michael Nielsen, Neural Networks and Deep Learning, 2016
4. Yoshua Bengio, Learning Deep Architectures for AI, 2009.

22EC952 APPLIED DATA SCIENCE WITH PYTHON

Source: https://www.classcentral.com/course/python-data-science-18393

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basic programming language, data structure.

COURSE DESCRIPTION AND OBJECTIVES:

This course will introduce the learner to the basics of the python programming environment, including fundamental python programming techniques such as reading and manipulating csv files, and the Numpy library. The course will also introduce data manipulation and cleaning techniques along with visualization.

MODULE - 1

UNIT-1 **12L+0T+8P=20 Hours**

FUNDAMENTALS:

Python Program Execution Procedure – Statements – Expressions – Flow of Controls – Functions – Numeric Data Types – Sequences – Strings – Tuples – Lists – Dictionaries. Class – Constructors – Object Creation – Inheritance – Overloading. Text Files and Binary Files – Reading and Writing.

UNIT-2 **12L+0T+8P=20 Hours**

NUMPY AND PANDAS PACKAGES:

NumPy ndarray - Vectorization Operation - Array Indexing and Slicing - Transposing Array and Swapping Axes - Saving and Loading Array - Universal Functions - Mathematical and Statistical Functions in Numpy.

Series and Data Frame data structures in pandas - Creation of Data Frames – Accessing the columns in a DataFrame - Accessing the rows in a DataFrame - Panda's Index Objects - Reindexing Series and DataFrames - Dropping entries from Series and Data Frames - Indexing, Selection and Filtering in Series and Data Frames - Arithmetic Operations between Data Frames and Series - Function Application and Mapping.

PRACTICES:

- Perform Creation, indexing, slicing, concatenation and repetition operations on Python built-in data types: Strings, List, Tuples, Dictionary, Set
- Solve problems using decision and looping statements.
- Apply Python built-in data types: Strings, List, Tuples, Dictionary, Set and their methods to solve any given problem
- Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.
- Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.
- Computation on NumPy arrays using Universal Functions and Mathematical methods.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

DATA WRANGLING:

Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String manipulations – Regular Expressions.

SKILLS:

- ✓ *Handle storage and data operations using NumPy arrays.*
- ✓ *Design an application with user-defined modules and packages using OOP concept.*
- ✓ *Demonstrate data preprocessing and visualization using Pandas.*

UNIT-2 **12L+0T+8P=20 Hours**

VISUALIZATION IN PYTHON:

Matplotlib and Seaborn Packages – Plotting Graph - Controlling Graphs – Adding Text – More Graph Types – Getting and Setting Values – Patches.

PRACTICES/TUTORIALS:

- Handle missing data by detecting and dropping/ filling missing values.
- Transform data using apply() and map() method.
- Detect and filter outliers.
- Perform Vectorized String operations on Pandas Series.
- Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various Python data structures to effectively manage various types of data.	Apply	1,2	1, 2, 3, 4, 5, 9,10, 12
2	Analyze data science pipeline with role of Python.	Analyze	1	1, 2, 3, 4, 5, 9,10, 12
3	Apply data Wrangling with Numpy for exploratory data analysis	Apply	2	1, 2, 3, 4, 5, 9,10, 12
4	Apply data visualization tools for effective interpretations and insights of data.	Apply	2	1, 2, 3, 4, 5, 9,10, 12

TEXT BOOKS:

1. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition, 2018.
2. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.

REFERENCE BOOKS:

1. Alex Galea, “Applied Data Science with Python and Jupyter”, Packt Publishing Limited, 2018.
2. Gowrishanker and Veena, “Introduction to Python Programming”, CRC Press, 2019.
3. Leo Chin and Tanmay Dutta, “NumPy Essentials”, Packt Publishing Limited, 2016.
4. Wes Mc Kinney, “Python for Data Analysis”, O’Reilly Media, 2012.
5. Y. Daniel Liang, “Introduction to Programming using Python”, Pearson, 2012.
6. Jake Vanderplas, “Python Data Science Handbook: Essential Tools for Working with Data”, 1st Edition, O’Reilly Media, 2017.

22EC954 REINFORCEMENT LEARNING IN PYTHON

Hours Per Week :

L	T	P	C
3	2	0	4

Source: https://www.learndatasci.com/tutorials/reinforcement-q-learning-scratch-python-openai-gym/

PREREQUISITE KNOWLEDGE: Introduction to Image Processing, Artificial Intelligence, Machine Learning, and Q Learning.

COURSE DESCRIPTION AND OBJECTIVES:

Reinforcement learning is an area of machine learning where an agent learns how to behave in an environment by performing actions and assessing the results. Students will study the fundamentals and practical applications of reinforcement learning and will cover the latest methods used to create agents that can solve a variety of complex tasks, with applications ranging from gaming to finance to robotics.

MODULE - I

UNIT-1 **12L+8T+0P=20 Hours**

FOUNDATIONS:

Introduction and Basics of RL, Defining RL Framework and Markov Decision Process, Polices, Value Functions and Bellman Equations, Exploration vs. Exploitation, Code Standards and Libraries used in RL (Python/Keras/Tensorflow).

UNIT-2 **12L+8T+0P=20 Hours**

TABULAR METHODS AND Q-NETWORKS:

Planning through the use of Dynamic Programming and Monte Carlo, Temporal-Difference learning methods (TD(0), SARSA, Q-Learning) Deep Q-networks (DQN, DDQN, Dueling DQN, Prioritised Experience Replay).

PRACTICES:

- Implement in code common algorithms following code standards and libraries used in RL.
- Understand and work with tabular methods to solve classical control problems.
- Understand and work with approximate solutions.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

POLICY OPTIMIZATION:

Introduction to policy-based methods, Vanilla Policy Gradient, REINFORCE algorithm and stochastic policy search, Actor-critic methods (A2C, A3C), Advanced policy gradient (PPO, TRPO, DDPG).

UNIT-2 **12L+8T+0P=20 Hours**

RECENT ADVANCES AND APPLICATIONS:

Model-based RL approach, Meta-learning, Multi-Agent Reinforcement Learning, Partially Observable Markov Decision Process, Ethics in RL.

PRACTICES/TUTORIALS:

- Explore imitation learning tasks and solution.
- Applying RL for real-world problems.
- Capstone project.

SKILLS:

- ✓ *Examine code standards and libraries used in RL.*
- ✓ *Demonstrate various Learning methods.*
- ✓ *Create, run and manipulate Python Programs with Keras or Tensorflow.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Learn and apply the policies, value functions, Bell-man equations in RL using Python/ Keras/ Tensor-flow.	Apply	1	1, 2, 3, 4, 5, 9, 10, 12
2	To solve classical control problems with tabular methods.	Apply	1	1, 2, 3, 4, 5, 9, 10, 12
3	Apply and Analyze the concepts of policy-based methods, Actor-critic methods and Advanced policy gradient for RL.	Analyze	2	1, 2, 3, 4, 5, 9, 10, 12
4	Develop an application using RL.	Create	2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Richard S. Sutton and Andrew G. Barto, “Reinforcement learning: An introduction”, Second Edition, MIT Press, 2019.
2. Russell, Stuart J., and Peter Norvig. “Artificial intelligence: a modern approach”, Pearson Education Limited, 2016.

REFERENCE BOOKS:

1. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. “Deep learning.” MIT press, 2016.
2. Zed A. Shaw, “Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code”, Addison-Wesley Professional, 2017.
3. James Herron, “Python Programming For Beginners”, Kindle Edition, 2021.

HONOURS

ELECTRONICS AND COMMUNICATION ENGINEERING

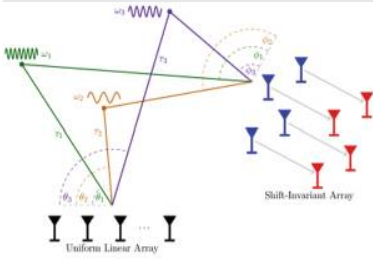
B.Tech.

22EC955	-	Array Signal Processing
22EC956	-	Free Space Optics
22EC957	-	Fundamentals of Massive MIMO
22EC958	-	Information Theory and Coding
22EC959	-	SDR for Future Communication Systems
22EC960	-	Wavelet Theory and Applications

COURSE CONTENTS

I SEM & II SEM

22EC955 ARRAY SIGNAL PROCESSING



Source: https://www.nts.tu-darmstadt.de/forschung_nts/forschungsprojekte_nts/array_proc/index.de.jsp

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Digital signal processing.

COURSE DESCRIPTION AND OBJECTIVES:

To introduce the student to the various aspect of array signal processing, and the Spatial Sampling theorem. Various array design methods and direction of arrival estimation techniques are discussed in this course.

MODULE –1

UNIT-1 **12L+8T+0P=20 Hours**

SPATIAL SIGNALS:

Introduction: Signals in space and time, Spatial Frequency vs. Temporal Frequency, Review of Co-ordinate Systems, Maxwell's Equation, and Wave Equation. Solution to Wave equation in Cartesian Co-ordinate system -Wavenumber vector, Slowness vector, Wavenumber -Frequency Space. Wavenumber -Frequency Space

UNIT-2 **12L+8T+0P=20 Hours**

SPATIAL SAMPLING:

Spatial Sampling Theorem-Nyquist Criteria, Aliasing in Spatial frequency domain, Spatial Frequency Transform, Spatial spectrum. Spatial Domain Filtering. Beam Forming. Spatially white signal, Spatial sampling of multidimensional signals.

PRACTICES:

- Identifying the stationarity of the real-world signals.
- Compute and plot the Fourier spectrum of signal.
- Use the short-time Fourier transform to plot the spectrum of the real-world signals.
- Wavelet properties, bases and their applications.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

SENSOR ARRAYS:

Linear Arrays, Planar Arrays, Frequency - Wavenumber Response and Beam pattern, Array manifold vector, Conventional Beamformer, Narrowband beamformer. Uniform Linear Arrays: Beam pattern in θ, u and ψ -space Uniformly Weighted Linear Arrays. Beam Pattern Parameters: Half Power Beam Width, Distance to First Null, Location of side lobes and Rate of Decrease, Grating Lobes, Array Steering

UNIT-2 **12L+8T+0P=20 Hours**

ARRAY DEISNG METHODS:

Visible region, Duality between Time -Domain and Space-Domain Signal Processing, Schelkunoff's Zero Placement Method, Fourier Series Method with windowing, Woodward -Lawson Frequency-Sampling Design, Narrow-beam low-side lobe design methods Narrow Band Direction of Arrival Estimation: Non parametric method -Beam forming, Delay and sum Method, Capons Method. Subspace Methods -MUSIC, Minimum Norm and ESPIRIT techniques

SKILLS:

- ✓ *Generate array steering vector for Uniform linear arrays*
- ✓ *Use of fist null width, side lobe(grating lobes) in the accuracy of Direction of Arrival*
- ✓ *Selection of DOA estimation method based on the design criteria ,accuracy, performance*
- ✓ *Finding DOA of narrowband signal using MUSIC algorithm*
- ✓ *Finding DOA of narrow band signal using ESPRIT algorithm*

PRACTICES:

- Compute the Wavenumber of spatiotemporal signal
- Generate Array Manifold Vector for Uniform Linear Arrays
- From a given radiation pattern/beam pattern mark Half power beam Width, First Null, Grating lobes
- Compare and contrast the duality between time and spatial domains
- Compute the direction of arrival of a Narrowband signal using MUSIC technique
- Computer the direction of arrival of a Narrowband signal usi9ng ESPRIT technique

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze theory of array signal processing.	Analyze	1,2	1,2, 9, 10, 12
2	Evaluate the Nyquist frequency and analyzing its impact on accuracy of the estimation technique	Evaluate	1	1, 2, 3,4, 5, 9, 10, 12
3	To Analyze the accuracy of various DoA estimation methods under different conditions	Analyze	2	1, 2, 3,4, 5, 9, 10, 12
4	Design a Uniform Linear Array and analyzing its steering vector , beam pattern	Apply	1	1, 2, 3,4, 5, 9, 10, 12
5	Apply the practical use of beamforming and DOA in everyday applications	Apply	1,2	1, 2, 3,4, 9, 10, 12

TEXT BOOKS:

1. Johnson, Don H., and Dan E. Dudgeon. Array Signal Processing: Concepts and Techniques. PTR Prentice Hall, 2002.
2. Stoica, Petre, and Randolph L. Moses. Spectral Analysis of Signals. Upper Saddle River, N.J: Pearson/Prentice Hall, 2005.

