Course Curriculum for B. Tech.

In

Electronics & Communication Engineering

(For students admitted in 2022-23 onwards)

National Institute of Technology
Arunachal Pradesh

P.O.: Jote, Dist.: Papumpare, Arunachal Pradesh, Pin–791113
www.nitap.ac.in

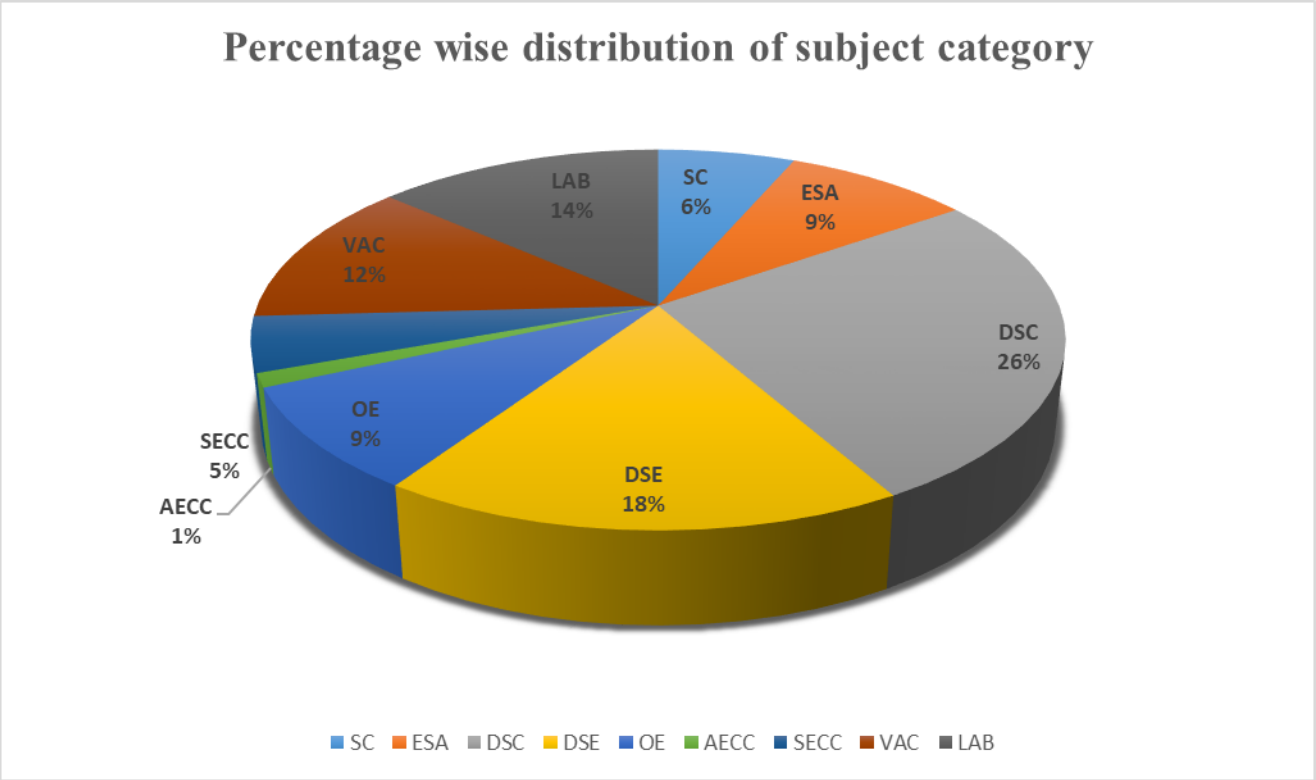
1.0 Semester wise Credit point distribution

Sl. No.	Year	Credit Point	
		ODD	EVEN
1	First	22	22
2	Second	21	21
3	Third	24	23
4	Fourth	20	17
Total Credit Point		**87**	**83**
		170	

1.1 Subject Category wise Credit point Distribution

Course Category	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Sem-VII	Sem-VIII	Total Credit Point
Science Core (SC)	6	2	3	-	-	-	-	-	**11**
Engineering Science and Arts (ESA)	4	11	-	-	-	-	-	-	**15**
Departmental Specific Core (DSC)	3	3	9	9	9	9	3	-	**45**
Departmental Specific Elective (DSE)	-	-	3	3	3	6	9	6	**30**
Open Elective (OE)	-	-	3	3	3	3	3	-	**15**
Ability Enhancement Compulsory Course (AECC)	-	-	-	-	1	-	1	-	**2**
Skill Enhancement Compulsory Course (SECC)	2	-	-	3	3	-	-	-	**8**
Value Added Course (VAC)	-	2	-	-	2	2	4	11	**21**
Laboratory (LAB)	7	4	3	3	3	3	-	-	**23**
Total Credit Point	**22**	**22**	**21**	**21**	**24**	**23**	**20**	**17**	**170**

1.2 Subject Category wise Credit point Distribution (in percentage)



2.0 Course Structure

I[st] Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1101	Engineering Mathematics-I	2	0	0	2
2	BS-1102	Engineering Chemistry	2	0	0	2
3	BS-1103	Engineering Physics	2	0	0	2
4	BT-1101	Biology for Engineers	2	0	0	2
5	EC-1101	Fundamentals of Electrical Measurement and Equipment	3	0	0	3
6	MH-1101	Communication Skill	2	0	0	2
7	EE-1102	Basic of Electrical and Electronics Engineering	2	0	0	2
8	CS-1101	Coding Laboratory	0	0	4	2
9	EE-1103	Basic of Electrical and Electronics Engineering Laboratory	0	0	2	1
10	BS-1104	Basic Science Laboratory-I	0	0	2	1
11	ME-1102	Engineering Drawing	0	0	2	1
12	EC-1102	Fundamentals of Electrical Measurement and Equipment Laboratory	0	0	2	1
13	MH-1102	Language Laboratory	0	0	2	1
14	MH-1103	NSS/NCC/Yoga (Audit Pass)	0	0	0	0
Contact Hours			15	0	14	
Total Credits						22

II[nd] Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1201	Engineering Mathematics-II	2	0	0	2
2	CS-1201	Programming and Data Structure	3	0	0	3
3	EC-1201	Introduction to Digital Engineering	2	0	0	2
4	MH-1201	Introduction to Innovation and Creativity	2	0	0	2
5	ME-1201	Engineering Mechanics	3	0	0	3
6	BS-1203	Introduction to Semiconductor Physics	3	0	0	3
7	EC-1202	System Design	2	0	0	2
8	ME-1204	Workshop Practice-I	0	0	2	1
9	EC-1203	Do It Yourself (DIY)/Industry Exposure	0	0	0	1
10	BS-1202	Basic Science Laboratory-II	0	0	2	1
11	CS-1202	Programming and Data Structure Laboratory	0	0	2	1
12	MH-1202	Gandhian Technology	0	0	2	1
Contact Hours			17	0	8	
Total Credits						22
III[rd] Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-2101	Engineering Mathematics-III	3	0	0	3
2	EE-2101	Electrical Circuit Analysis	3	0	0	3
3	EC-2101	Semiconductor Devices	3	0	0	3
4	EC-2102	Digital Logic Design	3	0	0	3
5	EE-210A	Electromagnetic Field Theory	3	0	0	3
6	EC-210X	OE1*	3	0	0	3
7	EE-2103	Electrical Circuit Analysis Laboratory	0	0	2	1
8	EC-2103	Semiconductor Devices and Physics Laboratory	0	0	2	1
9	EC-2104	Digital Logic Design Laboratory	0	0	2	1
Contact Hours			18	0	6	
Total Credits						21
IV[th] Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-2201	Analog Circuits	3	0	0	3
2	EC-2202	Antenna and Wave Propagation	3	0	0	3
3	EC-2203	Principle of Communication	3	0	0	3
4	EC-220A	Signal and System	3	0	0	3
5	EC-220X	OE2*	3	0	0	3
6	MH-2201	Entrepreneur Essential and Early-Stage Start-up	3	0	0	3
7	EC-2204	Analog Circuits Laboratory	0	0	2	1
8	EC-2205	Antenna and Wave Propagation Laboratory	0	0	2	1
9	EC-2206	Principle of Communication Laboratory	0	0	2	1
Contact Hours			18	0	6	
Total Credits						21
V[th] Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-3101	Introduction to Digital Integrated Circuits	3	0	0	3
2	EC-3102	Digital Communication	3	0	0	3
3	EC-3103	Digital Signal Processing	3	0	0	3

4	EC-310A	Microprocessor and Interfacing	3	0	0	3
5	EC-310X	OE3*	3	0	0	3
6	EC-3104	Internship-I	0	0	0	1
7	MH-3101	Engineering Economics	3	0	0	3
8	EC-3105	Minor Project-I	0	0	4	2
9	EC-3106	Introduction to Digital Integrated Circuits Laboratory	0	0	2	1
10	EC-3107	Digital Communication Laboratory	0	0	2	1
11	EC-3108	Digital Signal Processing Laboratory	0	0	2	1
12	EC-3109	Microprocessor and Interfacing Laboratory (Audit Pass)	0	0	2	0
Contact Hours			18	0	12	
Total Credits						24
VIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-3201	Introduction to Analog Integrated Circuits	3	0	0	3
2	EC-3202	Microwave Engineering	3	0	0	3
3	EE-3202	Linear Control Systems	3	0	0	3
4	EC-320A	Microcontrollers and Embedded Systems	3	0	0	3
5	EC-321A	Information Theory and Coding	3	0	0	3
6	EC-320X	OE4*	3	0	0	3
7	EC-3203	Minor Project-II	0	0	4	2
8	EC-3204	Introduction to Analog Integrated Circuits Laboratory	0	0	2	1
9	EC-3205	Microwave Engineering Laboratory	0	0	2	1
10	EC-3206	Microcontrollers and Embedded Systems Laboratory	0	0	2	1
Contact Hours			18	0	10	
Total Credits						23
VIIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	ME-4101	Product Design and Development	3	0	0	3
2	EC-410A EC-410B	Internet of Things Robotics and Automation	3	0	0	3
3	EC-411A	Wireless Communication	3	0	0	3
4	EC-412A EC-412B	Optical Communication Natural Language Processing	3	0	0	3
5	EC-410X	OE5*	3	0	0	3
6	EC-4102	Internship-II	0	0	0	1
7	EC-4103	Major Project-I	0	0	8	4
Contact Hours			15	0	6	
Total Credits						20
VIIIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-421A	Elective-IX (Swayam/ NPTEL)	3	0	0	3
2	EC-422A	Elective-X (Swayam/ NPTEL)	3	0	0	3
3	EC-4201	Major Project-II	0	0	22	11
Contact Hours			6	0	22	
Total Credits						17

* The students have to choose a subject offered by other department.

3.0 List of Department specific electives

DSE1	DSE2	DSE3	DSE4	DSE5	DSE6	DSE7	DSE8	DSE9	DSE10
EE-210A	EC-220A	EC-310A	EC-320A	EC-321A	EC-410A	EC-411A	EC-412A	EC-421A	EC-422A
					EC-410B		EC-412B		

- **Students are urged to register for the electives given under DSE9 and DSE10 using the SWAYAM/NPTEL, etc. portal.**

4.0 Open elective (offered by other departments)

- ❖ Students are free to choose any subjects of their interest offered as open electives by other department of the Institute.
- ❖ The total course has to be of 15 credits.
- ❖ During the beginning of the 3rd semester onwards, HoD, Electronics & Communication will notify the specific subject offered as an open elective for other departments.

Offered by ECE Dept. for other Departmental Students

Sl No	Course Code	Course Title	L	T	P	C
1	EC-210X	Semiconductor Devices	3	0	0	3
2	EC-220X	Principle of Communication	3	0	0	3
3	EC-310X	Microprocessor and Interfacing	3	0	0	3
4	EC-320X	Microcontrollers and Embedded Systems	3	0	0	3
5	EC-410X	Internet of Things / Robotics and Automation	3	0	0	3
Contact Hours			15	0	0	15
Total Credits						15

5.0 Internship

- ❖ Internship - I: Student will go for internship during summer vacation (after 4th semester) for a period of 4 weeks. The assessment will be done on 5th semester
- ❖ Internship - II: Student will go for internship during summer vacation (after 6th semester) for a period of 4 weeks. The assessment will be done on 7th semester
- ❖ At least one internship has to be done in Industry preferably during Internship - II.

6.0 Institute Vision

To transform into an acclaimed institution of higher learning with creation of an impact on the north eastern region in terms of innovation and entrepreneurship.

7.0 Institute Mission

1. To generate new knowledge through state-of-the-art academic program and research in multidisciplinary field.
2. To identify regional, Indian and global need to serve the society better.

3. To create an ambience to flourish new ideas, research and academic excellence to produce new leaders and innovators.
4. To collaborate with other academic, research institutes and industries for holistic growth of the students.
5. Utilization of available big resources to encourage entrepreneurship through formation of start-ups.

8.0 Department Vision

"To pursue excellence in education and research in Electronics and Communication Engineering"

9.0 Department Mission

The mission of the Department of Electronics and Communication Engineering are:

- To impart strong theoretical and experimental foundation in Electronics and Communication Engineering
- To educate students with state of art technologies to meet the growing challenges of industry as well as society
- To produce and disseminate theory, principles, practice and know – how of various fields of Electronics such as Communication, signal processing, VLSI, Nanotechnology and many more in tune with the needs and demands of changing times.

10.0 Programme Outcomes (POs)

The students who have undergone the B.Tech. programme in Electronics and Communication Engineering (ECE) will be able to:

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 analyse 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.

11.0 Program Educational Objectives (PEOs)

PEO1	Ensure practicing Electronics and Communication Engineers contribute to industry or academia in contemporary and multidisciplinary issues using appropriate EDA tools in a responsible, professional, social, economical and ethical manner including safety and environmental concerns.
PEO2	Engage innovation and creativity in product development by imparting knowledge, skills and engineering solutions.
PEO3	Encourage effective life-long learning approaches on new development of technologies by updating skills and knowledge to succeed in industry/higher education research.

12.0 Program Specific Outcomes (PSOs)

PSO1	Graduates will be able to achieve excellence in the fields of VLSI, Signal Processing and Communications related Engineering disciplines by acquiring the knowledge in basic science, mathematics, circuit design, signal processing to develop the technologically innovative systems.
PSO2	Graduates build their professional career by acquiring expertise on EDA tools, concepts and knowledge in emerging multidisciplinary fields with managerial, entrepreneurial skills to become team players, leaders, Technocrats and Entrepreneurs.
PSO3	Graduate will acquire adequate theoretical and practical knowledge of Electronics and Communication Engineering knowledge to comprehend, analyze, design and create innovative solutions for Research and Development, Industry and societal requirements.

Ist Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1101	Engineering Mathematics-I	2	0	0	2
2	BS-1102	Engineering Chemistry	2	0	0	2
3	BS-1103	Engineering Physics	2	0	0	2
4	BT-1101	Biology for Engineers	2	0	0	2
5	EC-1101	Fundamentals of Electrical Measurement and Equipment	3	0	0	3
6	MH-1101	Communication Skill	2	0	0	2
7	EE-1102	Basic of Electrical and Electronics Engineering	2	0	0	2
8	CS-1101	Coding Laboratory	0	0	4	2
9	EE-1103	Basic of Electrical and Electronics Engineering Laboratory	0	0	2	1
10	BS-1104	Basic Science Laboratory-I	0	0	2	1
11	ME-1102	Engineering Drawing	0	0	2	1
12	EC-1102	Fundamentals of Electrical Measurement and Equipment Laboratory	0	0	2	1
13	MH-1102	Language Laboratory	0	0	2	1
14	MH-1103	NSS/NCC/Yoga (Audit Pass)	0	0	0	0
Contact Hours			15	0	14	
Total Credits						22

Subject Code: BS-1101
Subject Name: Engineering Mathematics- I
Credit Point: 2 [L=2, T=0, P=0]

A. Course Objectives:

The course is designed to meet with the objectives of:

- providing high quality education in pure and applied mathematics in order to prepare students for graduate studies or professional careers in mathematical sciences and related fields,
- imparting theoretical knowledge and to develop computing skill to the students in the area of Science and Technology,
- providing teaching and learning to make the students competent to their calculating ability, logical ability and decision-making ability,
- giving students theoretical knowledge of Calculus, Algebra and the practical applications in the various fields of Science and Engineering,

B. Course Content:

Matrix Algebra: Basic concept of matrices & Determinant, Jacobi's theorem. Rank of a matrix, rank nullity theorem, Introduction to Vector space, Linear dependent and independent, System of homogeneous and non-homogeneous linear equations, Eigen values and Eigen vectors of a square matrix, Cayley-Hamilton theorem and its applications.

Differential Calculus: Higher order derivatives, Leibnitz's theorem and its application, Rolle's theorem and its application, Mean Value theorems–Lagrange & Cauchy and their application, Taylor's theorem and its application, Expansions of functions by Taylor's and Maclaurin's theorem. Partial Derivatives, Differential calculus for two variables.

Integral Calculus: Double and triple integrals and evaluation of area and volume, change of variables.

C. Text Books:

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, 2010, 11th edition.
2. Grewal B. S., Higher Engineering Mathematics, Khanna Publishers, 2014, 43rd edition.
3. Marsden J., Tromba A. J. and Weinstein A., Basic Multivariable Calculus, Springer, India, Private Ltd, 2009.

D. Reference Books:

1. Finney R. L. and Thomas G. B., Calculus and Analytical Geometry (Linear Algebra), Narosa Publishing House, 2021, 9th edition.
2. Hofmann K. M. and Kunze R., Linear Algebra, Prentice Hall, 2015, 2nd edition.
3. Bartle and Sherbart, Introduction to Real Analysis, Wiley, 2014, 4th edition.
4. Apostol T. M., Calculus, Vol I and II, John Wiley and Sons Ltd, 2007, 2nd edition.
5. Stewart J., Transcendental Calculus, Cengage; 2014, 2nd edition.
6. Mappa S. K., Higher Algebra, Shrat book House, 2014.
7. Mappa S. K., Real Analysis, Shrat book House, 2013, 7th edition.
8. Wylie C. R. and Barrett L. C., Advanced Engineering Mathematics, McGraw Hill, 1995.

E. Course Outcomes:

The outcomes of course are following:

1. Students will be more confident about their computing skill, logical skill and decision-making skill,
2. Students will find various applications of calculus and algebra in the practical fields of science and engineering,
3. Students will become more competent to analyze mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions,
4. Student will be able to explain the importance of mathematics and its techniques to solve real life problems and provide the limitations of such techniques and the validity of the results.

Subject Code: BS-1102
Subject Name: Engineering Chemistry
Credit Point: 2 [L=2, T=0, P=0]

A. Course Objectives:

- To enable the students to acquire knowledge about basic chemistry and its technology.
- To understand applicability of chemistry for engineering purposes.
- To make them apply the knowledge of chemistry for analysis, evaluation and design system components or processes related to chemistry.

B. Course Content:

Chemical thermo dynamics: first law, energy, enthalpy, Cp and Cv, second law, entropy, free energy, chemical kinetics: rate of elementary reactions, surface chemistry: surfactants and colloidal systems; electrochemistry: conductance, Kohlrausch's law, cell EMF.

Ligand, somerism, valence bond theory, valence shell electron pair repulsion theory, crystal field theory, molecular orbital theory, charge transfer transition, d-d transition, John-Teller effect, magnetic properties, bioinorganic chemistry.

