Course Curriculum for B. Tech.

In

Electronics & Communication Engineering

(For students admitted in 2019-20 onwards)

National Institute of Technology Arunachal Pradesh

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1.0 Semester wise Credit point distribution

Sl. No.	Year	Credit Point	
		ODD	EVEN
1	First	18.5	20.5
2	Second	22	21
3	Third	22	23
4	Fourth	15	18
Total Credit Point		**77.5**	**82.5**
		160	

2.0 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
Core (Basic Science)	**7**	**10**	**4**	**--**	**--**	**--**	**--**	**--**	**21**
Core (Engineering Science)	**6**	**3**	**--**	**--**	**--**	**--**	**--**	**--**	**9**
Core (Professional)	**--**	**--**	**12**	**16**	**18**	**19**	**6**	**--**	**71**
Core (Humanities)	**3**	**3**	**3**	**3**	**--**	**--**	**--**	**--**	**12**
Elective (Professional)	**--**	**--**	**--**	**--**	**--**	**--**	**3**	**--**	**3**
Open Elective	**--**	**--**	**--**	**--**	**--**	**--**	**3**	**--**	**3**
Elective (online course)	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**6**	**6**
Lab (Basic Science)	**1**	**1**	**--**	**--**	**--**	**--**	**--**	**--**	**2**
Lab (Engineering Science)	**1.5**	**3.5**	**--**	**--**	**--**	**--**	**--**	**--**	**5**
Lab (Humanities)	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Lab (Professional)	**--**	**--**	**3**	**2**	**4**	**4**	**1**	**--**	**14**
Internship	**--**	**--**	**--**	**--**	**--**	**--**	**2**	**--**	**2**
Academic Project	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**10**	**10**
Audit (NSS/NCC)	**0**	**0**	**--**	**--**	**--**	**--**	**--**	**--**	**0**
Grand Viva	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**2**	**2**
Total Credit Point	**18.5**	**20.5**	**22**	**21**	**22**	**23**	**15**	**18**	**160**

3.0 Course Structure

		Ist Semester				
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CY-101	Engineering Chemistry	3	0	0	3
2	CY-102	Engineering Chemistry Laboratory	0	0	2	1
3	MA-101	Engineering Mathematics-I	3	1	0	4
4	ME-101	Engineering Mechanics	3	0	0	3
5	ME-102	Workshop Practice-I	0	0	3	1.5
6	MH-101	Communication Skill	0	3	0	3
7	BIO-101	Bio-Science	3	0	0	3
8	MH-113	NSS/NCC	0	0	2	0
Contact Hours			12	4	7	
Total Credits						18.5
		IInd Semester				
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PHY-101	Engineering Physics	3	0	0	3
2	PHY-102	Engineering Physics Laboratory	0	0	2	1
3	MA-102	Engineering Mathematics-II	3	1	0	4
4	CY-108	Introduction to Environmental Science	3	0	0	3
5	CS-112	Introduction to Computer Programming	2	0	0	2
6	CS-113	Introduction to Computer Programming Laboratory	0	0	4	2
7	ME-121	Engineering Drawing	1	0	3	2.5
8	MH-106	Fundamentals of Economics	3	0	0	3
9	MH-113	NSS/NCC	0	0	2	0
Contact Hours			15	1	11	
Total Credits						20.5
		IIIrd Semester				
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	MA-201	Probability and Statistics	3	1	0	4
2	MH-201	Introduction to Human Values and Ethics	3	0	0	3
3	EE-201	Electrical Circuit Analysis	3	0	0	3
4	CS-201	Data Structure and Algorithm	3	0	0	3
5	EC-201	Analog Circuits – I	3	0	0	3
6	EC-202	Digital Logic Design	3	0	0	3
7	CS-203	Data Structure and Algorithm Laboratory	0	0	2	1
8	EC-203	Analog Circuits-I Laboratory	0	0	2	1
9	EC-204	Digital Logic Design Laboratory	0	0	2	1
Contact Hours			18	0	6	
Total Credits						22
		IVth Semester				
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	MH-206	Entrepreneurship	3	0	0	3
2	CS-206	Computer Organization and Architecture	3	1	0	4
3	EC-221	Electromagnetic Field Theory	3	0	0	3