REFERENCES BOOKS:

1. Bass J, Mc Pheeters C, Finnigan J, Rodriguez E. Array Signal Processing [Connexions Web site]. February 8, 2005. Available at:http://cnx.rice.edu/content/coll0255/1.3/
2. Chellappa, Rama, and Sergios Theodoridis. Academic Press Library in Signal Processing: Volume 2, 2014.
3. Van, Trees H. L. Optimum Array Processing: Part IV of Detection, Estimation and Modulation Theory. New York: John Wiley & Sons, 2002.

22EC956 FREE SPACE OPTICS

Source: http://www.fsona.com/technology.php?sec=fso_comparisons

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Basics of Optical Communication

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to build a grasp of the fundamental concepts of free space optical communication in engineering. The methods for establishing and analyzing free space optical link will be the primary focus. Students will learn optical communication through wireless channel by considering different types of atmospheric factors such as effect of turbulence and weather conditions viz., drizzle, haze fog on error performance and channel capacity, link availability.

MODULE - 1

UNIT-1 **6L+6T+6P=18 Hours**

INTRODUCTION:

General introduction, optical channel - Beam divergence, atmospheric losses, weather condition influence, atmospheric turbulence effects viz., scintillation, beam wander, beam spreading, etc.

UNIT-2 **10L+10T+10P=30 Hours**

CHANNEL MODELLING:

Linear time invariant model, channel transfer function, optical transfer function, models of turbulence induced fading viz., lognormal, exponential, K distribution, I- distribution, gamma-gamma distribution, Optical wave models - Plane, spherical and Gaussian, range equation, transmitting and receiving antenna gains.

BACKGROUND NOISE EFFECTS:

Background noise source, detector FOV, diffraction limited FOV, spatial modes, background noise power calculation.

PRACTICES:

- Study the beam divergence.
- Determine the effects of atmospheric losses on optical signal.
- Determine the effects of atmospheric turbulence on optical signal.
- Study the effects of noise on optical free space communication link.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

MODULATION AND DETECTION TECHNIQUES MODULATION TECHNIQUES:

Power efficiency, BW efficiency, bit versus symbol error rates, error rate evaluation for isochronous modulation schemes viz., M-PPM, OOK, mxnPAPM schemes, subcarrier modulation, an isochronous modulation schemes - DPPM, DHPIM, DAPPM, psd and bandwidth requirement.

DETECTION TECHNIQUES:

Photon counter, PIN/APD, PMT, coherent techniques viz., homodyne and heterodyne, bit error rate evaluation in presence of atmospheric turbulence, concept of adaptive threshold.

SKILLS:

- ✓ *Design and test an atmospheric turbulence model.*
- ✓ *Choose the various weather conditions and apply to optical links.*
- ✓ *Analyze the various photo detectors for free space links.*

UNIT-2 **8L+8T+8P=24Hours**

WEATHER IMPAIRMENTS

Effect of turbulence and weather conditions viz., drizzle, haze fog on error performance and channel capacity, link availability.

PRACTICES:

- Compute the power efficiency of optical signals.
- Compute the bandwidth efficiency of optical signals.
- Evaluate the error rate for isochronous modulation schemes.
- Study the characteristics of PIN detector.
- Study the characteristics of APD detector.
- Evaluate the bit error rate in presence of atmospheric turbulence.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply atmospheric channels for the intended terrestrial free space optical link.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Apply the concepts of OWC to calculate the system performance under background noise effects.	Apply	1, 2	1, 2, 5, 9, 10
3	Analyze various modulation/demodulation techniques in designing of transmitter/receiver for OWC system.	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Compare various detection techniques under various atmospheric conditions.	Analyze	2	1, 2, 5, 9, 10, 12
5	Evaluate the OWC system under different weather conditions.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

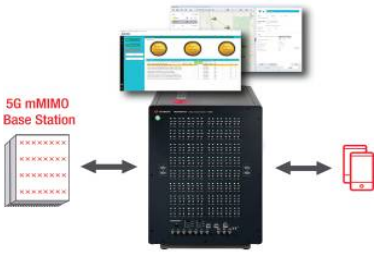
TEXT BOOKS:

1. Z. Ghassemlooy, W. Popoola, S. Rajbhandari, “Optical Wireless Communications”, 1st Ed., CRC Press, 2013.
2. L. C. Andrews, R.L.Phillips, “Laser Beam Propagation through Random Media”, 2nd Ed., SPIE Press, USA, 2005.

REFERENCE BOOKS:

1. J. H. Franz, V. K. Jain, “Optical Communications: Components and Systems”, 1st Ed., Narosa Publishing House, 2000.
2. D. Chadha, “Terrestrial Wireless Optical Communication”, 1st Ed., Tata McGraw-Hill, 2012.
3. Ramaswami Rajiv and Sivarajan K. N., “Optical Networks A Practical Perspective”, Elsevier, 3rd Ed., Morgan Kaufmann Publishers, 2009.

22EC957 FUNDAMENTALS OF MASSIVE MIMO



Source:https://www.keysight.com/in/en/product/S8803A/massive-mimo-base-station-fading-performance-toolset.html

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of wireless communications and Linear Algebra.

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with basic knowledge on Massive MIMO concepts and analysing the uplink and downlink data transmission in case of single cell systems and multi cell systems. The objective of the course is to develop the Massive MIMO techniques and algorithms to cater the needs of future wireless communication systems.

MODULE - I

UNIT-I **12L+8T+0P=20 Hours**

INTRODUCTION:

Point-to- point MIMO, Multi-user MIMO, Massive MIMO, and Time Division verses Frequency Division Duplexing

Single-Antenna Transmitter and Single-Antenna Receiver-Coherence Time, Coherence Bandwidth, Coherence Interval, Interpretation of Tc and Bc in Terms of Nyquist Sampling Rate

UNIT-II **12L+8T+0P = 20 Hours**

HOURS SINGLE CELL SYSTEMS:

Uplink and Downlink data transmission: Zero-Forcing, Maximum-Ratio

PRACTICES:

- Simulation of BER Performance Analysis of MIMO under Perfect CSI
- Simulation of downlink Massive MIMO using Zero-forcing receiver
- Simulation of downlink Massive MIMO using Maximal ratio combining

MODULE-II

UNIT-I **12L+8T+0P = 20 Hours**

MULTI CELL SYSTEMS:

Uplink and Downlink data transmission: Zero-Forcing, Maximum-Ratio

UNIT- II **12L+8T+0P = 20 Hours**

MASSIVE MIMO PROPAGATION CHANNEL:

Favourable Propagation and Deterministic channels, Favourable Propagation and Random Channels, Finite-Dimensional Channels

PRACTICES:

- Simulation of downlink data transmission for multi-cell system using Zero-forcing receiver
- Simulation of downlink data transmission for multi-cell system using Maximum ratio combining.
- Energy Efficient Massive MIMO 5G System with ZF Receiver.
- Simulation of BER Performance Analysis of Massive MIMO Networks under Perfect CSI

SKILLS:

- ✓ *Able to understand the MIMO systems.*
- ✓ *Mathematical analysis of uplink data transmission.*
- ✓ *Selection of the channel for the data transmission.*
- ✓ *Maximization of SNR for massive MIMO.*

- Simulation of BER Performance Analysis of Massive MIMO Networks under Imperfect CSI

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	To understand and analyse Massive MIMO systems with baseband signal processing aspects.	Analyse	1	1,2
2	Model and simulate a massive MIMO system	Create	1,2	1,2,5
3	Analyse complex wireless communication systems under various fading conditions	Analyse	1,2	1,2,5,12
4	Analyse the BER performance of Massive MIMO Systems	Analyse	1,2	1,2,5,9,12
5	Design of Massive MIMO communication system	Application	1,2	1,2,5,12

TEXT BOOKS:

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang and HienQuoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016.
2. David Tse and PramodViswanath, “Fundamentals of Wireless Communication”, Cambridge University Press 2005

REFERENCE BOOKS:

1. EzioBiglieri , Robert Calderbank et al “MIMO Wireless Communications” Cambridge University Press 2007.
2. Daniel W. Bliss and SiddhartanGovindasamy, “Adaptive Wireless Communications: MIMO Channels and Networks”, Cambridge University Press, 2013.

22EC958 INFORMATION THEORY AND CODING

Source: https://www.e-booksdirectory.com/listing.php?category=99

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Digital Communication.

COURSE DESCRIPTION AND OBJECTIVES:

To introduce the student to the various aspect of the information theories and their coding, to implement the algorithms of coding. Various array design methods and direction of arrival estimation techniques are discussed in this course.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

INTRODUCTION:

Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memory less channels – BSC, BEC – Channel capacity, Shannon limit

UNIT-2 **12L+8T+0P=20 Hours**

BLOCK AND CONVOLUTION CODES:

BLOCK CODES: Definitions and Principles: Hamming weight, hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC

Convolution codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding

PRACTICES:

- Determination of entropy of a given source
- Determination of various entropies and mutual information of a given channel (Noise free channel)
- Determination of various entropies and mutual information of a given channel (Binary symmetric channel)

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

SOURCE CODING:

TEXT, AUDIO AND SPEECH Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I, II, III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

UNIT-2 **12L+8T+0P=20 Hours**

2D SOURCE CODING:

Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I, B, P frames, Motion estimation, Motion compensation, H.261, MPEG standard

SKILLS:

- ✓ *Define the information theories and the types of coding*
- ✓ *Define the algorithms used in coding*
- ✓ *Implement the information theories techniques*
- ✓ *Compute the capacity of various types of channels*
- ✓ *Develop the various coding algorithms.*

PRACTICES:

- Evaluation of variable length source coding using Huffman Coding and decoding
- Coding and decoding of convolutional codes

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Learn and apply the concepts of different coding techniques for data transmission.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	To solve classical problems with linear blocks.	Apply	1	1, 2, 4, 5, 9, 10, 12
3	Apply and analyze the various masking techniques.	Analyze	1,2	1, 2, 3, 5, 9, 10
4	Image compression and extraction.	Apply	2	1, 2, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Ranjan Bose, Information Theory, Coding and Cryptography, Publication,2005
2. Cover, Thomas, and Joy Thomas. Elements of Information Theory. 2nd ed. New York, NY: Wiley-Inter science, 2006. ISBN: 9780471241959

REFERENCE BOOKS:

1. Thomas M. Grover and Joy A. Thomas, “Elements of Information Theory,” Wiley.
2. John G. Proakis and Masoud Salehi, “Digital Communications,” 5th edition, McGraw Hill.

22EC959 SDR FOR FUTURE COMMUNICATION SYSTEMS

Source: https://militaryembedded.com/comms/sdr/software-defined-radio-key-seamless-effective-military-communication

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITES KNOWLEDGE: Basics of Digital Communication and Signal Processing.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of this course is to provide knowledge of fundamental and state-of-the art concepts in software defined radio.

MODULE 1

UNIT-I **12L+8T+0P=20 Hours**

INTRODUCTION TO SDR:

Application of SDR in advanced communication systems, Challenges and issues regarding the implementation of SDR, Adaptive wireless communication systems, Spectrum efficiency and soft spectrum usage, Spectrum sensing, design principles of SDR.

Challenge of Receiver Design: RF receiver front-end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain.