Hybridization, inductive effect, resonance, hyper conjugation, carbocation, carbanion and free radicals, substitution and addition reactions, introduction to instrumental methods (IR, UV-vis, NMR and Mass-spectroscopy).

Polymers and materials: addition and condensation polymers, degree of polymerization, thermoplastic and thermosetting plastics, conducting polymers, nanomaterials and ceramics, nanocomposites, corrosion, explosive materials.

C. Text Books:

1. Morrison R. T., Boyd R. N. and Bhattacharjee S. K., Organic chemistry, Pearson education, New Delhi, 2010, 7th Ed.
2. Rakshit P.C., Physical chemistry, Sarat book distributors, Kolkata, 2004, 7th Ed.
3. Huheey J. E., Keiter E. A., Keiter R. L., Inorganic chemistry: principles of structure and reactivity, Pearson Education, New Delhi, 2009, 4th Ed.

D. Reference Books:

1. Ray B. C., Das S. N. and Biswas S., Engineering chemistry, New Central Book Agency, Kolkata, 2008.
2. Gowariker V. R, Viswanathan N. V and Sreedhar J., Polymer science, New Agency International, Kolkata, 2012.
3. Malik W. U., Tuli G. D. and Madan R. D., Selected topics in inorganic chemistry, S. Chand, New Delhi, 2012.
4. Ahluwalia V. K. and Parashar R. K., Organic reaction mechanisms, Narosa publishing house, Kolkata, 2013, 4th Ed.

E. Course Outcomes:

After studying this course, students will be able to

1. Acquire basic knowledge in engineering chemistry.
2. Apply their knowledge for various technological and engineering issues.
3. Select appropriate analysis, evaluation and methods for interpret the concern results.

Subject Code: BS-1103
Subject Name: Engineering Physics
Credit Point: 2[L=2, T=0, P=0]

A. Course Objectives:

The course is designed to meet with the objectives of:

- imparting theoretical & practical knowledge to the students in the area of engineering physics.
- providing teaching and learning to make students acquainting with modern state-of-art of Engineering.
- injecting the future scope and the research direction in the field of Physics with specific specialization.
- making students competent to design & development of Engineering Physics.

B. Course Content:

Electricity and Magnetism:

Coulombs law in vector form, Electric field, Gauss's law (differential and integral form), Electric potential and energy, multipole expansion of electric potential, Boundary value problem (Poisson's Eqn. and Laplace's Eqn.). Dielectric, Polarization and Bound charges, Biot-Savart's law, Ampere's law (differential and integral form), Faraday's law of electromagnetic induction, Lenz's Law, Self and mutual Inductance, Maxwell's field equation in vacuum and matter. Wave solution of Electromagnetic waves.

Modern Physics and Quantum Mechanics:

Photo electric effect, Compton effect, Blackbody radiation (no derivations), Wave particle duality, two slit experiments, de-Broglie's hypothesis, Heisenberg's uncertainty principle, concept of wave function and wave packet, phase velocity and group velocity, Formulation of quantum mechanics and basic postulates, physical interpretation of wave function, Schrodinger's wave equation, Steady state of Schrodinger's wave equation, One dimensional quantum problems: Free particle, particle in a box, particle in a step potential, harmonic oscillator.

C. Text Books:

1. Griffiths J. D, "Introduction to Electrodynamics," Pearson Education India Learning Private Limited, 2015, 4th edition.
2. Griffiths J. D, "Introduction to Quantum Mechanics," Pearson Education, 2015, 2nd edition.
3. Beise, A., Mahajan, S. and Choudhury S. R., "Concepts of Modern Physics," McGraw-Hill Education, 2017, 7th edition.

D. Reference Books:

1. Krane K., "Modern Physics", Wiley, 2016.
2. Jackson, J. D. "Classical Electrodynamics", Wiley, 1998, 3rd edition.
3. Feynman R. P., Leighton R. B. and Matthew S., "The Feynman Lectures on Physics Vol. 1 to Vol. 3" The New Millennium Edition, 2012.

E. Course Outcomes:

Students successfully completing this module will be able to:

1. demonstrate competency and understanding of the basic concepts found in physics.
2. utilize the scientific method for formal investigation and to demonstrate competency with experimental methods that are used to discover and verify the concepts related to content knowledge.
3. engineering applications capability to understand advanced topics in engineering. apply quantum mechanics to engineering phenomena
4. identify formula and solve engineering problems.

Subject Code: BT-1101
Subject Name: ESA1-Biology for Engineers
Credit Point: 2 (L=2, T=0, P=0)

A. Course Objectives:

- imparting knowledge on the origin of Earth and life forms on Earth, appreciating importance of biological diversity and understanding biomolecules being the main component of life.
- understanding "Cell" – the basic UNIT in different life forms, and structure and function of different organelles in living organisms
- imparting knowledge on nutrient uptake and assimilation, and metabolism in living organisms, providing knowledge on Bioenergetics of living cells, different organelles involved in electron transport systems, nervous, digestive and immune systems in animals.
- imparting knowledge on immunity of the body and various advanced applications derived out of the natural systems
- imparting knowledge on DNA as a genetic material and various advanced technology derived out of it for variety of applications
- imparting knowledge on interference of biological systems in various machines, structures, process and instrumentation
- motivating young minds to utilise their interdisciplinary knowledge to become a thinker in innovation of effective ideas for solving problems related to biological systems

B. Course Content:

Origin of Life: theories of origin of life, Classification of various forms of life (virus, bacteria, fungi, plantae, Animalia)
Nutrients and Bioenergetics: Essential nutrients (carbohydrates proteins, lipids, nucleic acids, minerals, vitamins), Bioenergetics; basics of aerobic and anaerobic glycolysis and citric acid cycle.
Cell: Cell concept, prokaryotic and eukaryotic cell, cell organelles and their functions, Cell division: Mitosis and meiosis, Cancer biology
Immunology: Immune systems and cell types, applications of immunology: biosensors, nanoparticles.
Genes and Chromosomes: Principles of inheritance, Mendelian Genetics, Discovery of DNA as genetic material, DNA mutation and effects, Genetic engineering/Cloning and its applications

C. Text Books:

1. Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; HiddePloegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon. Molecular Cell Biology (Ninth Edition). W. H. Freeman, 2020
2. J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, 8th Ed, W. H. Freeman & Co, 2015.
3. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 7th Ed, Macmillan Worth, 2017.
4. N.A. Campbell, J.B. Reece, "Biology" Person Education, Inc& Dorling Kinderley Publishing, Inc, 2015
5. wen, Judith A., Jenni Punt, and Sharon A. Stranford. Kuby immunology. New York, NY, USA:: WH Freeman, 2013.
6. Niemeyer, Christof M., and Chad A. Mirkin, eds. Nanobiotechnology: concepts, applications and perspectives. Vol. 1. John Wiley & Sons, 2004.

D. Reference Books:

1. Nruno Antonny, Catherine Rabouille. Cell Organlles, Current Opinion in Cell Biology, Elsevier, 2017
2. Joel B. Hagen. Five Kingdoms, More or Less: Robert Whittaker and the Broad Classification of Organisms, BioScience, Oxford Academic, 2012
3. Pascal Maguin, Luciano A. Marraffini, From the discovery of DNA to current tools for DNA editing, JEM, 2021

E. Course Outcomes:

1. Students will understand the characteristics of living organisms; appreciate the importance of diversity of life and their interaction with the environment.
2. Students will be able to explain the interrelationship between biomolecules and the living system, and influences of biomolecules upon the structure and function of intracellular components.
3. Students will have a broad knowledge on Bioenergetics of living cells; and a brief on important biological systems of animal.
4. Students will learn different functions of cell organelles, cell types and various positive and negative functional implications, development of new tools and kits from the knowledge of natural system.
5. Students will learn the basis of inheritance and introduction to technological aspects and varied applications and advanced tools to tackle medical complications
6. Students will learn the interference of biological systems in various machines, structures, process and instrumentation
7. Students will develop keen interest in applying basic engineering skills to solving problems related to biological systems through their concepts in biology

Subject Code: EC-1101
Subject Name: Fundamentals of Electrical Measurement and Equipment
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- Understand the calculations of electrical circuits / networks.
- Work with electrical circuits in cascaded form and implementation in real world.

B. Course Content

Errors in Measurements: Limiting Errors, Relative Limiting Errors; Static and Dynamic Errors; Types of Errors: Gross Errors. Systematic Errors, Instrumental Errors. Environmental Errors, Observational Errors, Random Errors.

Statistical Treatment of Data: Histogram, Arithmetic Mean, Measure of Dispersion from the Mean, Range, Deviation, Average Deviation, Standard Deviation, Variance.

Basic Measurement Techniques: Analog Ammeters, Voltmeters and Ohmmeters: Moving coil, Moving Iron, Dynamometer, Wattmeter, Electrostatic Instruments

AC/DC Bridges: Wheatstone Bridge, Kelvin Bridge, Wein Bridge, Anderson Bridge and Scherring bridge for Measurement of inductance, capacitance, resistance and frequency

Oscilloscope: Construction and principle of operation, Sweep and sweep synchronization, Measurement of various parameters by CRO, High frequency and low frequency limitations, sampling and digital storage oscilloscopes

Displacement Measurement: Resistive, inductive and capacitive type LVDT and RVDT

Pressure measurement: Bourden Tube, Liquid field, Manometer for use of pressure measurement, Low pressure measurements.

Flow Measurement: Pitot tube, Orifice plate, Venturi tube; Rotameter, Turbine type flow meter, Electromagnetic flow meter, Doppler flow meter.

Temperature measurement: Temperature scale, change in dimensions-bimetals, liquid-in-glass thermometers, Filled system thermometers, RTD, Thermistor, Thermocouple.

C. Text Books

1. E. O. Deobelin, Measurement Systems - Application and Design. Tata McGraw-Hill, 2003.
2. M. M. S. Anand, Electronic Instruments and Instrumentation Technology. Prentice-Hall of India, 2009.
3. D. A. Bell, Electronic Instrumentation and Measurements. Oxford University Press India, 2013.

D. Reference Books

1. R. P. Areny and T. G. Webster, Sensors and Signal Conditioning, Wiley-Interscience, 2012.
2. R. A. Witte, Electronic Test Instruments, Pearson Education, 2011.
3. C. F. Coombs, Electronic Instruments Handbook, McGraw-Hill, 2000.
4. B. G. Liptak, Instrument Engineers' Handbook: Process Measurement and Analysis, CRC Press, 2012

E. Course Outcomes

1. At the end of the course, a student will be able to:
2. Clear understanding & utilization of major test instruments.
3. Design and develop different instruments.
4. Measure their performances to apply in particular systems.
5. Know about different Transducers and actuators.
6. Understand the measurement techniques of various parameters by DSO.

Subject Code: MH-1101
Subject Name: Communication skills
Credit Point: 2 (L=2, T=0, P=0)

A. Course Objectives:

The course is designed to meet the following objectives:

- To increase the student's ability to improve and utilize the skills necessary to be competent communicator.
- To enhance the students' linguistic understanding of his or her own communication behaviour.
- To improve the students' communication skills in both social and professional contexts.
- To enhance language proficiency and thereby the employability of budding engineers and technologists.

B. Course Content:

Fundamentals of Communication-Concept and Meaning, Process of Communication, Communication Channels, Importance of Communication, Role of Cross-cultural Communication, Communication Cycle, Objectives and Barriers of Communication(linguistic and semantic, psychological, physical, mechanical, cultural), Importance of Audience and Purpose, Types of Communication, Styles of Communication, Verbal and Nonverbal Communication, Comparing General Communication and Technical Communication, Role of Communication in Technology, Persuasive Skills, Negotiation Skills, Language Skills (listening, speaking, reading, writing),Listening-Types of Listening, Writing-Writing Formal Letters, Résumés, Reports, User Manuals, Emails and Blogs, Essentials of Grammar- Sentence Formation, Common Errors and Misappropriations, Note Making, Oral and Poster Presentation Skills, Interview Skills and Etiquette, Language Usage in Social Media.

C. Text Books:

1. Salaria, R.S. and Kul Bhushun Kumar, Effective Communication Skills, Khanna Publishing, 2022.
2. Edwards, Vanessa Van. Cues: Master the Secret Language of Charismatic Communication, Penguin, 2022.
3. Kumar, Sanjay and Pushp Lata, Communication Skills: Workbook, Oxford University Press (OUP), 2018.
4. Mitra, Barun K. Personality Development and Soft Skills, Oxford University Press(OUP), 2016.

D. Reference Books:

1. Kumar, Sanjay and Pushpa Lata, English Language and Communication Skills for Engineers (as per AICTE Syllabus), Oxford University Press (OUP), 2018.
2. Raman, Meenakshi and Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press (OUP), 2017.
3. Quirk, Randolph, Sidney Greenbaum, Geoffrey Leech, Jan Svartvik. A Comprehensive Grammar of the English Language, Pearson Education India, 2010.

E. Course Outcomes:

By the end of this course, you will be able to:

1. Display competence in oral, written, and visual communication.
2. Apply communication theories in various speech acts.
3. Practice the effective way of communication with good personality traits and etiquette.
4. Understand the process of communication and its effect on giving and receiving information.

Subject Code: EE-1102
Subject Name: Basic of Electrical and Electronics Engineering
Credit Point: 3 (L=3, T=0, P=0)

A. Course Objectives:

- To understand the structure and properties of different type of electrical circuits, networks and sources.
- To apply different mathematical tools & techniques for analysing electrical networks.
- To apply circuit analysis techniques to simplify electrical networks.
- To solve problems of electrical circuits.

B. Course Content:

Network Theorems: Formulation of network equations, Source transformation, Loop variable analysis, Node variable analysis. Superposition, Thevenin's, Norton's & Maximum power transfer theorem and its application in three phase unbalanced circuit analysis. Solution of Problems with DC & AC sources.

Coupled circuits: Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modelling of coupled circuits, Solution of problems.

AC Fundamentals: RMS Values, Average Values, Peak Factor, Crest Factor, Resonance. Power in purely resistive, inductive, capacitive, RL, RC and RLC Circuits.

Number Systems: Decimal, Binary, Octal, Hexadecimal systems, conversion of a number from one base to another, complements of number systems and its addition and subtraction, Introduction to logic gates.

Boolean Algebra: Theorems and operations, Boolean expressions and truth tables, Duality and inversion, multiplying out and factoring expressions, Exclusive-OR and equivalence operations, Positive and negative logic.

C. Text Books:

1. Theraja B. L., Theraja A.K., A Textbook of Electrical Technology Vol 1, Shree Hari Publications, 2021.
2. Morris Mano M., Digital Logic and Computer Design, Pearson Education India, First Edition, 2016.

D. Reference Books:

1. Kumar Anand, Fundamentals of Digital Circuits, Prentice Hall, 3rd Edition, 2014.
2. Salivahanan.S., Pravin Kumar.S., Digital Electronics, Vikas Publishing House, 2011.

E. Course Outcomes:

After completion of this course, the learners will be able to

1. describe different type of networks, sources and signals with examples.
2. explain different network theorems, coupled circuit and tools for solution of networks.
3. apply network theorems and different tools to solve network problems.
4. select suitable techniques of network analysis for efficient solution.
5. estimate parameters of two-port networks.
6. design filter circuits.

Subject Code: CS-1102
Subject Name: Coding Laboratory
Credit Point: 2 (L=0, T=0, P=4)

A. Course Objectives:

- The student will gain a thorough understanding of the fundamentals of C programming.
- A student can code, compile and test C programs.
- Could take Systems programming or Advanced C programming course.
- Although this course does not deal with object-oriented programming methodology, it will assist the student build the required foundations to undertake a course in OOP.

B. Course Content:

Introduction: The von Neumann architecture, machine language, assembly language, high level programming languages, compiler, interpreter, loader, linker, text editors, operating systems, flowchart.

C Fundamentals: Introduction to C, Data types, Constants and variable declaration, Scope, Storage classes, Data input and output functions, Sample programs.

Operators & Expressions: Arithmetic, Relational, Logical, Bitwise operators, Conditional, Assignment, Library functions.

Decision making: Simple If statement, if-else statement, nested if else statement, Switch statement, nested switch, the operator, goto statement.

Decision making & branching: while statement, do-while statement, for statement.

Array: Declaration, Initialization and processing One-dimension array, Two-dimension array and multi dimension array and their operations.

String & pointer: String: Operation on String without using library function and using library function. Pointer: Declaration of pointer variables, accessing the variable by using pointer, pointer increment and decrement operator, pointer and array

Functions: Basic functions, function type, function with no argument & no return value, function with no argument but return value, function with argument & return value, Storage class identifier, Call by reference, Recursive function. Pointer to function.

Structure & Union: Defining a structure, accessing of structure variable, structure and array, array within structure. Nested structure, structure & functions, Pointer & structure, Unions, Enum.

File management system: Advantage of using file, Open, close, read, write in the files, Operation on files.

Dynamic memory Allocation: use of malloc, calloc, realloc, free. Library functions, Implementation of Linked list and their various operations.

The pre-processor: macro statements.

C. Text Books:

1. Kerninghan and Ritchie, The 'C' programming language, 2nd Edition, Pearson, 2008.
2. Yashavant P. Kanetkar, Let Us C: Authentic guide to C programming language, 15th edition, BPB, 2021.
3. Balaguruswamy, Programming In ANSI C, 8th Edition, Tata McGraw-Hill Education, 2019

D. Reference Books:

1. Zed A. Shaw, Learn C the Hard Way: Practical Exercises on Computational Subjects You Keep Avoiding (Like C), 2015.
2. Deepali Srivastava and S.K Srivastava, C in Depth, BPB Publication, 2017.
3. Griffiths David and Dawn Griffiths, Head First C, A Brain Friendly Guide, 2012.
4. Grey Perry and Dean Miller, C Programming Absolute Beginner's Guide, 3rd Edition, 2013.

E. Course Outcomes:

1. Understand the basic terminology used in computer programming.
2. Write, compile and debug programs in C language in different operating systems.

3. Design programs involving decision structures, loops and functions.
4. Use and apply the dynamics of memory by the use of pointers in engineering applications.
5. Use and apply the differences between structure oriented and function-oriented programming in programming applications.

Subject Code: EE-1103
Subject Name: Basic of Electrical and Electronics Engineering Laboratory
Credit Point: 1 (L=0, T=0, P=2)

A. Course Objectives:

- To understand the structure and properties of different type of electrical circuits, networks and sources.
- To apply different mathematical tools & techniques for analysing electrical networks.
- To apply circuit analysis techniques to simplify electrical networks.
- To solve problems of electrical circuits.

B. List of Practical:

1. V-I Characteristics of Carbon and Tungsten filament lamp.
2. V-I Characteristics of Fluorescence Lamp.
3. V-I Characteristics of RLC Series Circuit.
4. V-I Characteristics of RLC Parallel Circuit.
5. Verification of truth tables of different logic and universal gates.
6. Implementation of logic gates with the help of universal gates.

C. Course Outcomes:

After completion of this course, the learners will be able to

1. describe different type of networks, sources and signals with examples.
2. explain different network theorems, coupled circuit and tools for solution of networks.
3. apply network theorems and different tools to solve network problems.
4. select suitable techniques of network analysis for efficient solution.
5. estimate parameters of two-port networks.
6. design of filter circuits.