4	EC-222	Signals and Systems	3	0	0	3
5	EC-223	Analog Circuits-II	3	0	0	3
6	EC-224	Analog Communication	3	0	0	3
7	EC-225	Analog Circuits-II Laboratory	0	0	2	1
8	EC-226	Analog Communication Laboratory	0	0	2	1
Contact Hours			18	0	4	
Total Credits						21
Vth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EE 305	Linear Control Systems	3	0	0	3
2	EE-307	Power Electronics	3	0	0	3
3	EC-301	Linear Integrated Circuits	3	0	0	3
4	EC-302	Digital Communication	3	0	0	3
5	EC-303	Microprocessor and Interfacing	3	0	0	3
6	EC-304	Digital Signal Processing	3	0	0	3
7	EC-305	LIC Laboratory	0	0	2	1
8	EC-306	Digital Communication Laboratory	0	0	2	1
9	EC-307	Microprocessor and Interfacing Laboratory	0	0	2	1
10	EC-308	Digital Signal Processing Laboratory	0	0	2	1
11	EC-390	Internship - I	0	0	0	0
Contact Hours			18	0	8	
Total Credits						22
VIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-306	Computer Networking	3	1	0	4
2	EC-321	Information Theory and Coding	3	0	0	3
3	EC-322	Instrumentation and Measurement	3	0	0	3
4	EC-323	Microcontrollers and Embedded Systems	3	0	0	3
5	EC-324	Microwave Engineering	3	0	0	3
6	EC-325	VLSI Design	3	0	0	3
7	EC-326	Instrumentation and Measurement Laboratory	0	0	2	1
8	EC-327	Microcontrollers and Embedded System Laboratory	0	0	2	1
9	EC-328	Microwave Engineering Laboratory	0	0	2	1
10	EC-329	VLSI Design Laboratory	0	0	2	1
11	EC-391	Internship – II	0	0	0	0
Contact Hours			18	1	8	
Total Credits						23
VIIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-405X	Open Elective	3	0	0	3
2	EC-401X	Elective-I	3	0	0	3
3	EC-402	Wireless Communication	3	0	0	3
4	EC-403	Antenna and Wave Propagation	3	0	0	3
5	EC-404	Antenna and Wave Propagation Laboratory	0	0	2	1
6	EC-490	Internship – III	0	0	0	2

Contact Hours			12	0	2	
Total Credits						15
VIIIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-421X	Elective-II (Swayam/ NPTEL)	3	0	0	3
2	EC-422X	Elective-III (Swayam/ NPTEL)	3	0	0	3
3	EC-491	Grand Viva	0	0	4	2
4	EC-499	Project and Dissertation	0	0	20	10
Contact Hours			6	0	24	
Total Credits						18

4.0 List of subjects offered under Elective-I

Course Code (EC-401X)	Course Title
EC - 401A	Optical Communication
EC - 401B	Wireless Sensor Network
EC - 401C	Image processing
EC – 401D	Machine Learning

5.0 Open elective (offered by other department) — [EC-405X]

- Students are free to choose any subjects of their interest offered as open electives by other department of the Institute.
- The course has to be of 3 credits.
- During the beginning of the 7th semester, HoD, Electronics & Communication will notify the specific subject offered as an open elective for other departments.

Course Code (EC-401X)	Course Title
EC - 405A	Internet of Things
EC - 405B	Nanotechnology
EC - 405C	Spoken Language Processing
EC – 405D	Robotics and Automation

6.0 Elective-II & III

- These two courses will be chosen from NPTEL (https://nptel.ac.in/) / SWAYAM portal (https://swayam.gov.in).
- Student can enrol in 4th year (7th & 8th semester). However, the courses will be credited in 8th semester only.
- Courses will be of completely student's choice and should be of at least of 12 weeks including tutorials which will be considered as 3 credit course.
- The choice of courses should be from outside the core and electives offered / opted.

7.0 Internship

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

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INSTITUTE VISION

"Our vision is to impart quality technical education with strong underpinning of sound knowledge in the domain. Our approach is interactive, innovative and quintessentially holistic. Our goal is to produce imaginative entrepreneurs, technology leaders of the new millennium and researchers with a profound sense of humanistic and ethical values."

INSTITUTE MISSION

"Our mission is that of producing such Technical Engineers who will not run after jobs, but for whom jobs will run after them, and such that they will create employment and develop new technologies for a faster, sustainable and inclusive growth."