UNIT-2 **12L+8T+0P=20 Hours**

ADC AND DAC DESIGN CHALLENGES:

Direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Spurious components due to periodic jitter, Bandpass signal generation, Performance of direct digital synthesis systems, Hybrid DDS-PLL systems, Applications of direct digital synthesis.

PRACTICES:

- Simulation of basic Communication system using SDR
- Study of challenges in SDR for communications
- SDR architecture and issues- a case study
- Analysis of DDS
- Study of hybrid DDS-PLL systems

MODULE 2

UNIT-1 **12L+8T+0P=20 Hours**

DIGITAL HARDWARE CHOICES:

Introduction, Key hardware elements, DSP processors, FPGA, Tradeoffs in using DSPs FPGAs and ASICs, Power management issues, Combinations of DSPs , FPGAs and ASICs.

UNIT-2 **12L+8T+0P=20 Hours**

INTRODUCTION TO COGNITIVE RADIO:

Case study of different SDR platforms, Hands on demos on SDR platform to conduct digital communication experiments.

SKILLS:

- ✓ *Design and simulate digital communication system using SDR for multi standard communications.*
- ✓ *Simulate a SDR platform for Transmission and Receiving the signals.*
- ✓ *Choose the desired platform for SDR implementation*

PRACTICES:

- Study and identification of Hardware for SDRs
- Study of tradeoffs in DSP, FPGA and ASIC.
- Implemenation of SDR based communication systems
- Specific SDR based experimentation using Matlab and Hardware.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the various SDRs and Apply techniques for Digital Communication implementation	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Identify the SDR for proper multi standard communication systems.	Apply	1, 2	1, 2, 5, 9, 10
3	Analyse the SDR for proper transmission and reception of Digital communications	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Inspect the SDRs for multi standard communication systems.	Analyze	2	1, 2, 5, 9, 10, 12
5	Evaluate the performance of various SDRs for error free communication and its use in realtime applications	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

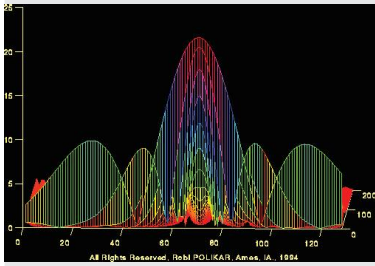
TEXT BOOKS:

1. Jeffrey H. Reed, “Software Radio: A Modern Approach to Radio Engineering”, 1st edition, Pearson Education, 2002.
2. C. Richard Johnson and Jr.William A. Sethares, “Telecommunication Breakdown”, Prentice Hall, 2003.

REFERENCES BOOKS:

1. K. Fazel and S. Kaiser, “Multi-carrier and Spread Spectrum Systems”, Wiley and Sons Publication, 2010.
2. e-learning: sdrforum.org.
3. Tools/Hardware for case study suggested: MATLAB/GNU Radio – SDR platforms suggested -HACK RF / WARP V3/ RTL SDR.

22EC960 WAVELET THEORY AND APPLICATIONS



Source: https://ccrma.stanford.edu/~unjung/mylec/WTpart1.html

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITES KNOWLEDGE: Basics of Digital signal processing.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to build a grasp of the fundamental concepts of wavelets found in engineering. The methods for characterizing and analyzing continuous-time and discrete-time signals will be the primary focus. Students will learn transform techniques that will help them realize algorithms for signal and image processing applications like noise cancellation, compression and watermarking.

MODULE 1

UUNIT-1 **12L+8T+0P=20 Hours**

REVIEW OF STOCHASTIC SIGNALS AND TRANSFORMS:

Introduction: Review of stationary and non-stationary signals, Fourier transform, Heisenberg Uncertainty principle, short time Fourier transform, multi-rate signal processing-decimation, interpolation, quadrature mirror filter bank.

UNIT-2 **12L+8T+0P=20 Hours**

CONTINUOUS WAVELET TRANSFORM:

Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet, inverse CWT, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Classes of wavelets bases: Haar, biorthogonal, Daubechies, symlets, coiflets, shannnon, meyer.

PRACTICES:

- Identifying the stationarity of the real-world signals.
- Compute and plot the Fourier spectrum of signal.
- Use the short-time Fourier transform to plot the spectrum of the real-world signals.
- Wavelet properties, bases and their applications.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

DISCRETE WAVELET TRANSFORM:

Memory: Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Wavelet basis for MRA, Filter banks- Analysis and Synthesis, 1D and 2D Discrete wavelet transform, inverse discrete wavelet transform, Wavelet Packets, Tree structured filter bank, filter bank implementation of two-dimensional wavelet transform..

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS:

Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in

SKILLS:

- ✓ *Understand the concept of wavelet transform and how well it can be used in nonstationary signal analysis.*
- ✓ *Learn different wavelet functions and their representations.*
- ✓ *Choose the appropriate wavelet function and filter structure for a given application.*
- ✓ *Apply transformation to real-world problems involving bio-signals.*

signal acquisition, coding and lossy transmission, Digital Communication and Multicarrier Modulation, Trans multiplexers , Image fusion, Edge Detection and object isolation

PRACTICES:

- Filter bank realization of Haar wavelet.
- Wavelet decomposition of real-time signals.
- Thresholding based denoising of signals.
- Image water marking using 2D wavelet transform.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the various properties and Apply transform techniques on continuous and discrete time signals	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Identify the wavelet function for analysing the target signal.	Apply	1	1, 2, 4, 5, 9, 10, 12
3	Analyse the frequency spectrum of continuous and discrete time signals.	Analyze	1,2	1, 2, 3, 5, 9, 10
4	Develop the algorithms for applications like noise cancellation and image watermarking.	Apply	2	1, 2, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Wavelet Transforms –Introduction and applications - Raguveer M. Rao and Ajit S. Bopardikar-Pearson Education, 2008.
2. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.

REFERENCE BOOKS:

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.
2. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.
3. Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichel Poggi, John Wiley & Sons, 2010.
4. Wavelets : from math too practice, Desanka.P.Radunovik, springer, 2009.

HONOURS

ELECTRONICS AND COMMUNICATION ENGINEERING

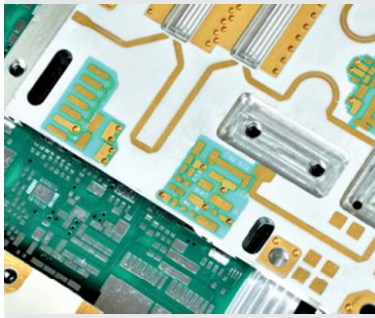
B.Tech.

22EC970	-	Applied RF Engineering I - Circuits and Transmission Line
22EC971	-	Microstrip and Printed Antenna Design
22EC973	-	Modeling and Simulation of Phased-Array Antennas
22EC974	-	RF Transceiver System Design

COURSE CONTENTS

I SEM & II SEM

22EC970 APPLIED RF ENGINEERING I-CIRCUITS AND TRANSMISSION LINE



Source: https://www.microwavejournal.com/articles/36671-rf-thermal-management-fabrication-methods-test

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Antenna Theory, Microwave Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of the course is intended for students with an electromagnetic theory, Transmission line and microwave engineering background or equivalent practical experience. The covers covered is similar to the RF Technology.

MODULE –1

UNIT-1 **12L+8T+0P=20 Hours**

COMPLEX IMPEDANCE, RESONANCE, TRANSMISSION LINES:

Introduction-Frequency spectrum, Power levels at RF.

Complex Impedance, Resonance: Series RC, RL networks, Parallel RC, RL networks, Resonance, Q factor, conversion between series and parallel circuits

Transmission Lines: Transmission line types, characteristic impedance, lumped vs. distributed networks, short and open terminated transmission lines

Reflections: mismatch and reflections, reflection coefficient, return loss, mismatch loss, SWR.

UNIT-2 **12L+8T+0P=20 Hours**

SMITH CHART AND COMPONENT MANIPULATIONS:

Smith Chart, Derivation of impedance curves - resistance – reactance, admittance chart. Component Manipulations-Series Capacitor, Inductor, Resistor , Parallel Capacitor, Inductor, Resistor, Transmission lines

PRACTICES:

Design and verify the following design using Simulation Software (HFSS/ADS).

- Design RC, RL and parallel RC and RL circuits using ADS
- Design 50Ω transmission line using HFSS.
- Design Quarter wave transformer using HFSS.
- Analyze smith chart with suitable example.
- Calculate VSWR and Z parameter using HFSS.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

S-PARAMETERS:

S-parameters: comparison with Z, Y, ABCD parameters

Measurement: basic network analyzer block diagram

Cascaded Calculations: Cascaded S-parameters, T-parameters

Differential Circuits: Mixed mode S-parameters, Description of X-parameters

SKILLS:

- ✓ *Understanding the basic theory Complex Impedance, Resonance.*
- ✓ *Covers the Smith chart parameters.*
- ✓ *Covers the S parameters.*
- ✓ *Addresses the impedance matching circuits.*

UNIT-2 **12L+8T+0P=20 Hours**

IMPEDANCE MATCHING

Impedance Matching: Analytical Techniques using Q to Match Impedances, resonating reactances, Smith Chart, Component Models, Lumped Elements at RF, resistor component models, capacitor component models, inductor component models, behavior at high frequencies, package effect, ferrite behavior.

PRACTICES:

Design and verify the following design using Simulation Software (HFSS/ADS.

- Design Y parameter with suitable example using HFSS
- Design ABCD
- Design differential circuits using ADS.
- Design lumped element with suitable examples.
- Design quart wave transformer with suitable example.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply Series RC, RL networks, Parallel RC, RL network and calculate reflection coefficients.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Analysis of smith chart	Analysis	1	1, 2, 4,5, 9, 10,12
3	Analysis of S parameter and measurements	Analysis	2	1, 2,4,5, 9, 10,12
4	Analysis impedance matching	Analysis	2	1, 2,3,4,5, 9, 10, 12

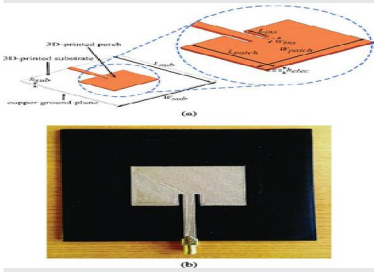
TEXT BOOKS:

1. Matthew N.O. Sadiku, “Elements of Electromagnetics”, 7th edition, Oxford Univ. Press, 2021.
2. William H. Hayt and John A. Buck, ‘Engineering Electromagnetics’, McGraw Hill Special Indian edition, 2014.

REFERENCES BOOKS:

1. Jordan, E.C. and Balmain, K.G., 1968. Electromagnetic waves and radiating systems. Prentice-Hall.
2. Kraus and Fleish, ‘Electromagnetics with Applications’, McGraw Hill International Editions, Fifth Edition, 2010
3. E.V.D. Glazier and H.R.L. Lamont, Transmission and Propagation, The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.
4. Joseph. A.Edminister, ‘Schaum’s Outline of Electromagnetics, Third Edition (Schaum’s Outline Series), McGraw Hill, 2010.

22EC971 MICROSTRIP AND PRINTED ANTENNA DESIGN



Source: https://www.researchgate.net/publication/334903778_Parametric_Study_of_3D_Additive_ Printing_Parameters_Using_Conductive_Filaments_on_Microwave_Topologies/figures?lo=1

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Antenna Theory.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of this course is to introduce the concepts and fundamentals of microstrip antennas basic concept, different structure like, metamaterial, reconfigurable antenna, Fractal structure antenna, DRA antenna and design aspects.

MODULE - 1

UNIT-1 **12L+8T+0P=20 Hours**

BASICS OF MICROSTRIP ANTENNAS:

Origin of Microstrip radiators, microstrip antenna analysis methods, Rectangular microstrip patch antennas. Circular microstrip patch antennas.

UNIT-2 **12L+8T+0P=20 Hours**

METAMATERIALS:

The concept of Metamaterials: Basic Electromagnetic and Optical properties, Basic structures, potential applications, Governing equations for Metamaterials.