Subject Code: BS-1104
Subject Name: Engineering Physics Lab
Credit Point: 1 [L=0, T=0, P=2]

A. Course Objectives:

The course is designed to meet with the objectives of:

- imparting practical knowledge to the students in the area of engineering physics.
- student will have exposure to various experimental skills which is very essential for an engineering student.
- to gain practical knowledge by applying the experimental methods to correlate with the physics theory.
- to learn the usage of various areas of physics like electricity and magnetism systems for various measurements.

B. List of Experiments:

1. Determination of Planck's constant using photocell.
2. Verification of Stefan's radiation law.
3. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
4. Verification of Biot-Savart's law.
5. Charging and discharging of capacitor using RC circuit
6. Hall Effect.
7. To determine e/m ratio

C. Reference Books:

1. Arora C. L., "Practical Physics", S. Chand Publications, 2010.
2. Squires G. L., "Practical Physics", Cambridge University Press, 2014.

D. Course Outcomes:

Students successfully completing this module will be able to:

1. apply the various procedures and techniques for the experiments.
2. develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
3. understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.

Subject Code: ME-1102
Subject Name: Engineering Drawing
Credit Value: 1 [L = 0, T = 0, P = 2]

A. Course Objectives:

The course is design to meet with the following objectives:

- Increase ability to understand Engineering Drawing.
- Learn to sketch and take field dimensions.
- Learn to take data and transform it into graphic drawings.
- Learn basic Auto Cad skills.
- Learn basic engineering drawing formats.
- Prepare the student for future Engineering positions.

B. Course Content:

Indian standards: Sheet layout, type of lines and their representations, scales.

Principles of orthographic projection (multi view drawing): 1st and 3rd angle projection.

Projections: Points, lines, surfaces and solids.

Projection of sections and intersections of solids: Isometric projection.

Use of drafting software

C. Reference Books:

1. Dhananjay, A. J., "Engineering Drawing", 1st Ed., 2017, TMH.
2. Bhatt, N.D. and Panchal, V.M., "Engineering Drawing", 43rd ed., 2014, Charotar Publishing House Pvt.Ltd.
3. Venugopal, K. and Prabhu,V. R., "Engineering Graphics", 15th Ed., 2018, New Age International Pvt. Ltd.

D. Course Outcomes:

Upon completion of the subject student's ability to:

1. Understand orthographic projections and sections.
2. Basic understanding of Indian standards of Engineering drawing.
3. Develop engineering drawings by projection techniques.
4. Utilise AutoCAD towards developments of drawings.

Subject Code: EC-1102
Subject Name: Fundamentals of Electronic Measurement and Equipment Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The Objective of the course is:

- To study different test instruments and get familiarize with those instruments.
- To be familiar with calibration of measuring instruments such as ammeter, voltmeter, energy meter
- To know the measurement techniques of different parameters using electronic instruments
- To know the statistical analysis of errors in measurement using computer simulation

B. List of Experiments

1. Instrument workshop – observe the construction of PMMC, Dynamometer, Electro thermal and Rectifier type instrument, Oscilloscope and digital multimeter.
2. To calibrate moving iron and electrodynamometer type ammeter/voltmeter by potentiometer
3. To calibrate dynamometer type wattmeter by potentiometer
4. Study of voltage shunt and series ammeter behavior.
5. To calibrate A. C. energy meter
6. Measure the resistivity of material using Kelvin double bridge
7. Measurement technique of power using instrument transformer
8. Measurement technique of in polyphase circuits
9. Measurement technique of frequency by Wien bridge using oscilloscope
10. Measurement technique of by Anderson bridge
11. Measurement technique of capacitance by De Sauty bridge
12. To study of static characteristic (accuracy, precision, hysteresis, repeatability, linearity) of a measuring instrument.
13. To study of dynamic characteristic (fidelity, speed of response)
14. To acquaintance with basic structure of DMM and measurement of different electrical parameters.
15. To statistical analysis of errors in measurement using computer simulation
16. To study of advanced A/D converter along with its associate circuitry
17. To study of advanced D/A converter
18. Realization of data acquisition system
19. Wave and spectrum analysis using digital storage oscilloscope & spectrum analyzer.

C. Text books

1. E.O. Doebelin; Measurement Systems, Application and Design; McGraw Hill International Edition, Singapore, 2008.
2. J.P. Bentley, Principles of Measurement Systems (3/e), Pearson Education

D. Reference books

1. A.K. Ghosh, Introduction to Measurement and Instrumentation (3/e), PHI Learning, New Delhi, 2009.
2. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai Co.

E. Course Outcomes

After the completion of this course, students will

1. Know calibration of different measurement instruments
2. Know the techniques of measurement
3. Be able to perform statistical analysis of errors in measurement using computer simulation

Subject Code: MH-1102
Subject Name: Language Laboratory
Credit Point:1 (L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet the following objectives:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking and interviews

B. Course Content:

Basics of Phonetics, Speech Sounds – Vowels and Consonants, Word Stress and Rhythm, Accent, Intonation, Phonetics Drills, Developing Effective Listening Skills- Listening Comprehension Drills, Speaking - Conversations, Dialogues, and Debates, Role Play, Situational Dialogues, Expressions in Various Situations, Making Requests and Seeking Permissions, Formal Presentations. Telephone Etiquette, Building Advanced Vocabulary and English Grammar Exercises.

C. Text Books:

1. Words Worth English Language Software
2. Kumar, Rajesh, English Language Communication Skills: Lab Manual Cum Workbook with CD, Cengage Learning India, 2014

D. Reference Books:

1. Jones, Daniel. English Pronouncing Dictionary, Cambridge University Press, 2011.
2. Bansal, R. K. & J. B. Harrison. Spoken English with CD, Orient Blackswan, 2013.

E. Course Outcomes:

By the end of this course, you will be able to:

1. Understand of nuances of English language through audio - visual experience and group activities.
2. Reach the neutral intelligibility.
3. Attain the clarity and confidence to enhance their employability skills.
4. Express themselves fluently and appropriately in social and professional contexts.

II[nd] Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1201	Engineering Mathematics-II	2	0	0	2
2	CS-1201	Programming and Data Structure	3	0	0	3
3	EC-1201	Introduction to Digital Engineering	2	0	0	2
4	MH-1201	Introduction to Innovation and Creativity	2	0	0	2
5	ME-1201	Engineering Mechanics	3	0	0	3
6	BS-1203	Introduction to Semiconductor Physics	3	0	0	3
7	EC-1202	System Design	2	0	0	2
8	ME-1204	Workshop Practice-I	0	0	2	1
9	EC-1203	Do It Yourself (DIY)/Industry Exposure	0	0	0	1
10	BS-1202	Basic Science Laboratory-II	0	0	2	1
11	CS-1202	Programming and Data Structure Laboratory	0	0	2	1
12	MH-1202	Gandhian Technology	0	0	2	1
Contact Hours			17	0	8	
Total Credits						22

Subject Code: BS-1201
Subject Name: Engineering Mathematics- II
Credit Point: 2 [L=2, T=0, P=0]

A. Course objectives:

The course is designed to meet the following objectives:

- imparting theoretical knowledge to the students about three and more dimensional objects in space and to improve their capability of visualizing of objects in space.
- Making student competent enough to construct a differential equation/mathematical modeling for every real-life situation with its solution.
- Giving students theoretical knowledge of vectors with the flavor of Calculus.
- Introduce the concepts of Laplace and Fourier transforms and its application to the solution of differential equations (ODE &PDE) to the students.

B. Course Content:

Vector Calculus: Basics of vector calculus, Line integral, Surface integral and Volume integral, Path independence, Fundamental theorem of Calculus, Green's, Gauss' and Stokes' theorems (without proofs) and their simple applications.

Ordinary Differential Equations: First order ODEs, Higher order linear differential equation with constant coefficients, Euler's homogeneous equation, Series solutions of linear differential equations with variable coefficients (Ordinary point).

Partial Differential Equations: Basic of PDEs (order, degree, Linear, Non-Linear, homogeneous, non-homogeneous), Classification of 2nd Order PDEs; boundary and initial value problems (Dirichlet and Neumann type) involving wave equation, D'Alembert method, heat conduction equation, Laplace's equations and solutions by method of separation of variables (Cartesian coordinates).

C. Text Books:

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, 2010, 11thedition.
2. Ross S. L., Ordinary Differential Equation, Wiley and Sons Ltd., 2010, 3rd edition.
3. Farlow S. J., Partial Differential Equation for Scientists and Engineers, Dover Publications, 1993, 1st edition.

D. Reference Books:

1. Boyce and Diprima R. C., Elementary Differential Equations and Boundary value Problems, Wiley publications, 2009, 9th edition.
2. Sneddon I. N., Elements of Partial Differential Equations, Dover Publications Inc., 2013, 2ndedition.
3. Jeffrey A., Advanced Engineering Mathematics, Academic Press, 2001, 1stedition.
4. Coddington E., and Levinson N., Introduction to Ordinary Differential Equations McGraw Hill Education, 2017, 1st edition.

E. Course Outcomes:

Upon completion of the subject:

1. Students will have strong visualizing capability in their mind about any object.
2. Students are so trained that they will recognize various real-life situation/problem and able to solve them by constructing a differential equation/ mathematical model.
3. Students will be able to find the Laplace representation as transforms of functions of one/two variable.

Subject Code: CS-1201
Subject Name: Programming and Data Structure
Credit Point: 3 (L=3, T=0, P=0)

A. Course Objectives:

- Designing principles of algorithms and data structures
- Learning efficiency and scaling of algorithms
- Learning essential algorithms in computing
- Understanding generic data structures for common problems

B. Course Content:

Performance of algorithms: Basic concepts, Mathematical Background, Complexity Analysis, space and time complexity, asymptotic notations, Types of Date Structure.

Linear Data Structures: Arrays: one dimensional, multi-dimensional, Sparse Matrix, Elementary Operations

Stacks: Representation, elementary operations and applications such as infix to postfix, postfix evaluation, parenthesis matching

Queues: Simple queue, circular queue, de-queue, elementary operations and applications.

Linked lists: Linear, circular and doubly linked lists, elementary operations and applications such as polynomial manipulation

Non-Linear Data Structures: Trees: Binary tree representation, tree traversal, complete binary tree, heap, binary search tree, height balanced trees like AVL tree and 2-3 tree, tries, red-black tree, B-tree, B+ tree, m-way Search tree, other operations and applications of trees

Graphs: representation, Adjacency list, graph traversal, path matrix, connected components, topological sort, Spanning tree, BFS, DFS.

Sorting and Searching:

Sorting: Selection sort, bubble sort, quick sort, merge sort, heap sort, insertion sort, selection sort, radix sort.

Searching: linear and binary search,

Hashing: hash tables, hash functions, and open addressing

File structures: Introduction, data file types, file organization, file access methods.

C. Text Books:

1. Lipschutz S., Data Structure, McGraw Hill Education, 2014.
2. Deshpande P.S., Kakde O.G., C & Data Structures, Charles River Media, 2004.
3. Balagurusamy E., Data Structures Using C, McGraw Hill Education, 2017.
4. Srivastava S.K., Srivastava D., Data Structures Through C In Depth, BPB Publications, 2004.

D. Reference Books:

1. Drozdek A., Data Structures and Algorithms in C++, Cengage Learning, 2012.
2. Radhakrishnan M., Srinivasan V., Data Structures Using C, BPB Publications, 2008.
3. Gupta P., Aggarwal V., Varshney M., Data Structure Using C, Laxmi Publications, 2011.
4. Aho A.V., Hopperoft J.E., UIlman J.D., Data Structures and Algorithms, Pearson, 1998.
5. Tanenbaum A.M., Data Structures using C, Pearson Education, 2009.
6. Agarwal A., Data structure Through C, Cyber Tech Publications, 2005.
7. Bandyopadhyay S.K., Data Structures Using C, Pearson Education India, 2009.
8. Thareja R., Data Structures Using C, Oxford University Press, 2011.

E. Course Outcomes:

After successfully completion of this module students will be able to:

1. Assess performance efficiency of sequential algorithms.
2. Design data structures to enable algorithms and design sequential algorithms for performance.

3. Implement designing algorithms and corresponding data structures using object-oriented programming languages.
4. Demonstrate deployment of essential data structures such as lists, stacks, queues, and trees.

Subject Code: EC-1201
Subject Name: Introduction to Digital Engineering
Credit Value: 2 (L = 2, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- Understand different digital technology used in everyday life.
- Work with electrical circuits in cascaded form and implementation in real world.

B. Course Content

Introduction- What is *digital* (analog vs. digital)? What is *technology*? History of Computing/Internet
Hardware – from electricity to hardware to software
Binary Arithmetic- Boolean Logic
Computer Architecture- Quantum computing
IoT - Introduction to principles and uses- BIG DATA - Introduction to principles and uses
VR/AR - Introduction to principles and uses
AI - Introduction to principles and uses
Blockchain - Introduction to principles and uses
Databases and mySQL queries
Networking Protocols
Introduction to Data Analytics, Machine Learning, Security, Quantum Technology and Cyber Physical System (CPS)
Careers in Digital Technologies
Ethics and the Future of Computing
Model based analysis; Data driven analysis

C. Text Books

1. B. Marr, "Tech Trends in Practice: The 25 Technologies that are Driving the 4th Industrial Revolution", Wiley, 2020.

D. Reference Books

1. A. Goel, "Computer Fundamentals", Pearson, 2010.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Understand basic fundamentals of different digital techniques
2. Understand the fundamentals of AI, Blockchain and its use
3. Understand different network protocols.

Subject Code: MH-1201
Subject Name: Introduction to Innovation and Creativity (3-0-0-3)
Credit Point: 3 (L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet the objectives of:

- To involve themselves in the innovation and creative activities
- Starting innovative practices in their entrepreneurial activities.
- Developing their skills on the traits that they want to carry forward.
- Starting activities based on the search of new ideas.

B. Course Content:

Introduction to innovation and creativity, opportunity identification: the search for new idea, entrepreneurial imagination and creativity, The role of creative thinking, Components of creativity, Indication of creativity, Developing your creativity, the creative thinking process, Two approaches to creative problem-solving, the most common idea killers, Arenas in which people are creative, the creative climate, Innovation and entrepreneur, the innovation process, types of innovation, Proof of Concept(PoC), product development, the major misconceptions of innovation, principles of innovation, Methods to initiate ventures, creating new ventures: new-new approach & new-old approach, ways to develop personal creativity: recognise relationships, develop a functional perspective, use your brains, and eliminate muddling mind –sets, design thinking, design innovation, technological innovation and designing entrepreneurship, creative design. Case study on startup/unicon

C. Text Books:

1. Donald F. Kuratko, Entrepreneurship: Theory, Process, Practice Cengage Learning 2017
2. Cynthia, L. Greene, Entrepreneurship Ideas in Action. Thomson Asia Pvt. Ltd., Singapore. 2004

D. Reference Books:

1. Barringer Entrepreneurship: Successfully Launching New Ventures, Pearson Education Publishing 2015
2. Timmons, Jerry A., and Spinelli, Stephen, 2009. New Venture Creation: Entrepreneurship for the 21st Century, 8th Edition, Boston, MA: IrwinMcGraw-Hill
3. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001

E. Programme Outcomes:

1. Start their venture more scientifically.
2. Start their venture by linking with the all the stakeholders.
3. Enable to identify various opportunity mapping
4. Explore many possibilities of generating new idea leading to enterprise.

Subject Code: ME-1201
Subject Name: Engineering Mechanics
Credit Point:3 (L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet with the following objectives:

- Ability to utilise scalar and vector analytical techniques for analysing forces in statically determinate structures.
- Ability to apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
- Student gets a basic idea of Centre of gravity, moment of inertia, mass moment of inertia, friction.

B. B. Course Content:

Forces and Moments: Force, moment and couple, wrench, equivalent force and moment, forces in space equilibrium, FBD, general equations of equilibrium-Lami's theorem, analysis of forces in truss and frames, brief introduction to vector approach.

Friction: Introduction to dry friction, laws of friction, friction of simple machines, inclined planes, screw jacks, clutch, and collar pivot bearing (uniform wear and uniform pressure assumptions).

Centre of gravity and moment of inertia: Centre of gravity, volume and composite bodies, area moment of inertia and mass moment of inertia for plane figures and bodies.

Virtual work and energy method: Virtual displacement; principle of virtual work; applications of virtual work principle to machines.

Kinematics of particle: Introduction, rectilinear motion, plane curvilinear motion, rectangular coordinates (x-y), normal and tangential coordinates (r-θ).

Kinetics of particle: Review of force, mass, acceleration, work and energy, impulse, momentum, linear impulse and linear momentum, angular impulse and angular momentum, impact, central-force and motion, and relative motion,

Kinetics of system of particles: Introduction, generalized Newton's second law, work-energy, impulse-momentum, conservation of energy and momentum, steady mass flow, variable mass.

Plane kinematics of rigid bodies: Introduction, rotation, absolute motion, relative velocity, instantaneous center of zero velocity, relative acceleration, motion relative to rotating axes.

Plane kinetics of rigid bodies: Introduction, general equation of motion, translation, fixed axis rotation, general plane motion, work energy relations, acceleration from work-energy, virtual work, impulse-momentum equation.

C. C. Text Books:

1. Timoshenko S. and Young D.H., "Engineering Mechanics", 5th Ed., 2017, MGH.
2. Beer and Johnston, "Vector Mechanics for Engineers: Statics and Dynamics", 10th Ed., 2012, TMGH.

D. D. Reference Books:

1. Meriam, J. L. and Kraige, L. G., "Engineering Mechanics, Volume 1: Statics", 8th Ed., 2017, Wiley.

2. Meriam, J. L. and Kraige, L. G., “Engineering Mechanics, Volume 2: Dynamics”, 5th Ed., 2006, Wiley.
3. Shames, I. H. and Rao,G. K., “Engineering Mechanics: Statics and Dynamics’”, 4thEd., 2006, Pearson.
4. Nelson A., “Engineering Mechanics: Statics and Dynamics”, 1st Ed., 2017, TMGH.

E. Course Outcomes:

Upon completion of the subject, students should have the knowledge of:

1. Basic understanding of different type of forces, moments and resolving them.
2. Evaluation of centre of gravity, moment of inertia and mass moment of inertia for various figures & bodies.
3. Apply principles of kinematics, kinetics and effects of friction for solving problems.

Subject Code: BS-1203
Subject Name: Introduction to Semiconductor Physics
Credit Point: 3 [L=3, T=0, P=0]

A. Course Objectives:

The course is designed to meet with the objectives of:

- imparting the basic understanding of crystal structure.
- Providing the concept of energy band gaps of solids
- Imparting the basic understanding of theory of semiconductor Physics.

B. Course Content:

Crystal Structure of Solids:

Types of Solids, Lattice points, the Basis and Crystal structure, Unit Cell and primitive cell, Crystal symmetry, Bravais lattice, Directions, Planes and Miller Indices, Cubic lattice, Reciprocal lattice, Imperfections and Impurities in Solids.

Electronic Properties of Solids:

Free Electron Theory of Metals (Classical and Quantum), Fermi-Dirac Statistics and Electronic Distribution in Metals, Fermi Energy and Density of Energy State, Electrical Conductivity, Heat Capacity, Band Theory of Solids, Kronig-Penney Model, Brillouin Zones.