DEPARTMENT MISSION

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

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.*

Programme Outcomes (POs)

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

PO1	Apply basic science and mathematics to analyze complex engineering problems
PO2	Gather requirement specifications, design and test electronic systems.
PO3	Apply EDA tools to design linear and digital IC systems.
PO4	Analyze and design noise-free analog and digital communication systems
PO5	Evaluate strengths and weaknesses of evolving state of art communication systems.
PO6	Understand and practice professional ethics.
PO7	Work in a team using technical skills, common tools and environments to achieve project objective.
PO8	Communicate effectively with peers and others.

B. Tech. 1st Year, Semester I

I st Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CY-101	Engineering Chemistry	3	0	0	3
2	CY-102	Engineering Chemistry Laboratory	0	0	2	1
3	MA-101	Engineering Mathematics-I	3	1	0	4
4	ME-101	Engineering Mechanics	3	0	0	3
5	ME-102	Workshop Practice-I	0	0	3	1.5
6	MH-101	Communication Skill	0	3	0	3
7	BIO-101	Bio-Science	3	0	0	3
8	MH-113	NSS/NCC	0	0	2	0
Contact Hours			12	4	7	
Total Credits						18.5

Name of the Module: Engineering Chemistry
Module Code: CY-101
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- To enable the students to acquire knowledge about chemistry and its technology, covering all important topics of research and related areas.
- To bring adaptability to new developments in engineering chemistry and a knowledge of contemporary issues relevant to engineering
- To understand applicability of chemistry for engineering purposes.
- To make them apply the knowledge of fundamental chemistry for design system components or processes considering the public health and safety, and the cultural, societal, and environmental considerations.

B. Course Content

Chemical thermodynamics: the first law, work, heat, energy and enthalpy; the relation between Cp and Cv; second law: entropy, free energy and chemical potentials; chemical equilibrium; chemical kinetics: rate of reaction, elementary reaction and chain reaction; surface chemistry: liquid surface, surfactants, colloidal systems; electrochemistry: conductance of electrolytic solutions, Kohlrausch's law, transport numbers, cell EMF and its thermodynamic significance, hydrogen and quinhydrone cell.

Shapes of inorganic compounds, ligand, nomenclature, isomerism, valence bond theory, crystal field and molecular orbital theory, bond order and energy, charge transfer transition, d-d transition, John-Teller effect, magnetic properties, spectrochemical series; bioinorganic and organometallic chemistry.

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

Polymers and materials: addition and condensation polymerization, degree of polymerization, thermoplastic & thermosetting plastics, conducting polymers, composite materials, nanomaterials, nanocomposites, explosive materials, corrosion-introduction; corrosion mechanisms

C. Text Books

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

D. Reference Books

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

E. Course Outcomes

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

CO1. An ability to function on multidisciplinary subjects.
CO2. Design economically, environmental friendly and new methods of synthesis nano materials.
CO3. Apply their knowledge for protection of different metals from corrosion.
CO4. A knowledge of exothermic and endothermic processes.
CO5. Categorize the materials on the basis of their properties.
CO6. Select appropriate method of analysis and interpret its result

Name of the Module: Engineering Chemistry Laboratory
Module Code: CY-102
Credit Value: 1 {L = 0, T = 0, P = 2}

A. Course Objectives

The objective of the course is:

- To enable the students to acquire knowledge about chemistry practical and its technological importance towards research works.
- To bring adaptability to new developments in engineering chemistry and a knowledge of contemporary issues relevant to engineering and research.

- 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

Expt. No. 1. Determination of the concentration of NaOH solution.
Expt. No. 2. Standardization of $KMnO_4$ solution by Mohr's salt.
Expt. No. 3. Estimation of hardness of water using EDTA titration.
Expt. No. 4. Conductometric titration for (a) Determination of the strength of a given HCl solution by titration against a standard NaOH solution. (b) Analysis of a mixture of strong and weak acid by strong base.
Expt. No. 5. Estimation of available chlorine in bleaching powder.
Expt. No. 6. Determination of pH value of the solution by digital pH meter and pH paper.
Expt. No. 7. Production of methyl ester from vegetable oil.