PRACTICES:

- Design Rectangular patch antenna for Bluetooth applications
- Design Zigbee antenna using insert feed techniques.
- Design Unit cell using HFSS
- Design metamaterial antenna for 5G applications
- Design metamaterial antenna for WLAN applications.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

RECONFIGURABLE ANTENNA:

Frequency reconfiguration methods: PIN diodes, Varactor Diodes, Liquid crystals, Graphene, Frequency reconfigurable slot antennas: Varactor loaded slot antenna, MIMO reconfigurable slot antenna.

UNIT-2 **12L+8T+0P=20 Hours**

DESIGN STRUCTURES AND APPLICATIONS OF DIFFERENT ANTENNAS:

Basic concepts of CPW-Coplanar Waveguide antennas, Fractal structure antenna, DRA-Dielectric Resonator Antennas, Micro strip antenna with DGS, Design structures of different antennas and applications of different antennas.

PRACTICES:

- Design reconfigurable antenna for WLAN and Bluetooth applications
- Design MIMO antenna using reconfigurable techniques.

SKILLS:

- ✓ *Select the required parameters to design different Microstrip patch Antennas.*
- ✓ *Identify the required microstrip Antennas for various Applications.*
- ✓ *Measure the antenna parameters and analyze the antenna performance.*

- Design CPW antenna for 5G applications.
- Design DRA for 5G applications
- Design DGS antenna for WLAN applications.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the basic rectangular and circular antenna.	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Analyze concept of metamaterial antenna.	Analyze	1	1, 2, 4,5, 9, 10,12
3	Analyze concept of reconfigurable antenna.	Analyze	2	1, 2,4,5, 9, 10,12
4	Analyze of different printed Antenna structures.	Analyze	2	1, 2,3,4,5, 9, 10, 12

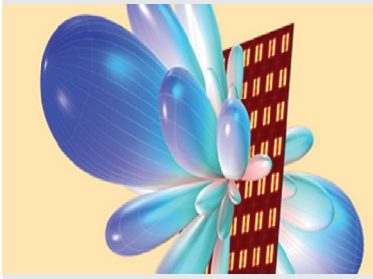
TEXT BOOKS:

1. Randy Bancraft, “Microstrip and Printed Antenna Design”,2nd Edition, Prentice-Hall of India, 2019.
2. Ramesh Garg, PrakashBhartia, InderBaul and ApisakIttipiboon, “Microstrip Antenna Design Handbook”, Artech House, 2018.

REFERENCE BOOKS:

1. A. Jichun Li, Yunqinghuang, “Time Domain Finite Element Methods for Maxwell’s equations in Metamaterials”, 2013
2. George tsoulos, “MIMO System Techonology for Wireless Communications”, 1st Edition
3. Jennifer T. Bernhard ,”Reconfigurable antennas”. 2007
4. Girish Kumar & KP Ray ,”Broadband microstrip antenna”, 2003.

22EC973 MODELING AND SIMULATION OF PHASED-ARRAY ANTENNAS



Source: https://www.comsol.com/blogs/how-to-synthesize-the-radiation-pattern-of-an-antenna-array/

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Antenna Theory.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of this course is to introduce the concepts and fundamentals of phased array antennas basic concept, Side lobe level requirements, different array methods, feeding techniques, beam forming techniques, improvement in isolation and cross-polarizations techniques and their design aspects.

MODULE - I

UNIT-1 **12L+8T+0P=20 Hours**

ARRAY ANTENNA:

Introduction, pattern, Formulas for Arrays with Arbitrary element Positions, Linear Arrays, Schelkunoff's Unit Circle Representations.

UNIT-2 **12L+8T+0P=20 Hours**

ARRAY SYNTHESIS:

Introduction, Sum and difference patterns, Uniform Antenna Array synthesis, Dolph- chebyshev Synthesis, Taylor Synthesis, Bayliss synthesis, Binomial array synthesis.

PRACTICES:

Design and verify the following Antenna array using Simulation Software (HFSS/MATLAB).

- Generate Liner array antenna using MATLAB software.
- Calculation of side lobe suppression using HFSS.
- Generation of Dolph- chebyshev Synthesis using MATLAB software
- Generation of Taylor Synthesis using MATLAB software.
- Generation of Bayliss synthesis using MATLAB software

MODULE-2

UNIT-1 **12L+8T+0P=20Hours**

ARRAY FEEDING METHODS:

Series Feeding, Parallel Feeding or Corporate Binary Feeding Method, Differential Feeding method, Pair-wise Anti-Phase feeding method, Antenna Array Distribution Network.

UNIT-2 **12L+8T+0P=20 Hours**

ANTENNA ARRAY UNIT COMPONENTS:

Digital Attenuator, Digital Phase shifter, Circulator, Isolator, Dual Directional Coupler, T/R Switch.

PRACTICES:

Design and verify the following Antenna array using Simulation Software (HFSS/MATLAB).

- Generate circular Taylor using MATLAB software.
- Generation of circular grid arrays using HFSS.

SKILLS:

- ✓ *Knowing the basic theory of array antenna.*
- ✓ *Different synthesis for antenna array.*
- ✓ *Know the basic concept of array feeding methods.*
- ✓ *Focus on antenna array unit components.*

- Generation of Bayliss Difference Patterns for Circular Arrays MATLAB software
- Generation of Adaptive Arrays using MATLAB software.
- Generation of Multiple-Beam Arrays using MATLAB software

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the basic s of Array Antennas antenna	Analyze	1	1, 2, 4, 9, 10, 12
2	Analyze concept of phased array antenna.	Analyze	1	1, 2, 4, 9, 10,12
3	Analyze of different Array feeding methods	Analyze	2	1, 2,4,5, 9, 10,12
4	Analyze of antenna array unit components	Analyze	2	1, 2,3,4,5, 9, 10, 12

TEXT BOOKS:

1. Antenna Theory and Design, R.S. Elliott, Wiley. 2003.
2. Antenna for All Application, J.D.Krauss, R.J.Marhefka and Ahmad.S.Khan Tata McGraw Hill Publishing Company Ltd, Third Edition, 2006.

REFERENCE BOOKS:

1. Mailloux, R.J., 2017. Phased array antenna handbook. Artech house.
2. Constantain A Balanis, “Antenna Theory: Analysis and Design”, 4th edition, Wiley Publishers, 2015.

22EC974 RF TRANSCEIVER SYSTEM DESIGN

Source: https://rahsoft.com/courses/receiver-transmitter-and-transceiver-architectures-rf-design-online-course-rahrf409rf-system-design-of-receivers-transmitters-transceivers/

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Microwave Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course helps to understand the basics of RF Filter, active components and circuits. This makes that student able to design of amplifier, oscillator and mixer circuit. With help of RF CAD software (ADS) students can able to perform it.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

RF FILTER DESIGN:

Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter.

UNIT-2 **12L+8T+0P=20 Hours**

ACTIVE RF COMPONENTS AND APPLICATIONS:

RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks- impedance matching using discrete components, microstripline matching networks, amplifier classes of operation and biasing networks.

PRACTICES:

Design and verify the following RF Passive Circuit using Simulation Software (HFSS/MATLAB).

- Generate of S parameter using MATLAB software.
- Design of Microstrip line using HFSS.
- Design of impedance matching circuit using ADS
- Design of Stubs using HFSS
- Design of Matching network design using Lumped elements- RC, RL, RLC using ADS

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

RF AMPLIFIER DESIGNS:

Characteristics, amplifier power relations, stability considerations, constant gain circles, constant VSWR circles, low noise circles broadband, high power and multistage amplifiers.

UNIT-2 **12L+8T+0P=20 Hours**

OSCILLATORS, MIXERS & APPLICATIONS:

Basic oscillator model, High Frequency oscillator configuration, basic characteristic of mixers, wireless synthesizers, phase locked loops, detector and demodulator circuits.

PRACTICES:

Design and verify the following RF Passive Circuit using Simulation Software (HFSS/MATLAB).

SKILLS:

- ✓ *Understanding the basic of RF filter.*
- ✓ *Analysis of Active RF components and applications.*
- ✓ *Analysis of RF amplifier.*
- ✓ *Focus on oscillator and mixer applications.*

- Generate of Wilkinson Power divider using HFSS software.
- Design of 90° Hybrids, Branch line couplers using HFSS.
- Design of Branch line couplers using HFSS
- Design of phase shifter using ADS
- Design of RF filter using ADS

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply and design of RF filter	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Design and analyze the performance parameters of RF components	Analyze	1	1, 2, 4,5, 9, 10,12
3	Design and analyse of RF Amplifier	Analyze	2	1, 2,4,5, 9, 10,12
4	Design and analyze RF oscillator and Mixer.	Anlayze	2	1, 2,3,4,5, 9, 10, 12

TEXT BOOKS:

1. D M Pozar, Microwave Engineering, John Wiley & Sons, 2011
2. Gonzalez, Guillermo, Microwave transistor amplifiers: analysis and design, Prentice hall ,2010.

REFERENCE BOOKS:

1. Chang K, Bahl I and Nair V, “RF and Microwave Circuit and Component Design for Wireless Systems”, Wiley Inter science. 2002
2. Reinhold Ludwig, Pavel Bretchko, “RF Circuit Design: Theory and Applications”, Prentice Hall, Year: 2000.ISBN: 0130953237.
3. Qizheng Gu, “RF System Design of Transceivers for Wireless Communications”, Springer, 2005.

MINORS

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech.

22EC901	-	ADHOC Sensor Networks
22EC902	-	Design Principles of IoT
22EC903	-	Introduction to Internet of Things
22EC904	-	Introduction to IoT Architecture
22EC905	-	Machine Learning for IoT Systems
22EC906	-	Security Aspects of IoT
22EC907	-	Sensors and Actuators for IoT

COURSE CONTENTS

I SEM & II SEM

22EC901 ADHOC SENSOR NETWORKS

Source: https://www.brainkart.com/subject/Ad-hoc-and-Wireless-Sensor-Networks_363/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of computer networks.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed at offering fundamental concepts of wireless ad-hoc networks and wireless sensor networks. Explore the various MAC routing protocols and their importance for designing of energy efficient and reliable wireless networks.

MODULE–1

UNIT-1 **12L+0T+8P=20hours**

INTRODUCTION AND ROUTING PROTOCOLS:

Introduction to Ad Hoc Networks - Fundamentals of Wireless Communication Technology The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks.

UNIT-2 **12L+0T+8P=20hours**

MAC PROTOCOLS FOR ADHOC WIRELESS NETWORK:

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

MODULE-2

UNIT-1 **12L+0T+8P=20hours**

SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES:

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT-2 **12L+0T+8P=20hours**

WSN NETWORKING CONCEPTS AND PROTOCOLS:

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – S MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols, Energy Efficient Routing, Challenges, and Issues in Transport layer protocol.

PRACTICES:

Experiments to be carried out in any network simulator like NETSIM, NS2 and OMNET++ etc.

- Examine the various path loss models available for wireless networks
- Identify the various reasons for hidden node terminal problem in wireless ad-hoc networks.

SKILLS:

- ✓ *Identify the various issues and their solutions in for designing wireless networks*
- ✓ *Implement routing algorithms for ad-hoc and sensor networks.*
- ✓ *Develop wireless sensor networks with respect to some protocol design issues.*

- Create a scenario where both ad-hoc and wireless sensor network are available and examine the interference problem.
- Simulate the MAC routing protocols for wireless sensor networks.
- Simulate the multiple wireless scenarios for throughput performance.
- Analyze performance of the MANET routing protocols in various parameters like end-to-end delay, bit error rate and throughput.
- Design a wireless sensor network and observe how the power consumption consumed for the network.
- Examine the importance of channel accessing mechanism helped for getting high throughput in wireless networks.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Realize concepts, network architectures and applications of ad hoc and wireless sensor networks	Create	1	1, 2, 4, 9, 10, 11, 12
2	Analyze the protocol design issues of ad hoc and sensor networks	Analyze	1	1, 2, 3, 4, 9, 10, 11, 12
3	Design routing protocols for ad hoc systems.	Create	2	1, 2, 3, 4, 9, 10, 11, 12
4	Evaluate the QoS related performance measurements of ad hoc and sensor networks	Evaluate	2	1, 2, 3, 4, 9, 10, 11, 12

TEXTBOOKS:

1. Carlos Corderio Dharma P. Aggarwal, “Ad-Hoc and Sensor Networks – Theory and Applications”, World Scientific Publications, March 2011.
2. Holger Karl and Andreas Willig “Protocols and Architectures for Wireless Sensor Networks”, “Wiley”, 2005.

REFERENCEBOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004.
2. Kazem sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks: Technology, Protocols and Application” John Wiley, 2007.
3. C.K Toh, “Ad-Hoc Mobile Wireless Networks: Protocols and Systems” 1st edition, Pearson, 2007.

22EC902 DESIGN PRICIPLES OF IOT

Source: https://embeddedcomputing.com/technology/iot/device-management/key-areas-to-focus-while- developing-connected-app-for-iot-solutions

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT.

COURSE DESCRIPTION AND OBJECTIVES:

This course emphasis on the design principles for developing an IoT product in the market. The objective of the course is to enable the students to understand the design principles while prototyping the IoT devices.

MODULE –1

UNIT-1 **8L+0T+8P=16 Hours**

DESIGN PRINCIPLES FOR CONNECTED DEVICES:

Introduction, Design Principles for Connected Devices, Calm and Ambient Technology, Magic as Metaphor, Privacy, Web Thinking for Connected Devices, Affordances.

UNIT-2 **12L+0T+8P=20hours**

PROTOTYPING EMBEDDED DEVICES;

Thinking About Prototyping: Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Open Source versus Closed Source, Tapping into the Community.

Prototyping Embedded Devices: Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp, Other Notable Platforms

PRACTICES:

- Sense the available networks using Arduino.
- Detect the vibration of an object using Arduino.
- Connect with the available wi-fi using Arduino.

MODULE-2

UNIT-1 **12L+0T+8P=20hours**

PROTOTYPING ONLINE COMPONENTS;

Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols

Techniques for Writing Embedded Code: Memory Management, Performance and Battery Life, Libraries, Debugging

UNIT-2 **12L+0T+8P=20hours**

FROM PROTOTYPE TO REALITY:

Business Models, Lean Start-ups, Moving to Manufacture, Designing Kits, Designing Printed circuit boards, Manufacturing Printed Circuit Boards, Ethics, Privacy, Control.

PRACTICES:

- Data Logging with Raspberry pi and Thing speak.
- Turn your smartphone into an IoT device.

SKILLS:

- ✓ *Design prototypes for IoT applications.*
- ✓ *Able to understand the design principle for IoT.*
- ✓ *Interface I/O devices with APIs*

- Interfacing Arduino with any cloud platform.
- Measure any physical quantity and tweet when it crossed the threshold limit.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the design principles for connected devices.	Apply	1	1, 2,3,5
2	Able to design the framework necessary for IoT applications	Apply	1	1, 2,3,5, 12
3	Develop prototypes for IoT devices	Apply	1	1, 2, 3, 5, 12
4	Develop APIs for IoT applications.	Apply	2	1, 2, 3,12
5	Design business models for IoT.	Apply	2	1, 2, 3

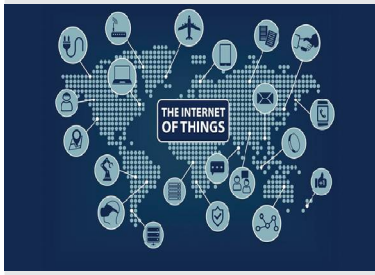
TEXT BOOKS:

1. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013.
2. Kamal R. Internet of Things, McGraw Hill, 2017.

REFERENCES BOOKS:

1. Perry Lea, “Internet of Things for Architects”, 1st edition, Packt Publishing, 2018.
2. Samuel Greengard, “The Internet of Things (Essential Knowledge)”, MIT Press, 2015.
3. Timothy Chou, Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020.

22EC903 INTRODUCTION TO INTERNET OF THINGS



Source: https://www.freecodecamp.org/news/introduction-to-iot-internet-of-things/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basic knowledge of internet.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers skills on interconnection and integration of the physical world and the cyberspace. The objective of the course is to enable the students to design and develop IoT systems for real-world problems.

MODULE-1

UNIT-1 **12L+0T+8P=20 Hours**

IOT INTRODUCTION & CONCEPTS:

Introduction: Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and deployment.

UNIT-2 **12L+0T+8P=20 Hours**

PROTOTYPING & APPLICATIONS:

Prototyping Embedded Devices: Electronics, Embedded Computing Basics, Arduino, ESP8266, Raspberry Pi.

Domain Specific Applications of IoT: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

PRACTICES:

- Familiarization with Arduino boards and ESP8266.
- Interfacing of LED and switch with Arduino boards and ESP8266.
- Traffic Light control using Arduino board and ESP8266.
- Interfacing DHT11 sensor with Arduino board and ESP8266.
- Interfacing of ultrasonic sensor with Arduino board and ESP8266.
- Interfacing of PIR sensor with Arduino board and ESP8266.
- DC motor control using L293D motor driver and Arduino board.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

INTERNET PRINCIPLES & M2M:

Internet Principles: Internet communications: An overview, IP addresses, MAC addresses, TCP and UDP ports, Application layer protocols; Python packages of interest for IoT.

M2M: Introduction to M2M, M2M architecture, Difference between IoT and M2M, SDN and NFV for IoT.

UNIT-2 **12L+0T+8P=20 Hours**

IOT DESIGN:

IoT Design: IoT Design Methodology, Python Web Application Framework, Django, Designing a REST full web API.Case Studies: Home Automation, Smart Cities, Environment, Agriculture, Productivity Applications.

SKILLS:

- ✓ *Use various sensors and actuators for IoT applications.*
- ✓ *Interface programming on I/O devices.*
- ✓ *Develop applications for the Internet of things.*

PRACTICES:

- Familiarization with Raspberry pi.
- Interfacing of LED and switch with Raspberry pi.
- Interfacing PIR sensor with Raspberry pi.
- Interfacing DHT11 sensor with Raspberry pi.
- Interfacing of ultrasonic sensor with Raspberry pi.
- Interfacing of Picam with Raspberry pi.
- Sending email with Raspberry pi.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Interface sensors with various embedded devices.	Apply	1	1, 2,5,12
2	Design the framework necessary for IoT applications	Apply	1	1, 2, 5, 12
3	Develop prototypes for IoT devices	Apply	1	1, 2, 3, 5, 12
4	Assess various internet principles and M2M technologies.	Apply	2	1, 2, 12
5	Classify various advanced IoT applications and case studies.	Apply	2	1, 2

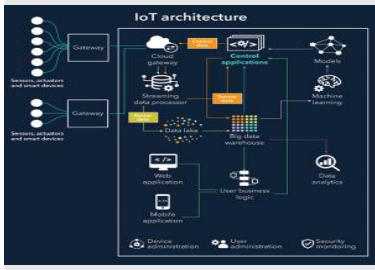
TEXT BOOKS:

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things A Hands-On- Approach”, 2014.
2. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013.

REFERENCE BOOKS:

1. Perry Lea, “Internet of Things for Architects”, 1st edition, Packt Publishing, 2018.
2. Samuel Greengard, “The Internet of Things (Essential Knowledge)”, MIT Press, 2015.
3. Timothy Chou,. Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020.

22EC904 INTRODUCTION TO IOT ARCHITECTURE



Source: https://www.scnsoft.com/blog/iot-architecture-in-a-nutshell-and-how-it-works

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the Architecture of IoT, basic concepts of IoT architectures and IoT Levels. The Course emphasizes the constraints, requirements, and architectures of hardware and software components for IoT systems. By the end of the course, a student will be able to: (1) Develop IoT solutions based on popular hardware/software platforms to address real-life problems (2) Evaluate the cost, power, and performance trade-offs associated with IoT solutions

MODULE - 1

UNIT-1 **12L+0T+8P=20hours**

IOT REFERENCE MODELS:

Introduction: Introduction to IoT, Applications of IoT, Use cases of IoT, The IoT Architectural Reference Model as Enabler,

IoT in Practice: Examples: IoT in Logistics and Health, IoT Reference Model: Domain, information, functional & communication models.

UNIT-2 **12L+0T+8P=20hours**

IOT ARCHITECTURE AND PROTOCOLS:

IoT Reference Architecture: Architecture, Functional, information, deployment and operation views; SOA based Architecture, API-based Architecture, OPENIoT Architecture for IoT/Cloud Convergence.

Application Protocols for IoT: UPnP, CoAP, MQTT, XMPP. SCADA, WebSocket; IP-based protocols: 6LoWPAN, RPL; Authentication Protocols; IEEE 802.15.4.

Case study: Cloud-Based Smart-Facilities Management, Healthcare, Environment Monitoring System.

PRACTICES:

- Implementation of home automation system using relay module.
- Implementation of traffic signal control using 6LoWPAN.
- Implementation of railway gate control by stepper motors.
- Direction and speed control of DC Motor.
- Familiarization with Arduino/Raspberry pi .
- To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn on led for 1sec after every 2 seconds.
- Write a program on Arduino/Raspberry Pi to publish temperature data to the MQTT broker.
- Write a program on Arduino/Raspberry Pi to subscribe to the MQTT broker for temperature data and print it.

MODULE-2

UNIT-1 **12L+0T+8P=20hours**

IOT REFERENCE ARCHITECTURE:

IIoT Architecture: The IIC Internet Reference Architecture, Industrial Internet Architecture Framework (IIAF), Architectural Topology, The Three-Tier Topology, Connectivity, Key System Characteristics, Data Management.

SKILLS:

- ✓ *Understand the specifications and how well different components work together for IoT Boards.*
- ✓ *Learn different data and number representations.*
- ✓ *Design ALU and Control unit.*
- ✓ *Identify the types of IoT application protocols and their uses.*
- ✓ *To enable the students to take up the real-time industry as well as interdisciplinary projects.*

UNIT-2 **12L+0T+8P=20hours**

DESIGNING INDUSTRIAL INTERNET SYSTEMS:

The Concept of the IIoT, The Proximity Network, WSN Edge Node, Legacy Industrial Protocols, Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, Gateways Examining the Access Network Technology and Protocols - The Access Network, Access Networks Connecting Remote Edge Networks

PRACTICES:

- Identify the industrial Sensors
- Interfacing raspberry pi with Boilers
- Implementation of scrolling belt using raspberry pi.
- implementation of the network using raspberry pi.
- To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to the smartphone using Bluetooth.
- To interface node MCU with Arduino/Raspberry Pi and write a program to send sensor data to the smartphone using Blynk Application/Cloud.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Build the IoT Design with sensors and actuators and analyse the levels of Arduino programming language.	Apply	1	1, 2, 12
2	Make use of sensors for collection data from the physical medium	Apply	1	1, 2, 5, 12
3	Apply the physical layer issues, analyse Medium Access Control Protocols/IoT Protocols	Apply	1	1, 2, 3, 5, 12
4	Categorize various topologies and Data management tools	Analyze	2	1, 2, 12
5	Comprehend network and transport layer characteristics and protocols and implement conventional protocols	Analyze	2	1, 2

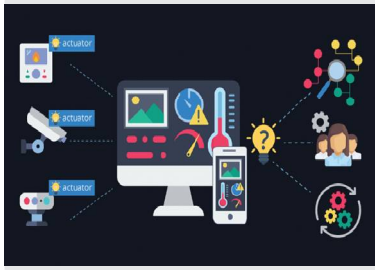
TEXT BOOKS:

1. Giacomo Veneri; Antonio Capasso, “Hands-on Industrial Internet of Things : create a powerful Industrial IoT infrastructure using Industry 4.0”, ,Packt Publishing, 2018
2. Vijay Madisetti, ArshdeepBahga,” Internet of Things A Hands-On- Approach”,2014

REFERENCE BOOKS:

1. Bassi, Alessandro, et al, “Enabling things to talk”, Springer-Verlag Berlin An, 2016.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017
3. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.
4. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016
5. Alasdair Gilchrist,“Industry 4.0: The Industrial Internet of Things” by, ISBN: 978-1-4842-2046-7, APRESS, 2016.
6. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything”, 1 st Edition, Apress Publications, 2013

22EC905 MACHINE LEARNING FOR IOT SYSTEMS



Source: https://www.scnsoft.com/blog/iot-systems-classification

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT.