Semiconductor Physics:

Band Structure of Semiconductors, Types of Semiconductors: Intrinsic and Extrinsic Semiconductors, Statistics of Holes and Electrons in Semiconductors, Mobility of Charge Carriers, effect of defects and impurities upon carrier life time and mobility, Mechanism of Electrical Conductivity in Semiconductors, Direct and Indirect band gap semiconductors, Optical processes in Semiconductors, Generation and Recombination, Photoconductivity, Hall Effect, p-n Junction and its applications

C. **Text Books:**

1. Kittel C., Introduction to Solid State Physics, John Wiley, 1996.
2. Neamen D.A., "Semiconductor Physics and Devices: Basic Principles", MGH, 2012
3. Singh J., "Semiconductor Devices: Basic Principle", Wiley, 2000.

D. Reference Books:

1. Sze S.M., "Physics of Semiconductor Devices", Wiley Eastern, 2008.
2. Streetman & Banerjee "Solid State Electronic Devices", Pearson Education, 2015.
3. Myers H. P., Introduction to Solid State Physics, Viva-Books, 1998.

E. Course Outcomes:

Students successfully completing this module will be able to:

1. Demonstrate competency and understanding of the basic concept's crystal structure of solids.
2. Demonstrate competency and understanding of the basic concept's semiconductor physics.
3. Engineering applications capability to understand advanced topics in semiconductor devices and crystallography of noble materials.

Subject Code: EC-1202
Subject Name: System Design
Credit Point: 3 [L = 3, T = 0, P = 0]

A. Course Objectives:

- Understand the basic concept of system engineering.
- Describe the various system engineering stages.
- Understand the system development process.
- Knowing the system management concept.

B. Course Content:

Introduction: Basic concept of system level input & output with qualities, properties, characteristics, functions, behaviours & performances

System Engineering Major Process flow: Concepts of Interdisciplinary design, integration, complex systems and life cycles

System Engineering Stages

a. Analysis of base level Requirement and appropriate Management.
b. Functional Analytics, Interpretation and Allocation of inference.
c. Design Synthesis.
d. Systems Analysis and Control.
e. Verification.
f. Conclusion

System Engineering Types **(concept of product system, service system, enterprise system and system of systems)**

Systems Engineering responsibilities

a. Management and monitoring of all installed systems and infrastructure.
b. Installation, configuration, testing and maintaining operating systems, application software and system management tools.
c. Ensure the highest levels of quality standards on systems and infrastructure.

System Engineering Skill (for analysis, problem solving, and conflict resolution)

a. Communication skill
b. Interpersonal skill
c. Project management skill
d. Governance skills

System Development Process

a. Life cycle Planning and Life Cycle integration
b. System Development Life Cycle Phasing (planning, analysis, design, development, testing, implementation, and maintenance)
c. Industrial System Engineering (Quality Function Deployment, Product Planning, Design Planning, Production & Operational Planning, Planning for Quality Control & Assurance, Whole Value chain concept)

System Engineering Management

a. Management of complex systems over their life cycles

C. Text Books:

1. Systems engineering principles and practice book by Alexander Kossiakoff

D. Reference Books:

1. Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities by INCOSE

2. Handbook of Systems Engineering and Management Book by Andrew P. Sage and William B. Rouse
3. A Practical Guide to SysML: The Systems Modeling Language Book by Alan Moore, Rick Steiner, and Sanford Friedenthal

E. Course Outcomes:

1. Understand the various stages and types of system engineering.
2. Know the system development process.
3. Understand the system management concept.

Subject Code: ME-1204
Subject Name: Workshop Practice-I
Credit Point:1 (L=0, T=0, P=2)

A. Course Objectives:

- Students able to understand different tool &equipment for work shop practice.
- Students acquire skills for the preparation of different Carpentry/fitting/welding models.
- Students able to understand the safety precaution in the workshop
- Student acquires skills of Application orientated tasks.

B. Course Content:

Introduction and demonstration: Introduction to various shops/ sections and workshop layouts, safety norms to be followed in a workshop should be conveyed to students.

Carpentry shop*:* Introduction of tools and operations, types of woods & their applications, types of carpentry hardware and their uses, carpentry joints, carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, types of woods and carpentry hardware.

Fitting shop: Introduction of tools and operations, types of marking tools and their uses, types of fitting cutting tool and their uses, fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, tapping.

Metal joining shop: Introduction of tools, types of welding joint, arc welding, gas welding, gas cutting.

Machine shop: Introduction of machine tools and operations, demonstrations of basic machine tools like lathe, shaper, drilling, milling machine and CNC with basic operations and uses.

List of workshop practices:

1. Hands on practice and job making in carpentry.
2. Hands on practice and job making in fitting.
3. Hands on practice and job making in welding.
4. Demonstrate the operations of machine shop.

C. Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2. Raghuvanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons. 2017.
3. Bawa H S., Workshop Practices, Tata McGraw-Hill, 2009.

D. Reference Books:

1. John K.C., Mechanical Workshop Practice. 2nd Edition, PHI, 2010.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edition, Scitech publishers, 2009.

E. Course Outcomes:

1. Study and practice on machine tools and their operation
2. Select the appropriate tools required for specific operation.
3. Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.

4. Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping

Subject Code: EC-1203
Subject Name: Do It Yourself (DIY)/ Industry Exposure
Credit Point: 1 (L=0, T=0, P=0)

A. Course Objectives:

The course is designed to meet with the objectives of:

- To inculcate in the mind of students the real meaning of electronics,
- To learn various electronics components along with their pin configuration,
- To give practical knowledge, on building circuits.

B. Course Content:

Improving soldering skill, Practicing soldering
Learning electronics concepts, Getting to know various electronics components and learning how they are working in the complete circuit, Learning how to properly use various electronics components
Learning about the right pin configuration, and a lot of other beneficial reasons.
Learning about circuit schematic diagrams

C. Text Books:

1. Alan R Winstanley, The Basic Soldering Guide Handbook: Learn to solder electronics successfully, CreateSpace Independent Publishing Platform, 2014
2. Manoj Yadav, Electronic Components: A must read for all beginners, students and those interested in electronics, Notion Press, 1st edition, 2021

D. Reference Books:

1. Oyvind Nydal Dahl, A Beginner's Guide To Circuits: Nine Simple Projects with Lights, Sounds, and More, No Starch Press, 2018
2. Stan Gibilisco, Beginner's Guide to Reading Schematics, McGraw Hill TAB; 4th Edition, 2018

E. Course Outcomes:

Students successfully completing this module will be able to:

1. Acquainted with soldering mechanism.
2. Acquainted with the methods of designing of innovative circuit using electronic components.
3. Substantially prepared to learn about techniques of schematic diagrams.

Subject Code: BS-1202
Subject Name: Engineering Chemistry Lab
Credit Point: 1 [L=0, T=0, P=2]

A. Course Objectives:

- To enable the students to acquire knowledge about chemistry practical and its technological importance towards research works.
- To understand applicability of chemistry for engineering and research purposes.
- To make them apply the knowledge of fundamental chemistry for design system components or processes and researches considering the public health and safety, and the cultural, societal, and environmental considerations.

B. List of Experiments:

1. Determination of the concentration of NaOH solution.
2. Standardization of $KMnO_4$ solution by Mohr's salt.
3. Estimation of hardness of water using EDTA titration.
4. Conductometric titration for
   - Determination of the strength of a given HCl solution by titration against a standard NaOH solution.
   - Analysis of a mixture of strong and weak acid by strong base.
5. Estimation of available chlorine in bleaching powder.
6. Determination of pH value of the solution by digital pH meter and pH paper.

C. Reference Books:

1. Rao M. V. B., Laboratory Mannual for Engineering and Physical Chemistry, Studium Press (India) PVT. Ltd. 2013.
2. Israel V. A., Vogel's Qualitative Inorganic Analysis, Publisher: Pearson Education Limited, ISBN: 9780582218666, 0582218667

D. Course Outcomes:

After studying this course, students will be able to

1. an ability to function on research areas in multidisciplinary subjects.
2. design economically, environmental friendly and new methods of synthesis for various needful products.
3. a knowledge of titration for various kinds of acid-base for new experimental aspects.

Subject Code: CS-1204
Subject Name: Programming and Data Structure Laboratory
Credit Point: 1 (L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet the objectives of:

- To implement linear and non-linear data structures
- To understand the different operations of search tree
- To implement graph traversal algorithms
- To get familiarized to sorting and searching algorithms

B. Course Content:

Laboratory assignments will be based on the implementation of the basic operations and application algorithms (as mentioned below) using various data structures. Programs are to be implemented using any preferable language such as C, C++, Java.

1. Array implementation of Stack and Queue ADTs.
2. Array implementation of List ADT.
3. Linked list implementation of List, Stack and Queue ADTs.
4. Applications of List, Stack and Queue ADTs.
5. Implementation of Binary Trees and operations of Binary Trees.
6. Implementation of Binary Search Trees.
7. Implementation of AVL Trees.
8. Implementation of Heaps using Priority Queues.
9. Graph representation and Traversal algorithms.
10. Applications of Graphs.
11. Implementation of searching and sorting algorithms.
12. Hashing – any two collision techniques.

C. Text Books/ Reference Books:

1. Mehta D.P., Sahni S., Handbook of Data Structures and Applications, Chapman and Hall, 2020.
2. Goodrich M.T., Tamassia R., Mount D. M., Data Structures and Algorithms in C++, Wiley, 2011.
3. Langsam Y., Augenstein M.J., Tenenbaum A.M., Data Structures Using C and C++, Pearson Education, 2011.

D. Course Outcomes:

After successfully completion of this module students will be able to:

1. Write functions to implement linear and non-linear data structure operations.
2. Suggest appropriate linear / non-linear data structure operations for solving a given problem.
3. Appropriately use the linear / non-linear data structure operations for a given problem
4. Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

Subject Code: MH-1202
Subject Name: Gandhian Philosophy and Technology
Credit Point: 1 (L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet the following objectives:

- To understand the life style and significance of M. K. Gandhi in modern world
- To introduce Gandhian Thought as an academic discipline to students
- To convey the importance of Gandhian Values in different walks of life
- To create awareness about the significance of Gandhian Thought for Academics and life in general, in students and common stakeholder through workshop and related activities done by Gandhi Study Center.

B. Course Content:

Ethics in Gandhian Thought: Socio- Political and Economic Thoughts of Gandhiji, Gandhian methods for Global Peace, Gandhian Development, Mahatma Gandhi's Perspectives on Technology. Participating practical oriented activities done by GSC/ Technology-attributes/innovation/activities of Gandhian way of life styles/Gandhian economics, Indian cottage industry and its improvement, Inclusive growth and through sustainable development

C. Text Books:

1. Gandhi, Gopal krishna, Mohandas Karamchand Gandhi: Restless as Mercury, My Life as a Young Man, Aleph Book Company, 2021.
2. Beitzel, Terry and et al. Reflections on Mahatma Gandhi: The Global Perspectives, Rawat Publications, India, 2021.
3. Gandhi, M.K. The story of my experiments with truth (an autobiography), Navajivan Publishing House, 1927.

D. Reference Books:

1. Awasthi, R.K. Technological Transformation and Relevance of Gandhi in Modern India, IJSW online, Retrieved May 2022.
2. Talwar, Sushant. Mahatma and machines: Understanding Gandhi's thoughts on modern technology, https://www.timesnownews.com/, 2019.
3. Kothari,L. S. Science and Technology in India: What Can We Learn From Gandhi?, Source: International Seminar on Gandhi And The Twenty First Century, (January 30-February 4, 1998) New Delhi- Wardha.
4. Ram K.Vepa, New Technology: A Gandhian Concept, Gandhi Book House New Delhi, 1975

E. Course Outcomes:

By the end of this course, you will be able to:

1. Understand how a simple thought changes the world
2. Identify the various barriers and challenges faced in India and try to solve from Gandhian perspectives
3. Dedicate your ideas to poor people and transform technology among people
4. Aware of the economic and social equality and relationship with peace

III[rd] Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-2101	Engineering Mathematics-III	3	0	0	3
2	EE-2101	Electrical Circuit Analysis	3	0	0	3
3	EC-2101	Semiconductor Devices	3	0	0	3
4	EC-2102	Digital Logic Design	3	0	0	3
5	EE-210A	Electromagnetic Field Theory	3	0	0	3
6	EC-210X	OE1*	3	0	0	3
7	EE-2103	Electrical Circuit Analysis Laboratory	0	0	2	1
8	EC-2103	Semiconductor Devices and Laboratory	0	0	2	1
9	EC-2104	Digital Logic Design Laboratory	0	0	2	1
Contact Hours			18	0	6	
Total Credits						21

Subject Code: BS-2101
Subject Name: Engineering Mathematics- III
Credit Point: 3 [L=3, T=0, P=0]

A. Course objectives:

The course is designed to meet the objectives of:

- imparting theoretical knowledge and practical application to the students in the area of Stochastic Process,
- introducing the basic notions of probability theory and develops them to the stage where one can begin to use probabilistic ideas in statistical inference and modeling, and the study of stochastic processes,
- providing confidence to students in manipulating and drawing conclusions from data and provide them with a critical frame work for evaluating study designs and results,
- injecting future scope and the research directions in the field of stochastic process.

B. Course Content:

Probability: Random Experiment, Sample space; Events; Probability of events, Frequency Definition of probability; Axiomatic definition of probability; Finite sample spaces, Probability of Non-disjoint events (Theorems). Conditional probability; General Multiplication Theorem; Independent events; Bayes'theorem and related problems.

Random variables: Probability mass function; Probability density function and distribution function. Distributions: Binomial, Poisson, Uniform, Exponential, Normal, t and $\chi 2$. Expectation and Variance (t and $\chi 2$ excluded); Moment generating function; Transformation of random variables (One variable); Central limit theorem (Statement only).

Basic Statistics: Measures of Central tendency: Moments, skew-ness and Kurtosis – Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression– Rank correlation.

Statistics: Population; Sample; Statistic; Estimation of parameters (consistent and unbiased); Sampling distribution of sample mean and sample variance (proof notrequired).

Estimation: Maximum likelihood estimate of statistical parameters (Binomial,Poissonand Normal distribution). Interval estimation (Normal distribution). Testing of hypothesis and $\chi 2$ goodness of fit.

Curve fitting: Linear and Nonlinear

C. Text Books:

1. Rohatgi V. K. and Saleh A. K. Md E., An Introduction to Probability and Statistics, Willy, 2008, 2nd edition.
2. Gupta S. C., & Kapoor V. K., Fundamental of Mathematical Statistics, Sultan Chand &Sons, 2014.

D. Reference Books:

1. Ross S. M., Introduction to Probability Models, Academic Press, 2014, 14th edition.
2. Cramer H., Random Variables and Probability Distributions, Cambridge University Press, 2014, Revised ed.
3. Spiegel M. R., Probability and Statistics, McGraw-Hill, 2017, 3rdedition.
4. Mayer P. L., Introductory Probability and Statistical Applications, Oxford & IBH, 1970, 2nd ed.
5. Feller W., An Introduction to ProbabilityTheory and Its applications, Vol I, Jon Willy and Sons, 2008, 3rd edition.

6. Chung K. L., A course of Probability Theory, Academic Press, 2000, 3rd edition.

E. Course Outcomes:

Upon Completion of the subjects:

1. Students will add new interactive activities to fill gaps that we have identified by analysing student log data and by gathering input from other college professors on where students typically have difficulties,
2. Students will add new simulation-style activities to the course in Inference and Probability, Student s will be able to take up prospective research assignments.

Subject Code: EE-2101
Subject Name: Electrical Circuit Analysis
Credit Point: 3 (L=3, T=0, P=0)

A. Course Objective:

The course has been designed to make students:

1. understand the calculations of electrical circuits / networks.
2. work with electrical circuits in cascaded form and implementation in real world.

B. Course Content:

Basic Concepts of Electrical Circuits, Circuit Concepts – R-L-C parameters – Voltageand Current sources – Independent and dependent sources-Source transformation – Voltage – Current relationship for passive elements (for different input signals-square, ramp, saw tooth, triangular); Kirchhoff's laws – network reduction techniques – series, parallel, series parallel, star-to-delta or delta-to- star transformation, Nodal analysis, Mesh analysis, Super node and Super mesh for D.C. Excitations Single Phase A.C Circuits: R.M.S and Average values and form factor for different periodic wave forms,– Concept of Reactance, Impedance, Susceptance and Admittance – Phase and Phase difference– concept of power factor, Real and Reactive powers – J-notation, Complex and Polar forms of representation, Complex power. Steady state analysis of R, L and C (in series, parallel and series parallel combinations) with sinusoidal excitation; Transient analysis of different electrical circuits with and withoutinitial conditions; Solution using Laplace Transforms, Fourier analysis of different types of input signals Locus Diagrams and Resonance: Locus diagrams – series R-L, R-C, R-L-C and parallel combination with variation of various parameters – Resonance – series, parallel circuits, concept of band width and Q factor. Magnetic Circuits: Magnetic Circuits – Faraday's laws of electromagnetic induction – concept of self and mutual inductance – dot convention – coefficient of coupling – composite magnetic circuit – Analysis of series and parallel magnetic circuits

Network Topology: Definitions – Graph – Tree, Basic cutest and Basic Tie-set matrices for planar networks – Loop and Nodal methods of analysis of Networks with independent voltage and current sources - Dualityand Dual networks.

Network Theorems:

Tellegen's, Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power Transfer, Millman's and Compensation theorems for D.C. and A.C. excitations. Three phase unbalanced circuits

C. Text Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.

D. Reference Books:

1. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
2. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
3. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

E. Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. apply network theorems for the analysis of electrical circuits.
2. obtain the transient and steady-state response of electrical circuits.
3. analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
4. analyse two port circuit behavior.

Subject Code: EC-2101
Subject Name: Semiconductor Devices
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- To make the students understand the fundamentals of electronic devices.
- To train them to apply these devices in widely used and important applications

B. Course Content

P-N Junction: Device structure, Barrier Potential, Space Charge width, forward & reverse characteristics, junction breakdown, linearly graded & hyper-abrupt junctions, PN diode forward current and reverse saturation current, minority carrier distribution, Small-signal equivalent, switching characteristics.

Bipolar Junction Transistor: History, Device structures and fabrication, Transistor action and amplification, Minority carrier distribution, Nonideal Effects: Base Width Modulation, High Injection, Emitter Bandgap Narrowing, Current Crowding, Nonuniform Base Doping, Breakdown Voltage, CB, CE, CC configuration, Transistor currents and current gains, Small-signal equivalent: Ebers-Moll model and Hybrid-pi model.

Other Semiconductor Junctions: Schottky Barrier Diode: Qualitative characteristics and difference with PN diode, metal-semiconductor Ohmic Contacts, tunnelling barrier, Hetero-junction: materials, band diagrams & I-V characteristics.

Metal Oxide Semiconductor Field Effect Transistor: Two-Terminal MOS, Energy-Band Diagrams, Depletion Layer, Surface Charge Density, Work Function Differences, Flat-Band Voltage, Threshold Voltage, CV characteristics & frequency effects, MOSFET structure: operation & I-V equation derivation, Substrate Bias effect and Channel length modulation, Small-Signal Equivalent: Frequency Limitation Factors and Cutoff Frequency, MOSFET Scaling

Junction Field Effect Transistor: JFET Concepts, Basic pn JFET Operation, Pinch-off Voltage, Drain-to-Source Saturation I-V Relationship, Depletion Mode JFET, Transconductance, Basic MESFET, Small-Signal Equivalent: Frequency Limitation Factors and Cutoff Frequency

C. Text Books

1. Streetman & Banerjee “Solid State Electronic Devices”, Pearson Education, 2015
2. D.A. Neamen, “Semiconductor Physics and Devices: Basic Principles”, MGH, 2012.