C. Text Books

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

F. Course Outcomes

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

CO1. An ability to function on research areas in multidisciplinary subjects.
CO2. Design economically, environmental friendly and new methods of synthesis for various needful products.
CO3. Apply their knowledge for protection of environment by controlling the experimental methods.
CO4. A knowledge of production of methyl ester from vegetable oil.
CO5. A knowledge titration for various kinds of acid-base for new experimental aspects.
CO6. Select appropriate method of analysis and interpret its result.

Name of the Module: Engineering Mathematics-I
Module Code: MA-101
Credit Value: 4 {L = 3, T = 1, P = 0}

A. Course Objectives

The objective of the course is:

- 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 their practical applications in the various fields of Science and Engineering,
- Apply their knowledge in modern industry or teaching, or secure acceptance in high-quality graduate programs in Mathematics and other fields such as the field of quantitative/Mathematical finance, Mathematical computing, statistics and actuarial science.

B. Course Content

Linear Algebra: Basic concept of matrices, Determinant, Jacobi's theorem. Singular and non-Singular matrices, Inverse and its properties, Orthogonal matrix and its properties, Trace of a matrix, Rank of a matrix, System of homogeneous and non-homogeneous linear equations, Introduction to vector space (up to basis), Eigen values and Eigen vectors of a square matrix (of order 2 or 3), Cayley-Hamilton theorem and its applications.

Differential Calculus: Limit and Continuity, 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.

Integral Calculus: Single integrals, Double and triple integrals and evaluation of area and Reduction formulae both for indefinite and definite integrals, volume, Change of order of integration.

C. Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 11th edition, 2010.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd edition, 2014.

D. Reference Books

1. Ross L. Finney and George B. Thomas, Calculus and Analytical Geometry (Linear Algebra), Narosa Publishing House, 6th edition 1998.
2. K. M. Hofmann and R. Kunze, Linear Algebra, Prentice hall, 2nd edition, 2015.
3. Bartle and Sherbart, Introduction to Real Analysis, Wiley 4th edition, 2014.
4. T. M. Apostol, Calculus, Vol I and II, John Wiley and Sons Ltd Wiley; 2nd edition, 2007.
5. James Stewart, Transcendental Calculus, Cengage; 2nd edition, 2014.
6. S. K. Mappa, Higher Algebra, Shrat book House, 2014.
7. S. K. Mappa, Real Analysis, Shrat book House, 7th edition, 2013.
8. Clarence Reymond Wylie and Louis C. Barrett, Advanced Engineering Mathematics, McGraw Hill, 1995.

E. Course Outcomes

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

CO1. Become more confident about their computing skill, logical skill and decision making skill,

CO2. Find various applications of calculus and algebra in the practical fields science and engineering,
CO3. More competent to analyse mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions,
CO4. Use mathematical and statistical techniques to solve well defined problems and present their mathematical work, both in oral and written format, to various audiences (students, mathematicians, and non-mathematicians),
CO5. Understand, and construct correct mathematical and statistical proofs and use the library and electronic data-bases to locate information on mathematical problems,
CO6. 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,
CO7. Propose new mathematical and statistical question and suggest possible software packages and/or computer programming to find solutions to these questions.

Name of the Module: Engineering Mechanics
Module Code: ME-101
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- 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. 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.

Dynamics: Kinematics and Kinetics, Rectilinear motion of particles, determination of position velocity and acceleration under uniform rectilinear motion (uniform and non-uniform accelerated rectilinear motion), Relative motion, construction of x-t, v-t and a-t graphs (simple problems),Projectile motion, Normal and Tangential components, Radial and Transverse components, simple problems, Equation of motion, D. Alembert's principle,

principle of virtual work, planar kinematics and kinetics of system of particles and rigid bodies.

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. 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

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

CO1. Different type of forces and how to resolve forces.
CO2. Centre of gravity of different size, shape, and solid.
CO3. Centre of gravity, moment of inertia, mass moment of inertia, friction.

Name of the Module: Workshop Practice-I
Module Code: ME-102
Credit Value: 1.5 {L = 0, T = 0, P = 3}

D. Course Objectives

The objective of the course is:

- Acquire skills in basic engineering practice.
- Identify the hand tools and instruments.
- Acquire measuring skills.
- Acquire practical skills in the trades.
- Acquire practical skills in welding, carpentry, fitting.