COURSE DESCRIPTION AND OBJECTIVES:

Machine learning can help demystify the hidden patterns in IoT data by analyzing massive volumes of data using sophisticated algorithms. Machine learning inference can supplement or replace manual processes with automated systems using statistically derived actions in critical processes. Machine learning for IoT to perform predictive capabilities on a wide variety of use cases that enable the business to gain new insights and advanced automation capabilities.

MODULE–1

UNIT-1 **9L+0T+6P=15 Hours**

INTRODUCTION:

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates.

UNIT-2 **15L+0T+10P=25 Hours**

Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

M2M to IoT- An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

PRACTICES:

- Establish a sense of relationship of all variables with one other in IRIS dataset. (Multivariate Analysis).
- Analyse individual variables for better understanding using IRIS dataset. (Univariate Analysis).
- Linear regression for Housing data set to predict the price of the house.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

INTRODUCTION TO MACHINE LEARNING:

Definition of learning systems. Goals and applications of machine learning, Supervised Learning, Unsupervised Learning, Bias-variance trade-off, Overfitting, under fitting, Gradient descent: -batch, stochastic, Model Evaluation, trees and ensembles, Support vector machines, Working with Text Data

UNIT-2 **15L+0T+10P=25 Hours**

AUTOMATION SYSTEMS USING ML AND IOT:

Analysis of systems using ML and IoT- Data collection, data processing and Analysis- CCTV data analysis, smart cities, smart fish system etc

PRACTICES:

- Implement k-nearest neighbour algorithm to classify the iris data set. Print both correct and

SKILLS:

- ✓ *Ingest and transform data into a consistent format*
- ✓ *Work with various communication technologies and sensors*
- ✓ *Build a machine learning model*
- ✓ *Apply a appropriate ML algorithm to a specific task*
- ✓ *Deploy this machine learning model on cloud, edge and device*

wrong predictions.

- Use appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
- Splitting the data into training and test data sets using K-fold cross-validation
- Regression problems using XGBoost.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse concise manner how the general Internet as well as Internet of Things work.	Analyse	1	1, 2, 3, 4, 9, 10, 11, 12
2	Analyse constraints and opportunities of wireless and mobile networks for Internet of Things.	Analyse	1	1, 2, 3, 4, 9, 10, 11, 12
3	Evaluate various Ml algorithms to various applications	Evaluate	2	1, 2, 3, 4, 9, 10, 11, 12
4	Analyse various IoT based smart systems.	Apply	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Introduction to Statistical Learning by Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani. Springer, 2013. Corrected 8th printing, 2017

REFERENCE BOOKS:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1stEdition, VPT, 2014.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.
3. Ammar Rayes, Samer Salam, “Internet of Things from Hype to Reality”, Springer, 2022.

22EC906 SECURITY ASPECTS OF IOT

Source: https://www.wsj.com/articles/BL-CIOB-8241

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to Internet of Things.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the methodologies of Cyber Physical systems and the basic Trust models of IoT. The course explores on different threads on IoT applications and provides privacy preservation for real time data using Attack detection techniques, Encryption, Hash Function, Elliptic curves, Signature Algorithms, Consensus Algorithms and Secured Access Protocols.

MODULE–1

UNIT-1 **12L+0T+8P=20 Hours**

CYBER PHYSICAL SYSTEMS & THREADS:

Introduction to IoT –Cyber Physical Systems: IoT and cyber-physicalsystems, IoT security (vulnerabilities, attacks, and countermeasures), security engineering for IoT development, IoT security lifecycle.

IoT as Interconnection of Threats: Network Robustness of Internet of Things- Sybil Attack Detection in Vehicular Networks- Malware Propagation and Control in Internet of Things- Solution-Based Analysis of Attack Vectors on Smart Home Systems

UNIT-2 **12L+0T+8P=20 Hours**

CRYPTO FOUNDATIONS & BLOCK CHAIN:

Crypto Foundations: Block ciphers, message integrity, authenticated encryption, hash functions, Merkle trees, elliptic curves, public-key crypto (PKI), signature algorithms

Block Chain: Crypto-currencies, Bitcoin P2P network, distributed consensus, incentives and proof-of-work, mining, script and smart contracts, wallets: hot and cold storage, anonymity, altcoins.

PRACTICES:

- Implement Block Cipher Encryption.
- Analyze Attacks on smart Home
- Vulnerabilities on IoT devices.
- Implement attacks on IoT.
- Evaluate Cyber-physical systems.
- Design smart contract for real time IoT applications.
- Implement Consensus Algorithm for IoT.
- Implement Sybil Attack Detection.
- Implement Malware Control in Internet of Things.
- Implement elliptic curve cryptography.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

PRIVACY PRESERVATION & TRUST MODELS:

Privacy Preservation for IoT: Privacy Preservation Data Dissemination- Privacy Preservation Data Dissemination- Social Features for Location Privacy Enhancement in Internet of Vehicles- Lightweight

SKILLS:

- ✓ *Understands the state-of-the-art methodologies in Cyber Physical system.*
- ✓ *Knowledge on Model threats and countermeasures.*
- ✓ *Explores the Privacy Preservation and Trust Models in Internet of Things (IoT)*
- ✓ *Designs Internet of Things Security in the real world scenarios*

and Robust Schemes for Privacy Protection in Key Personal IoT Applications: Mobile WBSN and Participatory Sensing

Trust Models for IoT: Authentication in IoT- Computational Security for the IoT- Privacy-Preserving Time Series Data Aggregation- Secure Path Generation Scheme for Real-Time Green Internet of Things- Security Protocols for IoT Access Networks- Framework for Privacy and Trust in IoT- Policy-Based Approach for Informed Consent in Internet of Things

UNIT-2 **12L+0T+8P=20 Hours**

INTERNET OF THINGS SECURITY:

Security and Impact of the Internet of Things (IoT) on Mobile Networks- Networking Function Security- IoT Networking Protocols, Secure IoT Lower Layers, Secure IoT Higher Layers, Secure Communication Links in IoTs, Back-end Security -Secure Resource Management, Secure IoT Databases, Security Products-Existing Test bed on Security and Privacy of IoTs, Commercialized Products.

PRACTICES:

- Implement IoT Networking protocols.
- Implement authorized login for IoT database.
- Secured IoT Access Networks.
- Security implementation at Lower Layers.
- Security implementation at Higher Layers.
- Design light weight security applications.
- Design policy for IoT data Approach.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify the areas of cyber security for the Internet of Things.	Analyze	1	1, 2
2	Assess different Internet of Things technologies and their applications.	Analyze	1	1, 2, 12
3	Model IoT to business	Apply	1	1, 2, 3, 5
4	Customize real time data for IoT applications.	Apply	2	1, 2, 12
5	Solve IoT security problems using light weight cryptography	Analyze	2	1, 2, 3, 5
6	Build security systems using elementary blocks	Apply	2	1, 2, 3, 5

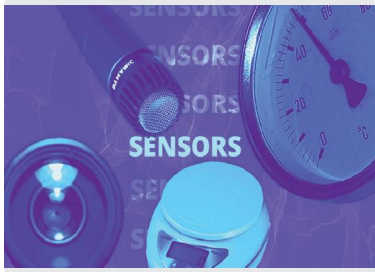
TEXT BOOKS:

1. Hu, Fei. Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations, 1 st edition,CRC Press, 2016.
2. Russell, Brian, and Drew Van Duren. Practical Internet of Things Security, 1 st edition, Packt Publishing Ltd, 2016.

REFERENCE BOOKS:

1. Whitehouse O. Security of things: An implementers' guide to cyber-security for internet of things devices and beyond, 1 st edition, NCC Group, 2014
2. DaCosta, Francis, and Byron Henderson. Rethinking the Internet of Things: a scalable approach to connecting everything, 1 st edition, Springer Nature, 2013.
3. Patel Chintan, Nishant Dosji. Internet of Things Security Challenges, Advances and Analysis, 1st Edition, Auerbach, 2018.

22EC907 SENSORS AND ACTUATORS FOR IOT



Source: https://www.iotforall.com/an-introduction-to-iot-sensors

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT or Embedded Systems.

COURSE DESCRIPTION AND OBJECTIVES:

Explore IoT smart sensor and actuator solutions. Compare types and technical requirements and protocols across market industries. Develop solutions for IoT using various sensors and actuators.

MODULE - I

UNIT-1 **12L+0T+8P=20 Hours**

INTRODUCTION TO SENSORS & ACTUATORS:

Definitions, Classification of sensors and Actuators, General Requirement for interfacing, Units.

Input output characteristics, Transfer function, Range, Span, input and Output full scale, resolution and dynamic range, accuracy, errors, and repeatability, sensitivity and sensitivity analysis, hysteresis, nonlinearity, and saturation, Frequency response, response time, and bandwidth, Calibration, excitation, deadband, reliability.

UNIT-2 **12L+0T+8P=20 Hours**

PRINCIPLES OF SENSORS:

Principles of sensing (Basics) : Capacitance, Magnetism, Resistance, Induction, Piezoelectric effect, Hall effects, Thermoelectric Effects

Ultrasonic Detectors, Optoelectronic Motion Detectors, Optical Presence Sensors, Pressure-Gradient Sensors, 2-D Pointing Devices, Gesture Sensing (3-D Pointing), Tactile Sensors

PRACTICES:

- Find the input characteristics of capacitive sensors
- Measure the range, sensitivity hysteresis, nonlinearity of temperature sensors
- Measure the frequency response of temperature sensor
- Measure the range of optical sensors and calibrate its use for displacement measurement.
- Calibrate a hall effect sensor
- Measure the displacement range, linearity, frequency response of piezoelectric sensor
- Measure the sensitivity of resistance sensors and establish their input characteristics
- Establish sensitivity, range, linearity and frequency response of tactile sensors.

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

INTERFACING ELECTRONICS FOR SENSORS:

Signal Conditioners: Input Characteristics, Amplifiers, Operational Amplifiers, Voltage Follower, Charge- and Current-to-Voltage Converters, Light-to-Voltage Converters, Capacitance-to-Voltage Converters, Closed-Loop Capacitance-to-Voltage Converters

Data Acquisition: Data Acquisition, Sensor Classification, Units of Measurements

Analog-to-Digital Converters: Basic Concepts, Digital to analog converters, V/F Converters, PWM Converters, R/F Converters, Successive-Approximation Converter, Resolution Extension, ADC Interface

SKILLS:

- ✓ *Use various sensors and actuators for IoT applications.*
- ✓ *Interface programming on I/O devices.*
- ✓ *Develop applications for the Internet of things.*

UNIT-2 **12L+0T+8P=20 Hours**

ACTUATORS & INTERFACING:

Thermal actuators, Optical actuators, Capacitive actuators, Magnetic actuators, magnetrostrictive actuators, Acoustic actuators, Electromagnetic actuators (DC, Stepper motors) and their control principles

Interfacing to microprocessor/microcontrollers. Microprocessor as general-purpose controller, General requirements for interfacing sensors and actuators. Interfacing examples

PRACTICES:

- Develop signal conditioning circuit for low level signals along with noise removal
- Develop a digital circuit for amplification of the capacitive sensor and establish various characteristics.
- Develop a digital circuit for measuring the optical sensitivity of optical sensor
- Control the rotation of stepper motor to precise angle without any sensors
- Tracking object by controlling servo motor precisely

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify sensors for selection of a specific physical parameter	Apply	1	1, 2, 12
2	Interface the sensor with different data acquisition systems	Create	2	1, 2, 5, 12
3	Control various actuators	Apply	2	1, 2, 3, 5, 12
4	Design a signal conditioner for the given sensor	Create	2	1, 2, 12
5	Select a sensor for a given application based on its principle of operation	Evaluate	1	1, 2

TEXT BOOKS:

1. Nathan Ida, Senosrs, Actuators, and Their Interfaces-A Multideisciplinary introduction, 2nd Edition, IET London UK, 2020
2. Jacob Fraden, Handbook of Modern Sensors Physics, Designs, and Applications, Fifth Edition, Springer, 2016

REFERENCE BOOKS:

1. John G. Webster, The Measurement Instrumentation and Sensors, CRC Press, 1999
2. Francisco André Corrêa Alegria, Sensors and Actuators, World Scientific Publichisng Co. Pvt. Ltd., 2022.
3. Ammar Rayes, Samer Salam, “Internet of Things from Hype to Reality”, Springer, 2022.