D. Reference Books

1. S.M. Sze, “Physics of Semiconductor Devices”, Wiley Eastern, 2008
2. JP Colinge, CA Colinge, “Physics of Semiconductor Devices”, Kluwer Academic Publishers, 2002
3. Kevin F Brennan, “The Physics of Semiconductors" Cambridge Univ. Press., 1999.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Apply the knowledge of basic semiconductor material physics
2. Characterize semiconductors, diodes, transistors and amplifiers
3. Analyze the characteristics of various electronic devices like diode, transistor etc.

Subject Code: EC-2102
Subject Name: Digital Logic Design
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The course is designed to meet the following objectives:

- To build a solid foundation about Boolean algebra
- To study Digital Logic Gates and Circuits
- To provide a clear foundation of Modern Digital Systems

B. Course Content

Minimization techniques: Minterms and maxterms expressions. Algebraic method, Karnaugh maps (including 5 and 6 variables), Quine-McCluskey method, Multi-output circuits, Multi-level circuits, Design of circuits with universal gates.

Codes: BCD, Excess- 3, Gray, ASCII, EBCDIC.

***Combinational circuits*:** Arithmetic circuits: adders and subtractor-ripple carry adders, Carry look ahead adders, Adder cum subtractor, BCD Adder and Subtractor, Comparator, Decoder, Encoder, Priority encoder, MUX/DEMUX and their structures, logic using ROM array, Applications of MSI designs.

Sequential circuits: Latches and Flip-Flops: SR latch, SR Flip-Flop, JK Flip-Flop, D Flip-Flop, T Flip-Flop, Flip-Flops with preset and clear inputs, Triggering methods and their circuits, Conversion of one type of flip flop to another, Excitation table, Applications of Flip Flops. Difference between synchronous and asynchronous circuits.

Shift Registers: Right shift, Left shift, Bidirectional, SISO, SIPO, PISO, PIPO, Universal shift registers.

Counters: Operation; up counter, Down counter, up/down counter, mod *n* counters, other types of Counters: Ring counter, Johnson counter, BCD counter.

Finite State Machines: Mealy & Moore types, Basic design steps, Design of counters using sequential circuit approach.

Asynchronous sequential circuits: Analysis and synthesis, State reduction and state assignment, Hazards.

Introduction to digital logic families: Characteristics, Basic working of TTL NAND gate, ECL gate and CMOS logic gate, Memory Devices: types of memories, RAM BJT cell and MOS RAM cells, Organization of a RAM

ADC & DAC: Analog and digital data conversions, D/A converter: Specifications, Weighted resistor type, R-2R ladder type, Voltage mode and current mode R-2R Ladder types, Switches for D/A converters, High speed sample-and-hold circuits, A/D Converters: Specifications, Flash type, Successive approximation type, Single slope type, Dual slope type, A/D converter using voltage-to-time conversion, Over-sampling A/D converters.

C. Text Books

1. Malvino & Leach, "Digital Principles and Applications", Tata McGraw Hill, 2010.
2. M. Morris Mano, "Digital Logic Design", Prentice Hall, 2018.

D. Reference Books

1. C. H. Roth (Jr.), "Fundamentals of Logic Design", Cengage Engineering, 2013.
2. R L Morris & J R Miller, "Designing with TTL Integrated Circuits", McGraw Hill, 1971.
3. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 2009.
4. Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall, 2014.
5. J Crowe & B. Hayes-Gill, "Introduction to Digital Electronics", Butterworth-Heinemann, 1998.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Design and analyse combinational and sequential logic circuits.
2. Optimize combinational and sequential logic circuits
3. Analyse a memory cell and apply for organizing larger memories

Subject Code: EE-210A
Name of the Module: Electromagnetic Field Theory
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- imparting theoretical & practical knowledge to students in the area of Electromagnetic Field Theory.
- providing teaching and learning to make students acquainting with modern state-of –art of Electromagnetic propagation.
- injecting the future scope and the research direction in the field of Electromagnetisms.
- making students competent to design & development of Electromagnetisms.

B. Course Content

Review of vector algebra- Rectangular, cylindrical and spherical, Curvilinear coordinates, Line, surface andvolume integrals, Gradient, Divergence, Curl, Divergence theorem, Stoke's theorem.

Coulomb's Law – Electric flux and flux density, Gauss's law and applications. Poisson's and Laplace equations and their solutions. Electric Current: Charge conservation and continuity equation–conductivityand Ohm's law.

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straightconductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media –Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

Faraday's law – Displacement current.

Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory, wave equation, Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space,lossy, lossless dielectrics and conductors- skin depth, Flow of energy and Poynting vector, Plane wave reflection and refraction: linear, elliptic and circular polarization, reflection coefficient and standing wave ratio, Brewster's angle. Transmission Lines; Concept of Lumped parameters and Distributed parameters. Line Parameters, Transmission line equations and solutions, Physical significance of the solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Distortion-less, lossy, lossless Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart - Applications; Load Matching Techniques / Quarter wave Matching.

Waves between parallel planes, TE and TM waves, Characteristics of TE andTM waves, TEM waves, Velocities of propagation, Attenuation in parallel plane guides, Wave impedance, Electric field and current flow within the conductor.

C. Text Books

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014

D. Reference Books

1. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
2. V. V. Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.
3. J. P. Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.
4. S. P. Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill, Education (India) Private Limited, 2012.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Understand calculations of electric and magnetic fields in space in some selected geometries with boundary conditions.
2. Perform calculations of stationery and time-dependent electrical currents in selected circuits containing resistors, capacitors, and inductors.
3. Analyse for the operational principles of common electrical devices.

Subject Code: EE-2103
Subject Name: Electrical Circuit Analysis Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- Work with electrical circuits in laboratory and apply theoretical knowledge of networks into practice.
- Familiar with devices used in electrical circuit analysis.

B. List of Experiments

1. Verification of KVL and KCL (Simulation using MATLAB and Hardware)
2. Mesh Analysis (Simulation using MATLAB and Hardware)
3. Nodal Analysis (Simulation using MATLAB and Hardware)
4. Verification of Superposition Theorem (Simulation using MATLAB and Hardware)
5. Verification of Reciprocity Theorem (Simulation using MATLAB and Hardware)
6. Verification of Maximum Power Transfer Theorem (Simulation using MATLAB and Hardware)
7. Verification of Thevenin's Theorem (Simulation using MATLAB and Hardware)
8. Verification of Norton's Theorem (Simulation using MATLAB and Hardware)
9. Verification of Compensation Theorem (Simulation using MATLAB and Hardware)
10. Verification of Millman's Theorem (Simulation using MATLAB and Hardware)
11. Verification of Series and Parallel Resonance (Simulation using MATLAB and Hardware)
12. Determination of Self, Mutual Inductance and Coefficient of Coupling

C. Text Books

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.

D. Reference Books

1. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
2. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
3. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

E. Course Outcomes

At the end of the course, a student will be able to:

1. apply fundamental laws to electric circuits.
2. select suitable instrument for measurement of electrical quantities.
3. verify basic network theorems to solve complex circuits.
4. demonstrate performance improvement by power factor correction.
5. compare resonance characteristics of series and parallel RLC circuits and determine resonant frequency.
6. design of filter to reduce ripple in rectifier circuits

Subject Code: EC-2103
Subject Name: Semiconductor Devices Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- To understand and verify the characteristics of electronic devices.
- To learn to apply these devices in popular and important applications

B. List of Experiments

1. Study of V-I characteristics of PN junction diode.
2. Study of BJT characteristics in different configurations.
3. Study of JFET characteristics in different configurations.
4. Study of MOSFET characteristics in different configurations.
5. Study of MOS capacitance.

C. Text Books

1. Streetman & Banerjee "Solid State Electronic Devices", Pearson Education, 2015
2. D.L. Schilling & C. Belove, "Electronic Circuits: Discrete and Integrated", McGraw Hill, 2002.

D. Reference Books

1. S.M. Sze, "Physics of Semiconductor Devices", Wiley Eastern, 2008
2. A.S. Sedra & K.C. Smith, "Microelectronic Circuits", Oxford, 2017.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Plot the characteristics of electronic devices to understand their behavior.
2. Characterize and classify diodes and transistors
3. Analyze the characteristics of various electronic devices like diode, transistor etc
4. Design simple analog circuits

Subject Code: EC-2104
Subject Name: Digital Logic Design Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- To build a solid foundation about Boolean algebra
- To study the applications of Digital Logic Gates and Circuits

B. List of Experiments

1. Design and verification of adder subtractor circuits using universal gates.
2. Minimize the following logic system with SOP/POS by tabular technique & implement the circuit.
    a. SOP: $f(A,B,C,D) = m_0 + m_1 + m_2 + m_3 + m_5 + m_6 + m_{10} + m_{13} + m_{15}$
    b. POS: $f(X,Y,Z) = M_0.M_1.M_3.M_7$
3. Design Gray to Binary and Binary to Gray code Converter & test the circuit.
4. Verification of the truth table of the Multiplexer / Demultiplexer.
5. Design and test of flip-flops using NOR/NAND gates.
6. Verification of 3-bit synchronous / asynchronous up / down counter.
7. Basic GATEs implementation in HDL
8. Design and implementation of 3-bit synchronous up/down counter in HDL.
9. Construction and verification of 4-bit ripple counter and Mod-10 / Mod-12 Ripple counters using JK flip-flop in HDL.

C. Text Books

1. Malvino & Leach, "Digital Principles and Applications", Tata McGraw Hill, 2010.
2. M. Morris Mano, "Digital Logic Design", Prentice Hall, 2018.

D. Reference Books

1. H. Roth (Jr.), "Fundamentals of Logic design", Cengage Engineering, 2013.
2. R L Morris & J R Miller, "Designing with TTL Integrated Circuits", McGraw Hill, 1971.
3. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 2009.
4. Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall, 2014.
5. J Crowe & B. Hayes-Gill, "Introduction to Digital Electronics", Butterworth-Heinemann, 1998.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Design and analyse combinational and sequential logic circuits.
2. Optimize combinational and sequential logic circuits

IVth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-2201	Analog Circuits	3	0	0	3
2	EC-2202	Principle of Communication	3	0	0	3
3	EC-2203	Antenna and Wave Propagation	3	0	0	3
4	EC-220A	Signal and System	3	0	0	3
5	EC-220X	OE2*	3	0	0	3
6	MH-2201	Entrepreneur Essential and Early-Stage Start-up	3	0	0	3
7	EC-2204	Analog Circuits Laboratory	0	0	2	1
8	EC-2205	Principle of Communication Laboratory	0	0	2	1
9	EC-2206	Antenna and Wave Propagation Laboratory	0	0	2	1
Contact Hours			18	0	6	
Total Credits						21

Subject Code: EC-2201
Subject Name: Analog Circuits
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- To make the students understand the fundamentals of electronic circuits.
- To train them to use the basic in important applications like Feedback network, oscillator and power amplifier

B. Course Content

Wave-shaping Circuits: Linear wave shaping circuits, RC high pass and low pass circuits with phase and frequency analysis, RC integrator and differentiator circuits, Piece-wise linear model of diode, Nonlinear wave shaping circuits, Rectifier, Series-shunt and two-level diode clipper circuits, Clamping circuits

Transistor Biasing and Thermal Stabilization: Need for biasing, Operating point, Load line analysis, Biasing methods, Stabilization against V_{BE}, Ic, and β, Stability factors, (S, S', S"), Bias compensation, Thermal runaway, Thermal stability, FET biasing methods and analysis.

Transistor Amplifiers & Frequency Response: Basic amplifier circuit, small signal analysis, Hybrid parameters, Phase splitter, low frequency and high frequency response amplifiers, Miller's theorem, Cascade/Cascode amplifiers

Power Amplifiers: Amplifier terms, two load lines, Class-A & Class-B operation, Class-B push pull emitter follower, Biasing class B/AB Amplifiers, Class B/AB driver, Class-C operation, Class-D operation.

Feedback Amplifier: Introduction, Basic concepts of feedback, Effect of negative feedback, Different topologies, Method of identifying feedback topology and feedback factor, Stability of feedback amplifier, Frequency response of the feedback amplifiers.

Oscillators: Conditions for oscillations, RC and LC type oscillators, Crystal oscillators, Frequency and amplitude stability of oscillators, Generalized analysis of LC oscillators, Quartz, Hartley, Colpitts, RC-phase shift and Wien-bridge oscillators.

C. Text Books

1. J. Millman and Halkias, Integrated Electronics, TMH, 2nd Edition, 2010
2. Salivahanan, Kumar, "Electronics Devices & Circuits", Tata McGraw Hill

D. Reference Books

1. A. S. Sedra & K.C. Smith, "Microelectronic Circuits (5/e)", Oxford, 2004.
2. D. L. Schilling & C. Belove, "Electronic Circuits: Discrete and Integrated", (3/e), McGraw Hill, 1989.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Apply the knowledge of basic BJT and diode-based circuits
2. Characterize wave shaping circuits
3. Analyze the characteristics of oscillators, power amplifiers and feedback circuit
4. Design of test circuits for real time applications.

Subject Code: EC-2202 / EC-220X
Subject Name: Principle of Communication
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- To develop a fundamental understanding on Communication Systems with emphasis on analog modulation techniques and noise performance.

B. Course Content

Elements of communication system: Transmitters, Transmission channels & receivers, Concept of modulation.

***Amplitude Modulation*:** AM, DSB-SC, SSB-SC and VSB-SC, Methods of generation and detection, FDM, Super heterodyne receivers.

***Angle Modulation*:** Basic definitions, FM, PM, narrow band FM, wide band FM, transmission bandwidth of FM waves, Generation of FM waves: indirect FM and direct FM, Demodulation/detection of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear effects in FM systems.

***Random Process*:** Random variables, Several random variables, Statistical averages, Function of random variables, Moments, Mean, Correlation and covariance function, Principles of autocorrelation function, Cross – correlation functions, Central limit theorem, Properties of Gaussian process.
Noise - Internal and external noise, Noise calculation, Noise figure, Noise in linear and nonlinear AM receivers, Threshold effect.
Noise in FM receivers, Threshold effect, Capture effect, FM threshold reduction, Preemphasis and de-emphasis.

Sampling Theorem: Nyquist sampling theorem, Low pass and band pass sampling theorems

Pulse Modulation: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) their generation and detection.

C. Text Books

1. Simon Haykin, "Communication Systems", Wiley publication, 4th Edition (2004).
2. H Taub and D. L. Schilling, "Principles of Communication System",(2nd Edition), McGraw Hill, New Delhi.

D. Reference Books

1. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press, India.
2. John Proakis "Digital Communications", Tata Mc Graw Hill, 5th Edition (2007).
3. Bernard Sklar "Digital Communication-Fundamentals and Applications", Pearson Education India, 2nd Edition (2009)

E. Course Outcomes

At the end of the course, a student will be able to:

1. Understand the basics of communication system and analog modulation techniques
2. Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
3. Apply the basic knowledge of electronic circuits and understand the effect of Noise in communication system and noise performance of AM system

4. Understand the effect of noise performance of FM system.
5. Understand TDM and Pulse Modulation techniques.

Subject Code: EC-2203
Subject Name: Antenna and Wave Propagation
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The course is designed to meet the outcomes of:

- To make the students to study Antennas & their characteristics and propagation patterns
- To expose students to application of particular antenna in particular communication system,
- To make students aware of EM wave propagation under different modes

B. Course Content

***Radiation Theory and Pattern*:** Review of Maxwell wave equation and Faraday's law, Radiation, Hertzian dipole, Different field components.

***Antenna Fundamentals*:** Antenna concept, Different types of antenna, Directivity, Beam Width, Gain, Radiation resistance, Application of network theorems, Basic terminology, Field radiated by dipole & loop antennas, Monopole antenna, Parabolic antenna, Effect of ground, Travelling wave antennas, Antenna impendence & bandwidth, Array analysis & synthesis special arrays like Binomial Yagi etc.

***Advanced Antenna*:** Introduction to adaptive & retro directive arrays, Circularly polarized antennas, Helical antennas, Broadband antennas and arrays (Log periodic & other), Secondary source & Aperture antenna, Microwave antennas, Horn, Slot, Paraboloidal Reflector, Lens & Microstrip antenna, Smart antennas. Remote sensing application of antennas, Radar range equations. Propagation effect to Link on EM.

***Wave propagation*:** Wave propagation in different frequency ranges, Interference effects of ground, Antennas located over flat & spherical earths' magnetic fields, Troposphere scatter, Ducts & nonstandard refraction, EIF propagation using earth-ionosphere waveguide model, Scattering & absorption at microwave frequencies, Introduction to propagation modeling and predictive studies on propagation, Fading, Friis transmission formula, Brightness & temperature of antenna and their role in link calculation.

C. Text books

1. J D Kraus,R. J. Marhefka, A. S Khan "Antennas and Wave Propagation", Tata McGraw Hill, 4th Edition.
2. C. A. Balanis "Antenna Theory: Analysis and Design" (3rd Edition) Wiley India.
3. J D Kraus, "Electromagnetics with Applications" McGraw Hill, 5th Edition.

D. Reference books

1. G Kenedy, "Electronic Communication Systems", McGraw-Hill, Latest Edition.
2. Hayt, "Engineering Electromagnetics", Tata McGraw Hill, Latest Edition.
3. E C Jordan and K G Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India
4. David M Pozar, "Microwave Engineering", John Willy & Sons. Inc.
5. Peter A Rizzi, "Microwave Engineering – Passive Circuits", Prentice Hall of India.

E. Course Outcomes

At the end of this module, students are expected to be able to:

1. Understand and utilize antenna as required in different communication systems.
2. Know about EM wave propagation effects & pattern in different media.

Subject Code: EC-220A
Subject Name: Signals and Systems
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- Understanding the fundamental characteristics of signals and systems.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Analyze the spectral characteristics of signals using Fourier analysis.
- development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling

B. Course Content

***Signal and Systems*:** Introduction, Operations on signals, Classification of signals, Classification of systems, System model- input output description

***Time Domain Analysis of Continuous Time Systems*:** Introduction, Convolution, System response to internal conditions - Zero input response, Unit impulse response, System response to external input- Zero state response, Classical solution of differential equations, System stability.

***Continuous Time Signal Analysis - The Fourier Series*:** Periodic signal representation by trigonometric Fourier series, Existence and convergence of the Fourier series, Exponential Fourier series, properties, LTIC system response to periodic inputs

***Continuous Time Signal Analysis - The Fourier Transform*:** Aperiodic signal representation by Fourier integral, Properties of FT, Transforms of some useful function, Frequency response of LTIC system.

***Continuous Time System Analysis Using the Laplace Transform*:** Laplace transform, Relation to FT, Properties of Laplace transform, Solution of differential equations, Unilateral Laplace transform: Properties of the unilateral Laplace transform.

***Sampling*:** Sampling theorem, Signal reconstruction.

***Discrete Time System Analysis Using the Z-Transform*:** Discrete-time signals and systems, Z-transform (BZT & UZT) and its properties, Analysis of LTI systems using Z – transform.

C. Text Books

1. A. V. Oppenheim, A. Willsky, S. Hamid Nawab, "Signals and Systems (2/e)", Pearson 2000.
2. S. Haykin and B.Van Veen "Signals and Systems, Wiley, 2012.

D. Reference Books

1. S. S. Soliman & M. D. Srinath, "Continuous and Discrete Signals and Systems", Prentice-Hall, 1998.
2. M.Mandal and A.Asif, "Continuous and Discrete Time Signals and Systems, Cambridge, 2007.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Analyse the spectral characteristics of continuous-time periodic and a periodic signal using Fourier analysis.