E. List of Experiments

Expt. No. 1. Study of various hand tools.
Expt. No. 2. Making various joints (carpentry, fitting, sheet metal)
Expt. No. 3. Welding (surface preparation and welding practice)
Expt. No. 4. CNC assembly/disassembly (lathe and milling using kit)
Expt. No. 5. 3-D printing (assembly kit)

F. Text Books

1. Choudhury, S. K. H., Choudhury, A. K. H., Roy, N., “Elements of Workshop Technology” Vol-1, 2008, Media promoters & pubmishers pvt ltd.

2. Begeman, M. L. and Amstead, B. H., “Manufacturing Process”8th edition, 1987, Wiley.
3. Chapman, W. A. J. and Arnold E., “Workshop Technology, Vol. I, II & III”, 5th, 4th and 3rd editions, 2001, 2005 and 1995, CRC press, Prentice Hall.

G. Course Outcomes

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

CO1. Workshop safety.
CO2. Handling workshop tools, machines.
CO3. Different welding types.
CO4. Different carpentry joints.
CO5. Working principle of different tools.

Name of the Module: Communication Skills
Module Code: MH-101
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- Increase the student’s confidence to improve and utilize the skills necessary to be competent interpersonal communicator.
- Increase the student’s linguistic understanding of his or her own communication behaviour.
- Increase the student’s understanding of other communication behaviours.
- Improve the student’s listening, speaking, reading and writing skills in both social and professional contexts.

B. Course Content

Basics of Communication: Concept and meaning, Communication cycle, Objectives, Barriers to communication (linguistic and semantic, psychological, physical, mechanical, cultural), The importance of audience and purpose, Types of communication, Styles of communication, Verbal and non-verbal communication, Comparing general communication and technical communication language skills (listening, speaking, reading, writing), Transactional analysis.

Listening Skills: Listening: Types of listening, Listening to classroom lectures/talks on engineering/technology- podcasts, Differentiation of minimal pairs and accents, Listening comprehension. Activities: Ear drills and listening exercises.

Speaking Skills: Speaking: Introducing oneself - exchanging personal information, Dialogue building, Demo presentations, Effective oral presentation skills, Neutral accent, Activities: Pronunciation Drills- vowels, consonants drills, songs, rhymes, chants and tongue twister drills, repetition drills.

Reading and Writing Skills:

Reading: Types of reading, Reading longer technical texts- identifying the various transitions in a text- Paragraphing.
Technical writing: Techniques to define an object, Writing instructions, Language exercises based on types of expositions (description of an object & explanation of a process), Blogs, Tweets, Online résumé, E-mails, SMS and online texting, Report writing, Describing charts and tables, Writing for media on current events, Résumé writing, Letters, Technical report writing.

Activities: Various reading and writing activities

C. Text Books

1. English Language and Communication Skills for Engineers (as per AICTE Syllabus), Sanjay Kumar and Pushp Lata, New Delhi: Oxford University Press (OUP), 2018.
2. Technical Communication: Principles and Practice, Second Edition by Meenakshi Raman and Sangeeta Sharma, Oxford Publications, 2017.

D. Reference Books

1. Communication Skills, Sanjay Kumar and Pushp Lata, Second Edition, New Delhi: Oxford University Press (OUP), 2018.
2. A Comprehensive Grammar of the English Language, Randolph Quirk, Sidney Greenbaum, Geoffrey Leech, Jan Svartvik. Pearson Education India; First edition (2010).

E. Course Outcomes

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

CO1. Display competence in oral, written, and visual communication.
CO2. Apply communication theories in various speech acts.
CO3. Use current technology to the communication field.
CO4. Understand the process of communication and its effect on giving and receiving information.

Name of the Module: Bio Science
Module Code: BIO-101
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- Impart 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
- Understand “Cell” – the basic unit in different life forms, and structure and function of different tissue systems in plants and animals
- Impart knowledge on water relations, nutrient uptake and assimilation, and metabolism in plants
- Provide knowledge on Bioenergetics of plant cells, an introduction to DNA and genetic engineering.

B. Course Content

Origin of Life: History of earth, theories of origin of life and nature of the earliest organisms. Varieties of life: Classification, Five kingdoms, viruses (TMV, HIV, Bacteriophage), Prokaryote (Bacteria-cellstructure, nutrition, reproduction), Protista, Fungi, Plantae and Animalia.