OPEN ELECTIVES

B.Tech.

ELECTRONICS AND COMMUNICATION ENGINEERING

22EC855	-	ADHOC Sensor Networks
22EC856	-	Design Principles of IoT
22EC857	-	Introduction to Internet of Things
22EC858	-	Introduction to IoT Architecture
22EC859	-	Machine Learning for IoT Systems
22EC860	-	Security Aspects of IoT

COURSE CONTENTS

I SEM & II SEM

22EC855 ADHOC SENSOR NETWORKS

Source; https://www.elprocus.com/what-is-android-introduction-features-applications/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Any programming language with Oops concepts.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of the course is that the student will be able to develop android application using Java in Android Studio.

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

UNDERSTANDING ANDROID OS:

Android App Creation in Android Studio, Overview of the Android Architecture, The Anatomy of an Android Application, Overview of Android View Binding, Understanding Android Application and Activity Lifecycles

UNIT-2 **8L+0T+8P=16 Hours**

UNDERSTANDING STATES AND ACTIVITIES:

Handling Android Activity State Changes, Saving and Restoring the State of an Android Activity, Understanding Android Views, View Groups and Layouts, Android Constraint Layout, Android Touch and Multi-touch Event Handling

Implementing gestures and touch: Detecting Common Gestures Using the Android Gesture Detector Class, Implementing Custom Gesture and Pinch Recognition on Android,

PRACTICES:

- Develop an application that uses GUI components, Font and Colors.
- Develop an application that uses Layout Managers and event listeners.
- Develop a native calculator application.
- Write an application that draws basic graphical primitives on the screen.
- Develop an application that makes use of database.
- Develop an application that makes use of RSS Feed.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

DESIGNING ANDROID COMPONENTS:

Modern Android App Architecture with Jetpack, An Android Jetpack View Model Tutorial, Working with the Floating Action Button and Snackbar, Creating a Tabbed Interface using the TabLayout Component

WORKING WITH INTENTS AND NOTIFICATIONS:

Adding Sample Data to a Project, Working with the AppBar and Collapsing Toolbar Layouts, Overview of Android Intents, Android Explicit & Implicit Intents, Android Broadcast Intents and Broadcast Receivers, Overview of Android Services & Notifications, Foldable Devices and Multi-Window Support

UNIT-2 **8L+0T+8P=16 Hours**

ACCESSING STORAGE AND MULTIMEDIA

An Android Storage Access Framework, Video Playback on Android using the VideoView and MediaController Classes, Making Runtime Permission Requests in Android, Android Audio Recording and Playback using MediaPlayer and MediaRecorder

Creating and testing android app:

Android App Links, Creating, Testing and Uploading an Android App Bundle

PRACTICES:

- Implement an application that implements Multi threading.
- Develop a native application that uses GPS location information.
- Implement an application that writes data to the SD card.
- Implement an application that creates an alert upon receiving a message.
- Write a mobile application that creates alarm clock.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Implement basic states, gestures for Android applications	Create	1	1, 2, 4, 9, 10, 11, 12
2	Identify and design the components for developing android applications	Apply	1	1, 2, 3, 4, 9, 10, 11, 12
3	Display notifications and access storage and multimedia in android OS	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Design an android app for a given need	Create	2	1, 2, 3, 4, 9, 10, 11, 12

TEXTBOOKS:

1. Smyth, Neil, “Android Studio 4. 2 Development Essentials - Java Edition”, 2021
2. Wei-Meng Lee, “Beginning Android 4 Application Development”, 1st edition, Wiely Publishers, 2011.

REFERENCEBOOKS:

1. Prasanna Kumar Dixit, “Android”, 1st edition, Vikas Publishers, 2014.
2. Jerome (J.F.) DiMarzio, “Android - A programmers Guide”, 1st edition, Tata Mc Graw Hill, 2010.
3. Reto Meier, “Professional Android 4 Application Development”, 1st edition, Wiley Publishers, 2008
4. John Horton, “Android Programming for Beginners”, 1st edition, Pact Publishing, 2015.

22EC856 INTERNET OF THINGS

Source: https://www.rtsrl.eu/blog/what-is-internet-of-things-iot/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Internet.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the introduction to Internet of Things and the basic concepts. The course emphasizes design issues and utilization of IoT devices, including various sensors and hardware boards.

MODULE –1

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION & CONCEPTS:

Introduction to Internet of Things, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels

UNIT-2 **8L+0T+8P=16 Hours**

INTERNET PRINCIPLES:

Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols, Python packages of interest for IoT.

DOMAIN SPECIFIC APPLICATIONS OF IOT

Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

PRACTICES:

- Familiarization of various hardware boards.
- To analyze the IP address of Personal Computer
- Working principles of various IoT protocols.
- Implementation of MQTT protocol using Arduino board
- Python packages for implementing IoT applications

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

INTERNET PRINCIPLES & M2M:

M2M: Introduction to M2M, M2M architecture, Difference between IoT and M2M, SDN and NFV for IoT.

IEEE 802.15.4: Physical layer, MAC layer, Uses and future of 802.15.4.

Zigbee: Architecture, Association, Network layer, APS layer and security.

Z-Wave: Z-wave Protocol.

UNIT-2 **8L+0T+8P=16 Hours**

CASE STUDY & ADVANCED IOT APPLICATIONS:

IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments.

SKILLS:

- ✓ *Understand the specifications and how well different components work together using IoT.*
- ✓ *Learn above different sensors for collecting data.*
- ✓ *Design a prototype for various IoT applications.*

Case study illustrating IoT design: Home Automation, Smart Cities, Environment, Agriculture, Productivity Applications.

PRACTICES:

- Interfacing of LED and switch with Arduino boards and ESP8266.
- Traffic Light control using Arduino board and ESP8266.
- Interfacing DHT11 sensor with Arduino board and ESP8266.
- Interfacing of ultrasonic sensor with Arduino board and ESP8266.
- Interfacing of PIR sensor with Arduino board and ESP8266.
- DC motor control using L293D motor driver and Arduino board.
- Familiarization with Raspberry pi.
- Interfacing of LED and switch with Raspberry pi.
- Interfacing PIR sensorwith Raspberry pi.
- Interfacing DHT11 sensor with Raspberry pi.
- Interfacing of ultrasonic sensor with Raspberry pi.
- Interfacing of Picam with Raspberry pi.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Able to programs for IoT applications.	Apply	1	1, 2, 12
2	Able to design the framework necessary for IoT applications	Apply	1	1, 2, 5, 12
3	Able to develop prototypes for IoT devices	Apply	1	1, 2, 3, 5, 12
4	Categorize various IoT applications	Apply	2	1, 2, 12
5	Classify various advanced IoT applications and case studies.	Apply	2	1, 2

TEXT BOOKS:

1. Vijay Madisetti, Arshdeep Bahga," Internet of Things A Hands-On- Approach", 2014,
2. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013,

REFERENCES BOOKS:

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013.
2. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1.
3. Kamal R. Internet of Things, McGraw Hill, 2017.

22EC857 INTRODUCTION TO EMBEDDED SYSTEMS

Source: https://cprimestudios.com/blog/5-myths-about-embedded-systems-development

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Computer Architecture and Organization, Microprocessors and Microcontrollers.

COURSE DESCRIPTION AND OBJECTIVES:

The course objective is to study the applications, categories, hardware and software architectures, memory, testing tools in embedded systems, Firmware, Embedded C, operating system functions and various kernel objects and RTOS.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION:

Basic concepts, Applications and Categories of embedded systems, Hardware architecture, Software architecture of Embedded Systems, Process of generating executable images, Development/testing tools.

UNIT-2 **10L+0T+10P=20 Hours**

PROGRAMMING:

Comparison of Assembly and C languages, C and Embedded C. Programming in C: Arrays, Structures, Loops and Decisions, Pointers, Functions, Embedded C: Header files for Project and Header files for Port.

PRACTICES:

- Programming with Embedded C using any compiler.
- Demonstration/Practical session for creation of header files.
- Program to create loops in Embedded C
- Program to implement decisions in Embedded C
- Develop program to implement interrupt function

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

OPERATING SYSTEMS:

Introduction to Operating Systems, Process and threads, Scheduling, Non-preemptive and Preemptive scheduling, Real Time Scheduling.

UNIT-2 **10L+0T+10P=20 Hours**

Introduction to Real Time Operating Systems, Shared Data Problem, Semaphores, Priority inversion problem, Inter process/task communication techniques.

PRACTICES:

- Create and schedule a process/task
- Demonstrate shared data problem
- Create and use semaphores

SKILLS:

- ✓ *Choose component for Embedded System*
- ✓ *Understand operating system concepts*
- ✓ *Understand*

- Find schedulability using Gantt charts
- Implement IPC techniques

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify the components of embedded systems and differentiate various embedded systems	Analyze	1	1, 2, 3, 4, 9, 10, 11, 12
2	Design embedded systems using standard procedure	Create	1	1, 2, 3, 4, 9, 10, 11, 12
3	Choose necessary component and buses for the embedded system	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Apply the knowledge of operating system functions and various kernel objects	Apply	2	1, 2, 3, 4, 9, 10, 11, 12

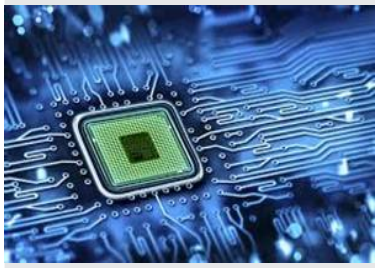
TEXT BOOKS:

1. Raj Kamal, “Embedded Systems Architecture, Programming and Design”, 3rd edition, Mc Graw Hill, 2017.
2. Lyla B. Das, “Embedded Systems An Integrated Approach,” Pearson Education, 2013

REFERENCE BOOKS:

1. Marilyn wolf, “Computers as Components: Principles of Embedded Computer systems design”, 4th edition, Morgan Kaufmann Publishers, 2017.
2. Dr. K.V.K.K. Prasad, “Embedded Real time Systems”, Black book, Dreamtech Press, 2003.
3. Daniel W. Lewis, “Fundamentals of Embedded Software: Where C and Assembly Meet”, 1st edition, Pearson, 2001.
4. John Catsoulis, “Designing Embedded Hardware”, 2nd Edition, O’Reilly Media, Inc., 2005.
5. “Getting Started with Arduino: The Open Source Electronics Prototyping Platform”, 3rd edition, Maker Media Inc., 2015.

22EC858 MICROPROCESSORS AND MICROCONTROLLERS



Source: https://www.google.com /search?q=Microcontroller&sxsrf=AliCzsbnrzqS2pUyMf6IF_

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Digital Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the principles of microprocessors and microcontrollers. It also deals with the programming concepts of microprocessors and microcontrollers.