2. Classify systems based on their properties and determine the response of LSI system using convolution.
3. Analyze system properties based on impulse response and Fourier analysis.
4. Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
5. Understand the process of sampling and the effects of under sampling

Subject Code: MH-2201
Subject Name: Entrepreneur Essential and Early-stage Start-up
Credit Point:3 (L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet the objectives of:

- To involve themselves in the business activities
- Starting innovative practices in their entrepreneurial activities.
- Developing theirs kills on the traits that they want to carry forward.

B. Course Content:

Introduction to Entrepreneurship Meaning, Role of Entrepreneur, Entrepreneur Process: different approaches, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Issues & Problems Entrepreneurial Practices, Motivation for becoming an Entrepreneur. SME Concept, its role, status, prospects and policies for promotion of SMEs. Importance of Entrepreneurship: innovations, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs, Issues & Problems Entrepreneurial Practices. Identifying and Assessing the Idea, Identifying Target Segment & Market Sizing, Analysing Environment & Competitive Advantage, Choosing the right legal structure, Permits, Registrations & Compliances, Components of a Business Plan, Creating an Effective B-Plan Part, Valuation, Investor pitch. Importance of Entrepreneurship: Entrepreneurship and Innovations, Converting Innovation to Economic Value which includes, Growth Strategies, value position, Market Segments, Value Chain Structure, Revenue Model, Contribution of Entrepreneurs: Towards R&D, creates Wealth of Nation & Self prospect with Challenge. Characteristics of Entrepreneurship idea generation techniques, Concept of product development, Business plan, Strategic Plan, issues and opportunity of early stage start-up etc.

C. Text Books:

1. Donald F. Kuratko, Entrepreneurship: Theory, Process, Practice Cengage Learning 2017
2. Desai, Vasant, Small Scale Industries and Entrepreneurship. Himalaya Publishing House, Delhi.2008
3. Kaulgud, Aruna Entrepreneurship Management. Vikas Publishing House, Delhi.2003
4. Cynthia, L. Greene. Entrepreneurship Ideas in Action. Thomson Asia Pvt. Ltd., Singapore. 2004

D. Reference Books:

1. Barringer Entrepreneurship: Successfully Launching New Ventures, Pearson Education Publishing 2015
2. Timmons, Jerry A., and Spinelli, Stephen, New Venture Creation: Entrepreneurship for the 21st Century, 8th Edition, Boston, MA: Irwin McGraw-Hill 2009.
3. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001

E. Programme Outcomes:

1. Start the venture more scientifically.
2. Start the venture by linking with the financial institutions.
3. Seeking for a start-up idea
4. To be an entrepreneurs

Subject Code: EC-2204
Subject Name: Analog Circuits Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- To make the students understand the fundamentals of electronic circuits.
- To train them to use the basic in important applications like Feedback network, oscillator and power amplifier

B. List of Experiments

1. Study and Implement RC Low Pass and High Pass Filter Circuits.
2. Study and Implement RC Integrator / Differentiator Circuits.
3. Study and Implement BJT/FET biasing methods.
4. Study and Implement RC-Phase shift and wien-bridge oscillator.
5. Study and Implement Class A/B/AB/C amplifier
6. Study and Implement push pull amplifier

C. Text Books

1. A. Malvino and D. Bates, Electronic Principles, McGraw-Hill, 2015
2. P. Horowitz and W. Hill, The Art of Electronics, Cambridge University Press, 2015.
3. J. Millman and A. Grabel, Micro Electronics, TMH, 2nd Edition, 2009.

D. Reference Books

1. A. S. Sedra & K.C.Smith, "Microelectronic Circuits (5/e)", Oxford, 2004.
2. D. L. Schilling & C. Belove, "Electronic Circuits: Discrete and Integrated", (3/e), McGraw Hill, 1989.
3. K.V. Ramanan, "Functional Electronics", Tata McGraw Hill ,1984

E. Course Outcomes

At the end of the course, a student will be able to:

1. Design and implement filters
2. Design and implement integrators and differentiators.
3. Design and implement oscillators, power amplifiers and feedback circuit

Subject Code: EC-2206
Subject Name: Principle of Communication Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- To make the students to understand different types of modulation and demodulation techniques.

B. List of Experiments

1. Study of Amplitude Modulation & Demodulation.
2. Measurement of output power with varying modulation index an AM signal.
3. Study of voltage-controlled oscillator (VCO) using IC 4046.
4. Study the performance of a phase locked loop.
5. Study of Frequency Modulation and Demodulation System.
6. Study of pre-emphasis & de-emphasis
7. Study of Double Side Band Suppressed Carrier (DSB-SC) Modulation & Demodulation Technique.
8. Study of Single Side Band Suppressed Carrier (SSB-SC) Modulation & Demodulation Technique
9. Study functioning of Superheterodyne AM Receiver.
10. Measurement of Noise Figure using a noise generator.
11. Study the characteristics of Pulse Amplitude Modulation & Demodulation.
12. Study the characteristics of Pulse Width Modulation & Demodulation.
13. Study the characteristics of Pulse Position Modulation & Demodulation.

C. Text Books

1. Simon Haykin, "Communication Systems", Wiley publication, 4th Edition (2004).
2. H Taub and D. L. Schilling, "Principles of Communication System", (2nd Edition), McGraw Hill, New Delhi.

D. Reference Books

1. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press, India.
2. John Proakis "Digital Communications", Tata Mc Graw Hill, 5th Edition (2007).
3. Bernard Sklar "Digital Communication-Fundamentals and Applications", Pearson Education India, 2nd Edition (2009)

E. Course Outcomes

At the end of the course, a student will be able to:

1. Characterize analog modulation techniques
2. Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
3. Understand TDM and characterize Pulse Modulation techniques.

Subject Code: EC-2206
Subject Name: Antenna and Wave Propagation Laboratory
Credit Value: 1 (L = 0, T = 0, P = 1)

A. Course Objectives

The Objective of the course is:

- To make an understanding and utilisation of horn antenna.
- To make an understanding and utilisation of Yagi antenna.
- To make an understanding and utilisation of Printed antenna.
- To become familiar with the Parabolic antenna.

B. List of Experiments

1. To describe the characteristics of the Horn antenna. To carry out gain measurements using method of comparison. Measurement of the gain of Horn Antenna using Method of the two antennas.
2. To investigate the properties of a system comprising a dipole and a parasitic element. Understand the terms "driven element", "reflector", "director". To know the form of a Yagi antenna and examine multi element Yagi. To see how gain and directivity increase as element numbers increase.
3. To investigate the Radiation Pattern of Printed antennas
4. Be familiar with the Parabolic/Dish form of antenna. To investigate the gain and directivity of the dish antenna. Appreciate the advantages and disadvantages of a dish antenna as compared with a Yagi.
5. Be familiar with the Log Periodic form of antenna. To investigate the gain, and directivity of the log Periodic antenna over a wide frequency range. Appreciate the advantages and disadvantages of a log periodic Antenna as compared with a Yagi.
6. Understand the terms "baying" and "stacking" as applied to antennas. To investigate stacked and bayed Yagi antennas. To compare their performance with a single Yagi.
7. Study and show variation in the radiation strength at a given distance from the antenna and detector will show a higher strength when it is nearer to the transmitting antenna and shall reduce gradually with increasing distance.

C. Text books

1. C. A. Balanis "Antenna Theory: Analysis and Design" (3rd Edition) Wiley India.
2. J D Kraus, "Electromagnetics with Applications" McGraw Hill, 5th Edition.

D. Reference books

1. G Kennedy, "Electronic Communication Systems", McGraw Hill, Latest Edition.
2. Hayt, "Engineering Electromagnetics", Tata McGraw Hill, Latest Edition.
3. John D Ryder, "Networks Lines and Fields", Prentice Hall of India, 2nd Edition.
4. E C Jordan and K G Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India
5. Matthew M Radmanesh, "Radio Frequency and Microwave" Electronics Illustrated, Pearson Education Asia.
6. David M Pozar, "Microwave Engineering", John Willy & Sons. Inc.

E. Course Outcomes

At the end of this module, students are expected to be able to:

1. Understand and realize antenna structures for practical communication systems
2. Understand and utilize antenna radiation pattern.

Vth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-3101	Introduction to Digital Integrated Circuits	3	0	0	3
2	EC-3102	Digital Communication	3	0	0	3
3	EC-3103	Digital Signal Processing	3	0	0	3
4	EC-310A	Microprocessor and Interfacing	3	0	0	3
5	EC-310X	OE3*	3	0	0	3
6	EC-3104	Internship-I	0	0	0	1
7	MH-3101	Engineering Economics	3	0	0	3
8	EC-3105	Minor Project-I	0	0	4	2
9	EC-3106	Introduction to Digital Integrated Circuits Laboratory	0	0	2	1
10	EC-3107	Digital Communication Laboratory	0	0	2	1
11	EC-3108	Digital Signal Processing Laboratory	0	0	2	1
12	EC-3109	Microprocessor and Interfacing Laboratory (Audit Pass)	0	0	2	0
Contact Hours			18	0	12	
Total Credits						24

Subject Code: EC-3101
Subject Name: Introduction to Digital Integrated Circuits
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The Objective of the course is:

- To introduce students to basic concepts of digital VLSI chip design using the simpler VLSI technology

B. Course Content

Basics of MOS: Semiconductor surfaces, The ideal and non-ideal MOS capacitors and diagrams and CVs;

***Metal Oxide Field Effect Transistor*:** Device structures and fabrication, Energy band diagram, MOS I/V characteristics, Effects of oxide charges, Defects and interface states; Threshold voltage, Body effect, Channel Length Modulation, Scaling Effects, Differences between a MOSFET and a BJT, Common source DC characteristics, Small-signal equivalent circuit SPICE level-1 model

MOS Inverters*:* Static characteristics, Inverter types. Switching characteristics: Delay times, Power dissipation, Progressive Inverters, Super buffer design.

Combinational Logic Circuits: CMOS logic circuits, Complex logic circuits, CMOS transmission gates, Pseudo-nMOS

Dynamic Logic Circuits: Principle of pass transistor, Dynamic circuit techniques, High performance dynamic CMOS.

Sequential logic circuits: Behaviour of bi-stable elements, Latch, Clocked latch and flip-flop circuits.

Digital Design with Verilog HDL: Typical design flow, Hierarchical modelling concepts: Design methodologies, Modules and ports, Instances, Components of a simulation, Data types, Arrays, Memories and parameters. Data low modelling & Behavioural modelling

C. Text books

1. S. M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits", 3/e, TMH, 2012
2. S. Palnitkar, "Verilog HDL- A Guide to Digital Design and Synthesis", 2/e, Pearson, 2007.

D. Reference books

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", Oxford University Press, 2004
2. J. M. Rabaey, A. Chandrakasan and B. Nikolic, "Digital Integrated Circuits", 2/e, PHI, 2003.

E. Course Outcomes

Upon completion of the subject, the student will have:

1. An ability to design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits.
2. An ability to extract the parasitic elements from the layout and analyze the circuit timing using a logic simulator.
3. An ability to build a cell library to be used by other chip designers.

Subject Code: EC-3102
Subject Name: Digital Communication
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- To understand the building blocks of digital communication system.
- To prepare mathematical background for communication signal analysis.
- To understand and analyze the signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.
- To understand concept of spread spectrum communication system.

B. Course Content

Source coder: Pulse code modulation, Quantization noise, Linear and non-linear quantization, Companding (μ -law and A-law), Differential pulse code modulation, Delta modulation, Adaptive delta modulation, Delta sigma modulation, Linear predictive coders, Vocoder.

Waveform coder: Unipolar, Polar, Bipolar – RZ/NRZ, Manchester, Miller, Differential encoding and their spectral characteristic, B3ZS, HDB3, Calculation of PSD.

Base band signal receiver: Integrate and dump type filter, Probability of error calculations, Optimum filters, Coherent reception, Matched filter and its transfer function, Probability of error of matched filter, Regenerative repeater.
Inter symbol interference (ISI), Purpose of equalization, Eye pattern, Nyquist criterion for zero ISI, Fixed equalizer, Design of equalizer, Partial response signalling.

Digital Modulation: ASK, FSK, PSK, DPSK, M-ary PSK, QPSK, M-ary FSK, MSK, Error calculation.

Spread Spectrum Modulation: Pseudo-noise sequence, Motion of spread spectrum, Direct-sequence spread spectrum with coherent binary phase shift keying, Processing gain, Probability of error, Frequency-hop spread spectrum, OFDM.

C. Text Books

1. Simon Haykin, "Communication Systems", Wiley publication, 4th Edition (2004).
2. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press, India.

D. Reference Books

1. Bernard Sklar "Digital Communication-Fundamentals and Applications", Pearson Education India, 2nd Edition (2009)
2. John Proakis "Digital Communications", Tata Mc Graw Hill, 5th Edition (2007).
3. H Taub and D. L. Schilling, "Principles of Communication System", (2nd Edition), McGraw Hill, New Delhi.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digital communication system.

3. Select the blocks in a design of digital communication system.
4. Analyze performance of spread spectrum communication system.

Subject Code: EC-3103
Subject Name: Digital Signal Processing
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

- To understand the basic concept of frequency in continuous-time and discrete-time signals
- To understand various transformation algorithm related to signals and systems

B. Course Content

***Introduction*:** Review of signals and systems, Concept of frequency in continuous-time and discrete-time signals, Analog to digital conversion.

Discrete time signals and systems: Discrete time signals, Discrete time systems, Analysis of discrete time linear time invariant systems, Convolution, Discrete time systems described by differential equations, Implementation of discrete time systems, Correlation of discrete time signals.

Discrete Time Fourier Transform (DTFT): DTFT **and its** Properties
Discrete Fourier Transform: Frequency domain sampling, Properties of DFT, Linear filtering methods based on DFT.

Efficient computation of the DFT: FFT algorithms, Linear filtering, Approach to computation of the DFT.

Implementation of Discrete-Time System: FIR system, IIR system
Design of Digital Filters: Design of FIR filters Design of IIR filters from analog filters, Frequency transformations.

C. Text Books

1. J.G.Proakis, D.G. Manolakis, "Digital Signal Processing", (4/e) Pearson, 2007.
2. A.V.Oppenheim & R.W.Schafer, "Discrete Time Signal processing", (2/e), Pearson Education, 2003.
3. S.K.Mitra, "Digital Signal Processing (3/e)", Tata McGraw Hill, 2006

D. Reference Books

1. P. Ramesh Babu, "Digital Signal Processing", Scitech Publications (India) Pvt. Ltd.
2. P.S.R.Diniz, E.A.B.da Silva and S.L.Netto, "Digital Signal Processing", Cambridge, 2002.
3. E.C.Ifeachor & B.W.Jervis, "Digital Signal Processing", (2/e), Pearson Education, 2002.
4. J.R.Johnson, "Introduction to Digital Signal Processing", Prentice-Hall, 1989

E. Course Outcomes

At the end of the course, a student will be able to:

1. Classify different signals and systems and perform time domain analysis of LTI DTS.
2. Compute Convolution, Correlation of the signals
3. Find DFT of a given signal through Fast Fourier Transform Techniques
4. Design FIR and IIR type digital filters
5. Identify filter structures and evaluate the coefficient quantization effects

Subject Code: EC-310A / EC-310X
Subject Name: Microprocessor and Interfacing
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

- To introduce students to basic concepts of microprocessor
- To give a knowledge on Assembly Level Language.
- To introduce interfacing of peripheral with microprocessor.

B. Course Content

Introduction: Microcomputer structure and operation, 8086 microprocessor family, Overview, Architecture of processor 8085 and 8086.

Assembly Language Programming: Programming development steps, Constructing machine development codes for 8085 and 8086 instructions, Assembly language program development tools.

Strings, Procedure and Macros: String instructions, Writing and using procedures, writing and using assembler macros

Instruction Description and Assembler Directives: Instruction descriptions, Assembler directives systems connections, Timing and troubleshooting: Basic 8086 microcomputer systems connections, Logic analyzer to observe microprocessor bus signals, Troubleshooting simple 8086-based microcomputer.

Peripheral Interfacing Applications: Basic interfacing concepts, Memory / IO interfacing, non-programmable peripheral interface, 8255 programmable peripheral interface, Interfacing display, Keyboards, 8279 programmable keyboard / display interface, 8253/54 programmable timer, DMA controller, Interrupt controller, ADC and DAC interfacing, 8086 interrupts and types, 8259A priority interrupt controller, Software interrupt applications.

Memories, Coprocessors and EDA Tools: 8086 maximum mode and DMA data transfer, Interfacing and refreshing dynamic RAMs, Coprocessor - 8087 Math coprocessor, Computer based design and development tools.

C. Text Books

1. Sunil Mathur, "Microprocessor 8085 and its Interfacing", PHI.
2. Sunil Mathur, "Microprocessor 8086: Architecture, Programming and Interfacing", PHI.
3. Gaonkar R. S., "Microprocessor Architecture, Programming and Applications with 8085", Penram International.

D. Reference Books

1. Ram B., "Fundamental of Microprocessor & Microcomputers", Dhanpat Rai Publications.
2. Leventhal Lance, "Introduction to Microprocessor - Software, Hardware and Programming", PHI.
3. Mathur A. P., "Introduction to Microprocessor", Tata McGraw-Hill.
4. Short K. L., "Microprocessor and Programming Logic", Pearson Education.
5. Hall D., "Microprocessor and Interfacing", Tata McGraw-Hill.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Students will have the thorough understanding of the evolution of microprocessor
2. Students will get to know the interfacing knowledge to get a kick start in embedded world.
3. Students will get the idea of doing lively embedded design projects.

Subject Code: MH-3101
Subject Name: Engineering Economics
Credit Point: 3 (L=3, T=0, P=0)

A. Course objectives:

The course is design to meet the following objectives:

- Learn the fundamentals of Engineering Economics
- Understand and use of Economic concepts in making business decision
- Use economic information to manage the organization
- Use economic tools with respect to acceptance or rejection of investment proposals
- Know the current issues relating to economic environment

B. Course content

Basics of Economics: Basic Concepts, Scope, Importance and definitions, Relevant to Managerial Economics-Factors Influencing Managerial Decision — Managerial economics and other disciplines, Relation between Science, Engineering, Technology and Economics Demand Analysis : Managerial Decisions-Meaning-Types—Determinants, Demand Functions, Demand Elasticity, Demand Forecasting Methods, Accuracy of Forecasting Cost concept :Costs Concepts-Accounting Cost and Economic Cost determinants of Cost, Cost —Output Relationship, Break Even Analysis- Meaning, Assumption, Uses and Limitation, Break Even Point (BEP)- Meaning, Determinants of Break Even Point- Break Even Charts, linear approach (Simple numerical problems to be solved). Market Structure and Product Pricing: Perfect and Imperfect Market Structures. Conditions of Perfect Competition. Price of a Product under demand and supply forces. Equilibrium Price. Pricing under Monopoly and Monopolistic Competition. Pricing under Oligopoly. Kinked Demand Curve. Discriminating Prices. Inflation, Business cycle, Nation alI income: Inflation- meaning, feature, Types, causes, Effects of Inflation, Measures to Control Inflation. Business Cycle - Features of Business Cycle, Causes of Business Cycle, Types of Business Cycle, Theories of Business Cycle, Impacts/ Effects of Business Cycle, Measures to Control Business cycle, National Income & Current Issues-Concepts of National Income, Factors Determining Level (Size)of National Income, Methods of Measurement of National Income, Choice of Methods of National Income, Importance of Measurement of National Income, Difficulties in Measuring National Income.

C. Text Books:

1. Park, S. Chan, Fundamentals of Engineering Economics, Fourth Edition, Pearson New York, 2019
2. Yates, J.K. Engineering Economics, 1st Edition, CRC Press, Boca Raton, 2016.
3. Brajesh Kumar, Zahid A.Khan, Arshad N. Siddiquee, Mustufa H. Abidi , Principles of Engineering Economics with Applications, Cambridge University Press; 2nd edition 2018
4. Singh, Seema, Economics for Engineering Students, Second Edition. I.K. International Publishing House, Delhi, 2014.

D. Reference Books:

1. Panneer Selvam, Engineering Economics, Second Edition, New Delhi, PHI Learning Private Limited,2013.
2. Pravin Kumar, Fundamentals of Engineering Economics, New Delhi, John, and Wile y ,2012.
3. Gupta, G.S. Managerial Economics, Joel Dean, Englewood Cliffs, N.J.: Prentice-. Hall, 2011
4. Diwedi, D.N., Managerial Economics, New Delhi, Pearson Education India,2012. 5. Varshney, S.C., Managerial Economics, New Delhi Sultan Chand & Sons, 2010

E. Course outcomes:

1. Learn the fundamentals of Engineering Economics.
2. Understand and use of Economic concepts in making business decision.
3. Use economic information to manage the organization.

4. Use economic tools with respect to acceptance or rejection of investment proposals.
5. Know the recent trends relating to economic environment.

Subject Code: EC-3106
Subject Name: Introduction to Digital Integrated Circuits Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- To design and study of NMOS, PMOS and CMOS along with several combinational and sequential circuits in transistor level/coding level.

B. List of Experiments

1. Study and characterization of I/V plot of NMOS and PMOS
2. Design of CMOS inverter to study voltage transfer characteristic plot and to determine critical points.
3. Delay estimation of CMOS inverter and to study the effect of design parameters on delay.
4. Design and study of basic gates and adders with timing diagram.
5. Design and study of latch and clocked latch with timing diagram.
6. Layout of basic gates, adders, latch, clocked latch and to observe the performance in pre and post layouts.
7. Design of adders and subtractor using behavioral level in Verilog.
8. Design of latch and clocked latch using behavioral level in Verilog

C. Text books

1. S. M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits", 3/e, TMH, 2012
2. S. Palnitkar, "Verilog HDL- A Guide to Digital Design and Synthesis", 2/e, Pearson, 2007.

D. Reference books

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", Oxford University Press, 2004
2. J. M. Rabaey, A. Chandrakasan and B. Nikolic, "Digital Integrated Circuits", 2/e, PHI, 2003.

E. Course Outcomes

Upon completion of the subject, the student will have:

1. To explore the tools like LtSpice and Cadence.
2. An ability to design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits.
3. An ability to extract the parasitic elements from the layout and analyze the circuit timing using a logic simulator.
4. An ability to build a cell library to be used by other chip designers.

Subject Code: EC-3107
Subject Name: Digital Communication Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- To understand the building blocks of digital communication system.
- To understand and analyze the signal flow in a digital communication system.
- To understand and analyze different digital modulation and demodulation techniques.
- To understand concept of time division multiplexing in communication system.

B. Course Content

1. Study of pulse code modulation and demodulation
2. Study of delta modulation and demodulation
3. Study of pulse data coding techniques for NRZ formats
4. Study of amplitude shift keying modulator and demodulator
5. Study of frequency shift keying modulator and demodulator
6. Study of phase shift keying modulator and demodulator
7. Study of quadrature phase shift keying modulator and demodulator
8. Study of time division multiplexing.

C. Text books

1. Simon Haykin, "Communication Systems", Wiley publication, 4th Edition (2004).
2. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press, India.

D. Reference books

1. Bernard Sklar "Digital Communication-Fundamentals and Applications", Pearson Education India, 2nd Edition (2009)
2. John Proakis "Digital Communications", Tata Mc Graw Hill, 5th Edition (2007).
3. H Taub and D. L. Schilling, "Principles of Communication System",(2nd Edition), McGraw Hill, New Delhi.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digital communication system.
3. Select the blocks in a design of digital communication system.
4. Analyze performance of time division multiplexing in communication system.

Subject Code: EC-3108
Subject Name: Digital Signal Processing Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- Study properties of discrete signals
- Obtain Z-Transform of various signals
- Obtain DFT of various signals
- Design FIR and IIR filters

B. List of Experiments

1. To analyze various properties of discrete signals and verify them on MATLAB.
2. To analyze unilateral and bilateral z transforms of various signals. Also to analyze how unilateral z transform can be used to obtain system responses with initial conditions or changing inputs.
3. To form a routine of discrete time Fourier transform on MATLAB and find discrete time Fourier transform of various signals on MATLAB. Also analyze different application of discrete time Fourier transforms.
4. To study various properties of discrete time Fourier transform and verify these properties on various signals on MATLAB.
5. To form a routine of discrete Fourier transform on MATLAB and find discrete Fourier transform of various signals on MATLAB. Also analyze different properties of discrete Fourier transform.
6. To analyze fast Fourier algorithms and see how it can efficiently be used to calculate discrete Fourier transforms.
7. To design and simulate Chebychev and Butterworth filters and analyze their responses on MATLAB.
8. To design and simulate Infinite Impulse Response (IIR) filters and Finite Impulse Response (FIR) filters and analyzes their responses on MATLAB.
9. To give basic introduction of DSP boards, their applications and implementation of some applications on DSP boards.

C. Text books

1. S. W. Smith, “Digital Signal Processing: A Practical Guide for Engineers and Scientists”, Elsevier, 2005
2. A.V.Oppenheim & R.W.Schafer, "Discrete Time Signal processing", (2/e), Pearson Education, 2003.

D. Reference books

1. P.S.R.Diniz, E.A.B.da Silva and S.L.Netto, “Digital Signal Processing”, Cambridge, 2002.
2. E.C.Ifeachor & B.W.Jervis, “Digital Signal Processing”, (2/e), Pearson Education, 2002.
3. J.R.Johnson, “Introduction to Digital Signal Processing”, Prentice-Hall, 1989

E. Course Outcomes

After completion of the course, a student can:

1. Write a code to obtain Z-transform and Inver Z-transform
2. Analyse frequency spectrum of any signal.
3. Design and implement digital FIR & IIR filter

Subject Code: EC-3109
Subject Name: Microprocessor and Interfacing Laboratory
Credit Value: 0 (L = 0, T = 0, P = 2)

A. Course Objectives

The objective of the course is:

- To introduce students to basic concepts of microprocessor
- To give a knowledge on Assembly Level Language.
- To introduce interfacing of peripheral with microprocessor.

B. Course Content

1. Introduction to 8085 / 8086 Kit and Peripheral Boards.
2. Program set for Architecture Operations.
3. Program set for Logical and Decimal.
4. Program set for Subroutines and Delay.
5. Program set for Program Control.
6. Interfacing with 8255.
7. Interfacing with 8279.
8. Interfacing with 8253.
9. Interfacing with ADC/DAC

C. Text books

1. Sunil Mathur, "Microprocessor 8085 and its Interfacing", PHI.
2. Sunil Mathur, "Microprocessor 8086: Architecture, Programming and Interfacing", PHI.
3. Gaonkar R. S., "Microprocessor Architecture, Programming and Applications with 8085", Penram International.

D. Reference Books

1. Ram B., "Fundamental of Microprocessor & Microcomputers", Dhanpat Rai Publications.
2. Leventhal Lance, "Introduction to Microprocessor - Software, Hardware and Programming", PHI.
3. Mathur A. P., "Introduction to Microprocessor", Tata McGraw-Hill.
4. Short K. L., "Microprocessor and Programming Logic", Pearson Education.
5. Hall D., "Microprocessor and Interfacing", Tata McGraw-Hill.

E. Course Outcomes

After completion of the course, a student can:

1. Students will have the thorough understanding of the evolution of microprocessor
2. Students will get to know the interfacing knowledge to get a kick start in embedded world.
3. Students will get the idea of doing lively embedded design projects.

VIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-3201	Introduction to Analog Integrated Circuits	3	0	0	3
2	EC-3202	Microwave Engineering	3	0	0	3
3	EE-3202	Linear Control Systems	3	0	0	3
4	EC-320A	Microcontrollers and Embedded Systems	3	0	0	3
5	EC-321A	Information Theory and Coding	3	0	0	3
6	EC-320X	OE4*	3	0	0	3
7	EC-3203	Minor Project-II	0	0	4	2
8	EC-3204	Introduction to Analog Integrated Circuits Laboratory	0	0	2	1
9	EC-3205	Microwave Engineering Laboratory	0	0	2	1
10	EC-3206	Microcontrollers and Embedded Systems Laboratory	0	0	2	1
Contact Hours			18	0	10	
Total Credits						23

Subject Code: EC-3201
Subject Name: Introduction to Analog Integrated Circuits
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- To introduce the theoretical & circuit aspects of Op-amp and other integrated circuits

B. Course Content

Single Stage & Differential Amplifiers: Common source, Source follower, common gate, differential operations, basic differential pair.

Current Mirror: Basic current mirror, Cascode current mirror- large signal and small signal analysis

Basics of Operational Amplifiers: **I**deal op-amp, general op-amp stages, One / two stage op-amp design, DC & AC performance characteristics, Slew rate, Open and closed loop configurations, DC offset, Common mode rejection, Common mode gain and CMRR

Applications of Operational Amplifiers: Sign changer, Scale changer, Phase shift circuits, Voltage follower, V-to-I and I-to-V converters, Adder, Subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, Peak detector.

Analog Multiplier**:** Gilbert multiplier cell, Variable trans-conductance technique, Analog multiplier ICs and their applications.

Active Filters: Introduction, RC active filters, Chebyshev & Butterworth filters, State variable filter, Switched capacitor filter

C. Text Books

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata Mc Graw-Hill, 2007.
2. B. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill Education, 2017.

D. Reference Books

1. D. Roy Choudhury, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
2. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.
3. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India,1996.
4. S. Salivahanan & V. S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2008.
5. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Pearson Education, 2001.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Study of single stage differential amplifier along with current mirrors.
2. Explore the design of Op-Amps at certain technology.
3. Design op-amp circuits to perform arithmetic operations.
4. Analyze and design linear and non-linear applications using op-amps.

Subject Code: EC-3202
Subject Name: Microwave Engineering
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The Objective of the course is:

- To make the students to study the microwave spectrum, tubes, components, diodes and device
- To study the operation, functions of microwave sources, diodes and devices and to know about the application of these devices for microwave circuits & systems, radar and satellite communication
- To expose students to the measurement of microwave & RF circuits
- To make the students to learn about EMI and EMC
- To understand and study in depth of the theory and the technology of microwave components, devices, diodes, tubes and sources
- To know about the microwave circuit measurement & communication system design; and to understand EMI & EMC

B. Course Content

Transmission line theory: Primary and secondary constants, Phase and group velocities, Transmission line equations, Distortion, Loading of lines, Characteristics of LF lines.

RF lines: RF lines, Lossless lines, Reflection coefficient and VSWR, Quarter-wave, Half-wave and 1/8 wave lines, Smith chart: Impedance matching with single and double stub.

***Microwave waveguides and components*:** Rectangular waveguide and circular waveguide – mode structure, Cut-off frequency, Wall current, Attenuation, Microwave cavities – rectangular cavity resonator, Q factor, Scattering matrix and transmission matrix, Return loss, Gain considerations, Noise figure, Attenuator, Phase shifter, Directional coupler, Bethe hole coupler, Magic tee, Hybrid ring, Circulator, Isolator.
***Microwave Tubes*:** Limitations of conventional tubes, Multicavity klystron, Reflex klystron, Magnetron, Travelling wave tube, Backward wave oscillator

***RF Circuit*:** Low pass filter, High pass filter, Band pass filter, RF amplifier - low noise consideration.

***EMI / EMC*:** EMI standard, Radiated and conducted EMI and susceptibility, Wire antenna, EMI sensor, Antenna factor, Cable to cable coupling, Electrostatic discharge.

***Applications of Microwave*:** Principles of radar systems and applications, Radar range equations, Satellite communication system, Industrial applications of microwave.

***Microwave Measurement*:** VSWR measurement, Power measurement, Impedance measurement, Frequency measurement.

C. Text & Reference Books

1. S Y Liao, "Microwave Devices and Circuits", Prentice Hall of India, 2006.
2. Reinhold Ludwig and Pavel Bretchko "RF Circuit Design", Pearson Education, Inc., 2006
3. Matthew M Radmanesh, "Radio Frequency and Microwave" Electronics Illustrated, Pearson Education Asia.

D. Reference Books

1. David M Pozar, "Microwave Engineering", John Willy & Sons. Inc, 2006.
2. Peter A Rizzi, "Microwave Engineering – Passive Circuits", Prentice Hall of India.

3. M L Sisodia, “Microwave Active Devices – Vacuum and Solid State”, New Age Int. Publication.
4. M N O Sadiku, “Elements of Electromagnetics”, Oxford University Press.
5. K C Gupta, “Microwave Engineering” New Age Int. Publication, New Delhi.
6. M I Skolnik, “Introduction to Radar Systems”, Tata McGraw Hill.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Recognize the limitations of existing vacuum tubes and solid-state devices at microwave frequencies
2. Know the operation, functions of microwave sources, diodes and devices and also know about the application of these devices for microwave circuits & systems, radar and satellite communication
3. Analyse microwave & RF circuits.
4. Know in depth of the theory and the technology of microwave components, devices, diodes, tubes and sources
5. Have clear understanding of the microwave circuit measurement & communication system design; and understand EMI & EMC.

Subject Code: EE-3202
Subject Name: Linear Control Systems
Credit Point: 3 [L=3, T=0, P=0]

A. Course Objectives:

The course is designed:

- To enable the students to carry out mathematical modelling of any given physical systems.
- To analyse the time response and frequency response of the considered systems.
- To impart knowledge on stability of systems and to control the systems and perform design of controllers and compensators.

B. Course Content:

Introduction to Systems: Mathematical models of physical systems - Control hardware and their models - Transfer Function models of linear time-invariant systems – Industrial Control examples. **Feedback Control:** Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Standard test signals: Time response of first and second order systems for standard test inputs - Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability: Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Frequency response analysis: Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin - closed-loop frequency response. Root-loci method of feedback controller design. Design specifications in frequency domain.

Design of Controllers and Compensators: Application of Proportional, Integral and Derivative Controllers - Lead and Lag compensation in designs - Analog and Digital implementation of controllers.

C. Text Books:

1. Norman.S.Nise, "Control Systems Engineering", Wiley India Edition, 2018.
2. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 4th Edition, 2012.
3. Farid Golnarghi & Benjamin. C. Kuo, "Automatic Control System", McGraw Hill Education, 1st Edition, 2018.

D. Reference Books:

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson Education India, 5th Edition, 2015.
2. Richard.C.Dorf & Robert.H.Bishop, "Modern Control Systems", Pearson Education India, 15th Edition, 2013.
3. S.N.Sivanandam & S.N.Deepa, "Problems & Solutions in Control System Engineering", Jaico Publishing House, 1st Edition, 2005.

E. Course Outcomes:

At the end of the course, a student will be able to:

1. Understand the modelling of linear-time-invariant systems using transfer function and state-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers and compensators

Subject Code: EC-320A / EC-320X
Subject Name: Microcontrollers and Embedded Systems
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The Objective of the course is:

- To understand microcontrollers and concept of embedded system
- To understand the operation of 8051 and PIC
- To get familiar with ARM processor family, Raspberry Pi and Arduino processor

B. Course Content

Introduction to Microcontroller and Embedded Processors: Introduction to microcontrollers, types of microcontrollers, Concept of embedded systems, embedded system classifications, Use of embedded systems software and its applications, scheduling algorithms, RTOS- Inter process communication, Interrupt driven input and output.

8051 Microcontroller Programming: Bit wise handling of registers, Timers and counter, Normal mode, Match mode, PWM mode.

Interrupts*:* Theory, Vectored and nested vectored interrupts, Internal and external interrupts, Non-maskable interrupt, Software interrupt for different microcontrollers.
Models of computation, GPIO programming.

Embedded Controller Arduino Family**:** Introduction and its variety, Intel Galileo, Reading data from analog and digital sensors on serial monitor/LCD monitor, Work with LED controlled by switch/potentiometer, 7 segment LED display/control, Interfacing relays and servomotors to Arduino and Galileo.

Raspberry Pi**:** Introduction, Configuration and applications.

ARM: Assembly instructions and modes, ARM ISA and processor variants, ARM instruction sets, Program control flow.

Interrupt: Instruction, Latency, Handling schemes.

C. Text Books

1. Prasad K.V.K.K, Embedded /Real-Time Systems: Concepts, Design and Programming—The Ultimate reference, Dreamtech Press, New Delhi, 2003.
2. Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

D. Reference Books

1. Thomas W Schultz, C and the 8051: Building efficient applications, Volume II, Prentice hall, 1999.
2. Zurell, Kirk, C Programming for Embedded systems
3. Schultz, Thomas W, C and the 8051 Programming for Multitasking –
4. Steven Holzner, C with assembly language, BPB publication
5. Schultz, Thomas W, C and the 8051: Hardware, Modular Programming and Multitasking Vol 1
6. Stuart Russell and Peter Norving, Artificial Intelligence: A Modern Approach, Prentice Hall.
7. Davin Poole, Alan Mackworth, and Randy Goebel, Computational Intelligence: A logical Approach, Oxford University Press.

E. Course Outcomes

After the completion of this course, students will be able:

1. Understand microcontrollers and embedded systems
2. Use microcontroller in different applications.
3. Understand ARM processor family, Raspberry Pi and Arduino processor

Subject Code: EC-321A
Subject Name: Information Theory and Coding
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The Objective of the course is:

- To equip students with the basic understanding of the fundamental concept of entropy and information as they are used in communications.
- To make students equip with various data compression technique.
- To apply various linear block codes and convolution codes for error detection and correction

B. Course Content

Information Theory: Information, channel capacity, The concept of amount of information, entropy, Information rate, Conditional and joint entropies

Source Coding: Noise less coding, Shannon's first fundamental theorem, Discrete memoryless channels, Mutual information, sources with finite memory, Markov sources, Shannon's second fundamental theorem on coding, Huffman coding, Lempel-Ziv algorithm, Shannon-Fanon algorithm

Channel Coding: Error detecting codes, Hamming distance, Error correcting codes, Repetition codes, Linear block codes, Binary cyclic codes, BCH codes, Reed-Solomon codes, Golay codes

Convolutional Codes: Code tree, State diagram, Trellis diagram, Maximum likelihood decoding-Viterbi's algorithm, Sequential decoding

C. Text books

1. T. M. Cover and J. A. Thomas, "Elements of Information Theory", John Wiley.
2. R. E. Blahut, "Algebraic Codes for Data Transmission", Cambridge University Press.

D. Reference books

1. Simon Haykin, "Communication Systems", John Wiley.
2. JB Proakis, "Digital Communications", Mc Graw Hill.
3. S Roman, "Coding and Information Theory", New York: Springer-Verlag.

E. Course Outcomes

At the end of the course student will be able

1. Students will be introduced to the basic notions of information and channel capacity
2. Students will be introduced and equipped with the convolutional and block codes, decoding techniques
3. Students will understand how error control coding techniques are applied in communication systems.