MODULE - 1

UNIT-1 **6L+0T+6P=12 Hours**

8086 MICROPROCESSOR:

Architecture, Flag register, Signals, Memory segmentation, Physical address generation, Minimum mode, Maximum mode, Interrupts, Memory organization.

UNIT-2 **10L+0T+10P=20 Hours**

8086 INSTRUCTIONS:

Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, String instructions, machine control instructions; Addressing Modes, Assembler directives, Procedures and macros.

PRACTICES:

- Introduction to TASM software.
- 8-bit, 16-bit Addition, Subtraction.
- 8-bit, 16-bits Multiplication and Division.
- Find square, cube and square root.
- Find number of zeros and ones, Separate the 10s and 1s of a given 8-bit number.
- Searching a number, Find and replace the number in a given array.
- Convert Hexa to BCD and Hexa to ASCII.
- Factorial, sum of n numbers, average of n numbers.
- Find the smallest/largest number, Arrange the given numbers in sorting order.
- Block transfer using string instructions.
- Display of character/ string on console using DOS INT 21H function calls.
- File management using DOS INT 21H function calls.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

8051 MICROCONTROLLERS:

Comparing Microprocessors and Microcontrollers; Selection of Microcontrollers, Architecture, PSW, Signals, Memory organization, Instruction set, Addressing modes of 8051.

UNIT-2 **10L+0T+10P=20 Hours**

8051 COMPONENTS:

On-chip Components: Parallel Ports, Timers/Counters, Serial port, Interrupts. Interfacing with 8051: LCD, Keyboard, Stepper Motor.

SKILLS:

- ✓ *Understand the specifications and how well different components work together for IoT Boards.*
- ✓ *Learn different data and number representations.*
- ✓ *Design ALU and Control unit.*
- ✓ *Identify the types of IoT application protocols and their uses.*
- ✓ *To enable the students to take up the real-time industry as well as interdisciplinary projects.*

PRACTICES:

- Introduction to Keil vision 4 software,
- Addition, Subtraction, Multiplication and Division.
- Find number of zeros and ones, Separate the 10s and 1s of a given 8bit number.
- Factorial, sum of n numbers, average of n numbers.
- Find the smallest/largest number, Arrange the given numbers in sorting order.
- Addition, Subtraction, Reverse subtraction.
- Find number of zeros and ones, Separate the 10s and 1s of a given 8bit number.
- Factorial, sum of n numbers, average of n numbers.
- Find the smallest/largest number, Arrange the given numbers in sorting order.
- Blinking of LED's, Reading Switches and Glowing LED's using Assembly and C.
- 7 segment LED with 8051.
- LCD module with 8051.
- Stepper motor speed and rotation control using 8051.
- Waveform generation using DAC with 8051.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Architect a microprocessor or microcontroller system and estimate the required hardware and software resources.	Apply	1	1, 2, 3, 4, 9, 10, 11, 12
2	Select a microprocessor or microcontroller suitable to the application.	Analyse	1	1, 2, 3, 4, 9, 10, 11, 12
3	Write assembly language program in 8086 for various applications.	Apply	1	1, 2, 3, 4, 9, 10, 11, 12
4	Create the memory and IO interfacing techniques 8051.	Create	2	1, 2, 3, 4, 9, 10, 11, 12
5	Write assembly language program in microcontroller 8051 for various applications	Apply	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. Kenneth J. Ayala, "The 8086 Microprocessor: Programming and Interfacing the PC", 3rd edition, Cengage Learning, 2007.
2. Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.Mckinlay, "The 8051 Microcontroller and Embedded Systems", 2nd edition, Pearson Education, 2012.

REFERENCE BOOKS:

1. Barry B. Brey, "The Intel microprocessors 8086/8088, 80186/80188, 80286, 80386,80486, Pentium, Pentium Pro processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit extensions: architecture, programming, and interfacing", 8th edition, Pearson Prentice Hall, 2014.
2. Yu Cheng Liu and Glenn A Gibson, "Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design", 2nd edition, Prentice Hall, 2015.
3. Kenneth J. Ayala, "The 8051 Microcontroller: Architecture Programming and Applications", 3rd edition, Cengage Learning, 2008.
4. K. M. Bhurchandi and A. K. Ray, Advance Microprocessor and Peripherals, 3rd edition, Tata McGraw Hill, 2017.1 st Edition, Apress Publications, 2013.

22EC859 SMART & VIRTUAL INSTRUMENTATION

Source: https://new.siemens.com/uk/en/products/automation/process-instrumentation/smart-instruments.html

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basic understanding of Sensors, any programming language concepts.

COURSE DESCRIPTION AND OBJECTIVES:

To familiarize students with the smart and intelligent sensors with VI software. Acquire knowledge on Data Acquisition Systems and network interface concepts. Understand various analysis tools and develop programs for Industrial Applications

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION TO VIRTUAL INSTRUMENTATION:

Computers in Instrumentation, Virtual Instrumentation (VI), LabVIEW and VI, Conventional and Graphical Programming, Components of LabVIEW, Owned and Free Labels, Tools and Other Palettes, Arranging Objects, Pop-Up Menus, Color Coding, Code Debugging.

UNIT-2 **8L+0T+8P=16 Hours**

VI PROGRAMMING TECHNIQUES:

VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

Data Acquisition System: Measurement and Automation Explorer, The Waveform Data Type, Working in DAQmx, Working in NI-DAQ(Legacy DAQ), Use of Simple VIs, Intermediate VIs.

PRACTICES:

- Introduction to LabVIEW
- Use of NI Elvis
- Use of SubVI
- Formula node
- Shift registers
- Array, Strings
- Function Generator
- DC voltage measurement using DAQ

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

INTERFACING INSTRUMENTS:

GPIB and RS232: RS232C versus GPIB, handshaking, GPIB interfacing, RS232C/RS485 interfacing, Standard commands for programmable instruments, VISA, Instrument interfacing and LabVIEW.

UNIT-2 **8L+0T+8P=16 Hours**

INTERFACING SMART SENSORS:

Introduction, Classification, Smart Sensors, Cogent Sensors, Soft or Virtual Sensors, Self Adaptive Sensors, Self-Validating Sensors, VLSI Sensors, Temperature Compensating Intelligent Sensors. Film sensors (Thick film sensors, this film sensor), MEMS and Nano-Sensors.

PRACTICES:

- Analog Input and Output Interface
- Frequency Measurement
- Network Interface
- Thermocouple Interface and Celsius to Fahrenheit conversion
- Stepper Motor
- Simulation of Tank Process
- Clusters
- PID controller for DC motor

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the basic concept of smart sensors, virtual instrument.	Analyze	1	1, 2, 4, 9, 10, 11, 12
2	Create a Virtual Instrument using graphical programming	Create	1	1, 2, 3, 4, 9, 10, 11, 12
3	Develop systems for real-time signal acquisition and analysis.	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
4	Apply concepts of network interface for data communication.	Create	2	1, 2, 3, 4, 9, 10, 11, 12
5	Interface physical parameters with computer through data acquisition systems for practical applications	Apply	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:

1. Dr. Sumathi. S and Prof. Surekha. P, “LabVIEW Based Advanced Instrumentation Systems”, 2nd edition, 2007.
2. Jovitha Jerome, “Virtual Instrumentation using LabVIEW”, PHI Learning Pvt. Ltd, New Delhi, 2010.

REFERENCE BOOKS:

1. Lisa .K, Wells and Jeffrey Travis, “LABVIEW for Everyone”, Prentice Hall, 2009.
2. Skolkoff, “Basic concepts of LABVIEW 4”, PHI, 1998.
3. Gupta. S, Gupta. J.P, “PC Interfacing for Data Acquisition and Process Control”
4. Gary Johnson, “LabVIEW Graphical Programming”, McGraw Hill, 2006.

22EC860 WIRELESS SENSOR NETWORKS

Source: https://www.smart-energy.com/magazine-article/wireless-sensor-network-tech-iiot/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of computer networks.

COURSE DESCRIPTION AND OBJECTIVES:

This course is targeted at understanding and obtaining hands-on experience with the state of the art in such wireless sensor networks which are often composed using relatively inexpensive sensor nodes that have low power consumption, low processing power and bandwidth. Explore the various MAC routing protocols evolved in wireless sensor networks.

MODULE–1

UNIT- 1 **8 L+0T+8P=16hours**

INTRODUCTION:

Introduction to Wireless Networks, Protocol Suites, and Standards, OSI Model and TCP/IP Protocol Suite, Ad-hoc Networks, Comparison of Ad-hoc and Sensor Networks, applications of WSNs, challenges for WSNs, hardware components of wireless sensor node, energy consumption of a sensor nodes, operating system and execution environments and examples of sensor nodes.

UNIT-2 **8L+0T+8P=16hours**

NETWORK ARCHITECTURE AND PHYSICAL LAYER:

Sensor network scenarios, optimization goals and figures of merit, design principles for wireless sensor networks, service interfaces for wireless sensor networks, gateway concepts, wireless channel and communication fundamentals, physical layer, and transceiver design considerations in wireless sensor networks.

MODULE-2

UNIT-1 **8L+0T+8P=16hours**

MAC LAYER PROTOCOLS FOR WIRELESS SENSOR NETWORKS:

Fundamentals of wireless MAC protocols, Low duty cycle protocols and wakeup concepts, contention-based protocols, schedule- based protocols, IEEE 802.15.4 MAC protocols, error control and link layer management.

UNIT-2 **8L+0T+8P=16hours**

ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORKS:

The forwarding and routing concept, Gossiping and agent-based unicast forwarding, energy efficient unicast methods, broadcast and multicast methods, geo-graphic routing methods and mobile nodes, TEEN, APTEEN and SPIN protocols.

PRACTICES:

Experiments to be carried out in any network simulator like NETSIM, NS2 and OMNET++ etc.

- Examine the various path loss models available for wireless networks
- Identify the various reasons for hidden node terminal problem in wireless ad-hoc networks.
- Create a scenario where both ad-hoc and wireless sensor network are available and examine he interference problem.

SKILLS:

- ✓ *Able to adapt the wireless sensor network with sensor nodes which have limitations in power consumption, processing power and bandwidth.*
- ✓ *Able to specify the requirements for the hardware and software solutions for energy-efficient sensor network for new applications.*
- ✓ *Able to apply appropriate algorithms to improve existing or to develop new wireless sensor network applications.*

- Simulate the MAC routing protocols for wireless sensor networks.
- Simulate the multiple wireless scenarios for throughput performance.
- Analyze performance of the hierarchical routing protocols in various parameters like end-to-end delay, bit error rate and throughput.
- Design a wireless sensor network and observe how the power consumption consumed for the network.
- Examine the importance of channel accessing mechanism helped for getting high throughput in wireless networks.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the various solutions involved for designing WSN	Analyze	1	1, 2, 4, 9, 10, 11, 12
2	To identify the Wireless Sensor Network node architecture and real time nodes.	Apply	1	1, 2, 3, 4, 9, 10, 11, 12
3	Analyze the performance of Medium Access Control protocols for power consumption, fairness, channel utilization and control packet overhead.	Analyze	2	1, 2, 3, 4, 9, 10, 11, 12
4	Evaluate the performance of routing protocols for wireless sensor network.	Evaluate	2	1, 2, 3, 4, 9, 10, 11, 12
5	Solve IoT security problems using light weight cryptography	Analyze	2	1, 2, 3, 5

TEXT BOOKS:

1. Holger Karl, Andreas Willig “Protocols and Architecture for Wireless Sensor Networks” John Wiley and Sons, Ltd, 2007
2. Feng Zhao and Leonides Guibas, “Wireless Sensor Networks”, Elsevier Publication–2002.

REFERENCE BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004.
2. Kazem sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks: Technology, Protocols and Application” John Wiley, 2007.
3. C.K Toh, “Ad-Hoc Mobile Wireless Networks: Protocols and Systems” 1st edition, Pearson, 2007.