Subject Code: EC-3204
Subject Name: Introduction to Analog Integrated Circuits Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The Objective of the course is:

- To introduce students to electronic design automation tools to design Analog CMOS circuits using process nodes

B. List of Experiments

1. Estimation of Resistance and Transconductance of NMOS/PMOS and verify it's mathematical equation.
2. Design and study of common source, source follower and common gate amplifiers in order to understand input output characteristics.
3. Design of CMOS differential amplifier with different gate size and input with different slew rate for the generation I/V plot.
4. Design of study differential amplifier with input output plots and to understand the difference from single stage amplifiers
5. Design of Single stage Op-Amp.
6. Study the characteristics of Operational Amplifiers (IC741)
7. Study and implement circuits using IC741 for many applications: Voltage Follower, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector
8. Waveform Generation using Op-Amp (IC741)

C. Text Books

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata Mc Graw-Hill, 2007.
2. B. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill Education, 2017.

D. Reference Books

1. D. Roy Choudhury, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
2. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.
3. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India,1996.
4. S. Salivahanan & V. S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2008.
5. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.

E. Course Outcomes

At the end of the course, a student will be able to:

1. Study of single stage differential amplifier along with current mirrors.
2. Explore the design of Op-Amps at certain technology.
3. Design op-amp circuits to perform arithmetic operations.
4. Analyze and design linear and non-linear applications using op-amps.

Subject Code: EC-3205
Subject Name: Microwave Engineering Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The Objective of the course is:

- To make the hands-on of students on matching stub
- To make the hands-on of students on reflex klystron
- To make the hands-on of students on waveguide
- To make an understanding on smith chart

B. List of experiments

1. A matching stub is a piece of transmission line which is normally short circuited at the far end. Stub has an input admittance which a pure susceptance and it is used to tune the susceptance component of the line admittance. Stubs are particularly used at higher frequencies for variety of loads. How a matching stub used to matching the frequency.
2. Study the characteristics of the Reflex Klystron Tube and to determine its electronic tuning range. What do you mean by beam voltage and rippled voltage? How rippled voltage helps to get estimated frequency. Measure frequency from microwave bench.
3. By the use of the slotted line. To determine the unknown frequency. To determine the Voltage Standing Wave Ratio (VSWR) and Reflection Coefficient.
4. By use of slotted waveguide. To observe how the load impedance affects the VSWR. To determine when a waveguide is properly terminated.
5. To measure unknown load impedance attached to a waveguide using the smith chart.

C. Text books

1. S Y Liao, "Microwave Devices and Circuits", Prentice Hall of India, 2006.
2. Reinhold Ludwig and Pavel Bretchko "RF Circuit Design", Pearson Education, Inc., 2006
3. Matthew M Radmanesh, "Radio Frequency and Microwave" Electronics Illustrated, Pearson Education Asia.

D. Reference books

1. David M Pozar, "Microwave Engineering", John Willy & Sons. Inc, 2006.
2. Peter A Rizzi, "Microwave Engineering – Passive Circuits", Prentice Hall of India.
3. M N O Sadiku, "Elements of Electromagnetics", Oxford University Press.
4. K C Gupta, "Microwave Engineering" New Age Int. Publication, New Delhi.

E. Course Outcomes

1. Clear understanding & utilization of matching stub and reflex klystron.
2. Clear understanding and utilisation of waveguide.
3. Clear understanding of smith chart.

Subject Code: EC-3206
Subject Name: Microcontrollers and Embedded System Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

The Objectives of the course is:

- To study and apply microcontrollers to generate waveforms
- To learn the applications of Arduino and Raspberry Pi
- To get familiarize with Proteus design suit

B. List of Experiments

1. To study development tools/environment for ATMEL microcontroller programs and architecture
2. Generate square wave of desire frequency using Timer, PWM.
3. Interface seven segments with Arduino and display 0-9 on it.
4. Control joint movement of Robot arm by using Gallio.
5. Using Proteus design suit, develop IoT circuits to control different switches.
6. Model-based design using uKeil
7. Interfacing Raspberry Pi with camera module.
8. Hardware implementation using any advanced controller

C. Text books

1. Prasad K.V.K.K, Embedded /Real-Time Systems: concepts, Design and Programming—The Ultimate reference, Dreamtech Press, New Delhi
2. Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

D. Reference books

1. Thomas W Schultz, C and the 8051 Volume II, Building Efficient Applications, Prentice Hall
2. Zurell, Kirk, C Programming for Embedded Systems
3. Schultz, Thomas W, C and the 8051 Programming for Multitasking, – Prentice Hall
4. Steven Holzner, C with assembly language, BPB publication
5. Schultz, Thomas W, C and the 8051: Hardware, Modular Programming and Multitasking Vol 1
6. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall.
7. Davin Poole, Alan Mackworth, and Randy Goebel, Computational Intelligence: A logical Approach, Oxford University Press.

E. Course Outcomes

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

1. Understand microcontrollers and embedded systems
2. Use microcontroller in different applications
3. Understand ARM processor family, Raspberry Pi and Arduino processor.

VIIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	ME-4101	Product Design and Development	3	0	0	3
2	EC-410A EC-410B	Internet of Things Robotics and Automation	3	0	0	3
3	EC-411A	Wireless Communication	3	0	0	3
4	EC-412A EC-412B	Optical Communication Natural Language Processing	3	0	0	3
5	EC-410X	OE5*	3	0	0	3
6	EC-4102	Internship-II	0	0	0	1
7	EC-4103	Major Project-I	0	0	8	4
Contact Hours			15	0	6	
Total Credits						20

Subject Code: ME-4101
Subject Name: Product Design and Development
Credit Point: 3 [L = 3, T = 0, P = 0]

A. Course Objectives:

1. To study the basic concepts of product design and development process.
2. To expose the students to different design principles like designing for function, production, maintenance, packaging etc.
3. To study the applicability of product design and development in industrial applications including product specifications, concept development, design for prototyping and manufacturing.

B. Course Content:

Introduction*:* Product design definition and evolution, product design morphology, product life cycle, product policy of an organization, selection of a profitable product, product design process, product analysis.

Product design*:* Flow charting, creativity techniques, translating customer needs, product development process.

Value engineering in product design*:* Advantages, applications in product design, problem identification and selection, functional analysis, functional analysis system techniques (FAST), case studies.

Product design tools*:* Quality function development (QFD), computer aided design, robust design, design for excellence, design for manufacturing, design for assembly, ergonomics in product design.

Product costing*:* Elements of product cost, life cycle costing, material selection, metals and alloys, plastics, ceramics, rubber.

Design for manufacturing and assembly*:* Guidelines, product design for manual assembly, design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., rapid prototyping, needs, advantages, working principle of stereo lithography, laminated object manufacturing, selective laser sintering.

C. Text Books:

1. Eppinger S and Ulrich K, Product design and development, McGraw Hill Higher Education, 2015.
2. Magrab E. B, Gupta S. K, McCluskey F. P and Sandborn P, Integrated product and process design and development: The product realization process, CRC Press, 2009.
3. Ulrich K. T, Steven D. E, Product Design & Development, Tata McGraw Hill, New Delhi, 2003.

D. Reference Books:

1. Boothroyd G, Product design for manufacturing and assembly: Computer Aided Design, 26 (7), pp 505-520, 1994.
2. Hollins B and Pugh S, Successful Product Design, Butter Worths, London.
3. Bralla J G, Handbook of Product Design for Manufacture, McGraw Hill, New York.

E. Course Outcomes:

Upon completion of the subjects, students will be able to:

1. Describe an engineering design and development process.
2. Employ engineering, scientific and mathematical principles to execute a design from concept to finished product.

3. Choose an appropriate standardization method for product and develop methods to minimize the cost.
4. Explain product design for manufacturing and manual assembly.

Subject Code: EC-410A / EC-410X
Subject Name: Internet of Things
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics
- Understand the recent application domains of IoT in everyday life
- Understand the protocols and standards designed for IoT and the current research on it.

B. Course Content

The Internet of Things: An Overview, Design Principles for Connected Devices

Internet Principles: Internet communications-An overview, IP, TCP, UDP, HTTP, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, Prototyping Embedded Devices, Prototyping online components, IoT and M2M, IoT Platforms Design Methodology, IoT Systems

Logical Design using Python: Introduction, Python data types and data structures, functions, modules, packages, IoT Physical Devices and Endpoints

IoT Physical Servers and Cloud Offerings: Introduction to cloud storage models and communication APIs

Data Analytics for IoT, IoT and RTOS: Why RTOS, requirements of OS for IoT, scalability, modularity, connectivity, Reliability, programming languages, IoT Security Options, Low Power Optimization of IoT Systems, Fundamentals of data acquisition systems, Analysis of some Real-World Use Cases, Case Studies Illustrating IoT design e.g. Smart Lighting, home intrusion detection, smart parking, smart irrigation, forest fire detection

C. Text Books

1. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiely, 2015
2. A. Bahga and V. Madisetti, Internet of Things: A hands on Approach, Universities Press, 2015

D. Reference Books

1. Oliver Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key Applications and Protocols, Wiley, 2012
2. Ian G Smith, The Internet of Things 2012 New Horizons, IERC, 2012

E. Course Outcomes

1. The students will be thorough about the technology behind the IoT and associated technologies
2. The students will be able to use the IoT technologies in practical domains of society
3. The students will be able to gain knowledge about the state-of-the-art methodologies in IoT application domains.

Subject Code: EC-410B / EC-410X
Subject Name: Robotics and Automation
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- To impart knowledge about basic mathematics related to industrial robots for their control, design and application in robotics & automation Industries.
- Illustrate the Kinematics and Dynamics of robotics
- Elucidate the need and implementation of related Instrumentation & control in robotics
- Illustrate the movement of robotic joints with computers/microcontrollers.
- Explain sensors and instrumentation in robotics

B. Course Content

Introduction to Robotics

Types and components of a robot, Classification of robots,
Kinematics systems; Definition of mechanisms and manipulators, Degrees of Freedom
Robot Kinematics and Dynamics
Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity, and Statics
Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation

Sensors

Sensor: Contact and Proximity, Position, Velocity, Force, Tactile, etc.
Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations
Vision applications in robotics.
Robot Actuation Systems
Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

Robot Control

Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID
Linear and Non-linear controls
Control Hardware and Interfacing
Embedded systems: Microcontroller Architecture and integration with sensors, actuators, components, Programming Applications for Industrial robot - programming in – VAL II

AI in Robotics: Applications in unmanned systems, defense, medical, industries, etc.
Robotics and Automation for Industry 4.0 Robot safety and social robotics.

C. Text Books

1. Marcelo Corrales, Mark Fenwick, Nikolaus Forgó, Robotics, AI and the Future of Law, Springer, 2018
2. Wang, Yaobing, Space robotics. Springer, 2021.

D. Reference Books

1. J. Craig, Introduction to Robotics: Mechanics and Control, Pearson, 2004
2. Spong & Vidyasagar, Robot Dynamics and Control, Mc Graw Hill, 2008
3. Subir K Saha, Introduction to Robotics, Mc Graw Hill, 2014

4. M. P. Groover, Ashish Dutta, Industrial Robotics - Technology, Programming and Applications, McGraw Hill, 2017

E. Course Outcomes

1. Perform kinematic and dynamic analyses with simulation.
2. Design control laws for a simple robot.
3. Integrate mechanical and electrical hardware for a real prototype of robotic device.
4. Select a robotic system for given industrial application.

Subject Code: EC-411A
Subject Name: Wireless Communication
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The Objective of the course is:

- To expose the students to understand mobile radio communication principles
- To provide an overview of Wireless Communication networks area and its applications in communication engineering.
- To understand the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.

B. Course Content

Introduction to wireless communication*:* Evolution of mobile radio communication, Examples of wireless communication system.

The cellular engineering fundamentals: Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity.

Mobile Radio Propagation models: Free space propagation models, Two Ray model, Knife edge diffraction model, Log-distance path loss model, Outdoor propagation model, Indoor propagation model, Small scale multipath propagation, Small scale fading

Modulation techniques for mobile radio: Analog modulation techniques, Line Coding, Pulse shaping, Linear modulation techniques, Constant envelope modulation techniques, Combined modulation techniques, Spread spectrum modulation techniques

Multiple access techniques**:** TDMA, FDMA, CDMA, SDMA, CSMA, OFDMA
GSM, 3G, 4G (LTE), NFC systems, WLAN technology, WLL, HiperLAN, Ad hoc networks.

C. Text books

1. T. S. Rappaport, Wireless Communications, PHI.
2. A Goldsmith, Wireless Communications, Cambridge publication

D. Reference books

1. K. Feher, Wireless Digital Communications: Modulation and Spread Spectrum Applications.
2. J. G. Proakis, Digital Communications, Mc Graw Hill.
3. W. C. Lee, Mobile Communications Engineering.
4. S. Haykin and M. Moher, Modern Wireless Communications.

E. Course Outcomes

After completion of this course students will be able to:

1. Understand the cellular system design and technical challenges.
2. Analyse the Mobile radio propagation, fading, diversity concepts and the channel modelling.
3. Analyse the design parameters, link design, smart antenna, beam forming and MIMO systems.
4. Analyse Multiuser Systems, CDMA, WCDMA network planning and OFDM Concepts.
5. Clearly know the principles and applications of wireless systems and standards

Subject Code: EC-412A
Subject Name: Optical Communication
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion, SM fibers.
- To learn the various optical sources, materials and fiber splicing
- To learn the fiber optical receivers and noise performance in photo detector.
- To learn link budget, WDM.

B. Course Content

Fiber Structures and Types, Rays and modes, Single-mode and multimode fibers, Refractive index profiles, Graded index fiber, Numerical aperture, Acceptance angle, V-parameter, Loss mechanisms in fibers, Loss vs. wavelength plot and its significance, Dispersion mechanisms in Fibers: Intermodal and intramodal (chromatic) dispersions, Components of intramodal dispersions, Dispersion vs. wavelength plots and their significance.

Optical Sources: LED and LASER structures, Operating principle and modulation characteristics.

Photo Detectors: PIN diode and avalanche photodiode (APD) as photo detector: Structure, operating principle, Shot noise, Avalanche multiplication (excess) noise.

Optical isolators, polarizer, Circulators, Attenuators, Oscillators, Filters, Add/drop multiplexers, Optical modulators. Optical amplifiers: Basic applications and types, Semiconductor optical amplifiers, EDFA.

Wave division multiplexing and demultiplexing, Intensity modulation/direct detection system, Link budget using direct detection, Coherent system, Wavelength converters, Coherent and WDM systems.

C. Text books

1. R.P. Khare, “Fiber Optics and Optoelectronics”, Oxford University Press
2. John M. Senior, “Optical Fiber Communications: Principles and Practice - Principles and Practice”, Pearson Education India; Third edition

D. Reference books

1. Gerd Keiser, “Optical Fiber Communications”, McGraw Hill Education; Fifth edition
2. Govind P. Agrawal, “Fiber-Optic Communication Systems”, Wiley; Third edition

E. Course Outcomes

At the end of the course, a student will be able to:

1. Recognize and classify the structures and types of Optical fiber.
2. Discuss the channel impairments like losses and dispersion.
3. Classify the optical sources and detectors and discuss their principle.
4. Be familiar with different optical devices such as Optical isolators, polarizer, Circulators, Attenuators, Oscillators, Filters
5. Perform characteristics of optical fiber, sources and detectors, design as well as conduct experiments in software and hardware, analyze the results to provide valid conclusions.

Subject Code: EC-412B
Subject Name: Natural Language Processing
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- Understand the basic principles of pattern classification;
- Understand Gaussian mixture models, hidden Markov models and N-gram language models;
- Understand weight finite state transducers;
- Be able to apply the above approaches to speech processing applications.

B. Course Content

Introduction: Scope of the course and introduction to speech sounds and frequency domain representations.

Basic pattern processing: Bayes' decision rule, forms of statistical classifier and generative models.

GMM-based speaker verification: Basic feature vectors (MFCC/deltas), MAP parameter estimation, decision rules/ROC curve.

Hidden Markov Models and the Viterbi algorithm: HMM structure and underlying assumptions, training using Baum-Welch and the EM algorithm. Networks and the Viterbi algorithm.

Decision trees and context modelling: Phone-level variation, dictionaries, decision trees and context clustering.

Weighted finite state transducers: Basic operations of WFST, and WFST representation of information in speech systems.

N-gram language models: N-gram language models, discounting, smoothing, backing-off, mixture language models and interpolation. WFST representation of language models.

Applications of spoken language processing: Examples of applications, including speech recognition and speech synthesis.

C. Text Books

1. Ghosh, S.; Guning, D., Natural Language Processing Fundamentals, Packt Publishing Limited, 2019.

D. Reference Books

1. Blokdyk, G., Natural-Language Processing, Createspace Independent Publishing Platform, 2018
2. Huang, X., Acero, A. & Hon, H-W., Spoken language processing, Prentice-Hall, 2001.
3. Jurafsky, D. & Martin, J., Speech and language processing, Prentice-Hall, 2008.
4. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, "Spoken Language Processing, A guide to theory, algorithm and system development", Prentice Hall, Inc, New Jersey, USA, 2001.

E. Course Outcomes

1. Understand statistical approaches and some of the major techniques used for spoken language processing.
2. Understand weight finite state transducers.
3. Apply the above approaches to speech processing applications.

Subject Code: EC-412C
Subject Name: 5G Communications
Credit Point: 3 [L = 3, T = 0, P = 0]

A. Course Objectives

- Learning the Basics of 5G and Beyond Wireless communication
- Providing a basic understanding of the key technologies and enablers of 5G and beyond communication systems.
- Study of 5G wireless channel models
- Learning 5G techniques e.g. massive MIMO. mmWave etc.

B. Course Content

Overview of 5G Broadband Wireless Communications: Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G.

The 5G wireless Propagation Channels: Channel modelling requirements, propagation scenarios and challenges in the 5G modelling, Channel Models for mmWave MIMO Systems.

Transmission and Design Techniques for 5G: Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques – orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA).

Device-to-device (D2D) and machine-to-machine (M2M) type communications – Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multi-hop and multi-operator D2D communications.

Millimeter-wave Communications – spectrum regulations, deployment scenarios, beam-forming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM)

C. Text book

1. Martin Sauter “From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband”, Wiley-Blackwell.
2. Afif Osseiran, Jose. F. Monserrat, Patrick Marsch, “Fundamentals of 5G Mobile Networks”, Cambridge University Press.
3. Athanasios G. Kanatos, Konstantina S. Nikita, Panagiotis Mathiopoulos, “New Directions in Wireless Communication Systems from Mobile to 5G”, CRC Press.
4. Theodore S. Rappaport, Robert W. Heath, Robert C. Danials, James N. Murdock “Millimeter Wave Wireless Communications”, Prentice Hall Communications.

D. Reference book

1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, John Wiley & Sons.
2. Amitabha Ghosh and Rapeepat Ratasuk “Essentials of LTE and LTE-A”, Cambridge University Press.

E. Course Outcomes

After completion of this course students will be able to:

1. Gain an in-depth understanding of how 5G is revolutionizing the way we do business in the 2020s.
2. Learn about the technologies that make 5G possible, including mmWave, Massive MIMO, RAN, and more.
3. Learn how companies can take advantage of 5G Private Networks and Industrial IoT to transform the way they operate on a daily basis.
4. Gain the base-level knowledge of 5G you need to continue your wireless education and advance in the rapidly-growing field of wireless technology.