Chemicals of life: (Biomolecules) - Carbohydrates lipids, amino acids, proteins, nucleic acids and identification of biomolecules in tissues.

Cell: Cell concept, structure of prokaryotic and eukaryotic cells, plant cells and animal cells, cell membranes, cell organelles and their function, Structure and use of compound microscope.

Histology: Meristematic tissue (apical, intercalary, lateral) and their function; simple tissue (parenchyma, collenchymas, sclerenchyma); Complex tissue (xylem and phloem); Tissue systems (epidermal, ground, vascular); primary body and growth (root, stem, leaf); Secondary growth (root, stem). Animal tissues (Epithelial, connective, muscle and nervous tissues) and their functions in the body.

Transport: Plant water relationships, properties of water, diffusion, osmosis, imbibition, uptake of water by roots and theories of transport of water through xylem (ascent of water in xylem, cohesion- tension theory), apoplast and symplast theory; Transpiration-structure of leaf, opening and closing mechanisms of stomata, factors affecting transpiration and significance of transpiration.

Nutrition: Mineral Nutrition in plants, Heterotrophic nutrition in plants; Photosynthesis (Autotrophic- forms of nutrition), Chloroplast structure, two pigment systems, photosynthetic UNIT, light absorption by chlorophyll and transfer of energy, phosphorylation and electron transport system, Calvin-Benson Cycle (C3), Hatch Slack Pathway (C4), Crassulacan Acid Metabolism (CAM), factors affecting photosynthesis.

Genetics: Introduction to Principles of inheritance, Discovery of DNA as genetic material, Structure and Function of DNA, DNA mutation and types, Genetic diseases, Applications of Genetic engineering.

C. Text Books

1. Rajveer Singh Chauhan: A Text Book of Life Science Paperback, 3rd Revised Aug. 2010 edition, Publisher: International Book Distributing Co
2. P. S Verma and V K Agarwal: Cell Biology Paperback – Jan 2016 edition, S. Chand Publishing, S. Chand and Company PVT. LTD., Ram Nagar, New Delhi
3. P. S Verma and VK.Agarwal: Genetics, 2010 edition, S. Chand Publishing, S. Chand and Company PVT. LTD., Ram Nagar, New Delhi
4. B. P Pandey: College Botany Volume III Paperback, 2015 edition, S. Chand Publishing, S. Chand and Company PVT. LTD., Ram Nagar, New Delhi

D. Reference Books

1. P.S Verma and VK.Agarwal: Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, 2015 edition, S. Chand Publishing, S. Chand and Company PVT. LTD., Ram Nagar, New Delhi

E. Course Outcomes

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

CO1. Understand the characteristics of living organisms; appreciate the importance of diversity of life and their interaction with the environment

CO2. Explain the interrelationship between biomolecules and the living system, and influences of biomolecules upon the structure and function of intracellular components

CO3. Have a broad knowledge on Bioenergetics of plant cells; DNA and genetic engineering

CO4. Understand the concept of DNA as hereditary material and harmful consequences of mutation thereby enable them to initiate a healthy lifestyle and environment

B. Tech. 1st Year, Semester II

IInd Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PHY-101	Engineering Physics	3	0	0	3
2	PHY-102	Engineering Physics Laboratory	0	0	2	1
3	MA-102	Engineering Mathematics-II	3	1	0	4
4	CY-108	Introduction to Environmental Science	3	0	0	3
5	CS-112	Introduction to Computer Programming	2	0	0	2
6	CS-113	Introduction to Computer Programming Laboratory	0	0	4	2
7	ME-121	Engineering Drawing	1	0	3	2.5
8	MH-106	Fundamentals of Economics	3	0	0	3
9	MH-113	NSS/NCC	0	0	2	0
Contact Hours			15	1	11	
Total Credits						20.5

Name of the Module: Engineering Physics
Module Code: PHY-101
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- 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

Physical Optics: Superposition of waves, Interference: Newton's ring, Diffraction: single slit diffraction, double slit diffraction and diffraction granting, Polarization.

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, Biot-Savart law, Ampere's law (differential and integral form), Faraday's law of electromagnetic induction, Maxwell'sfield equation in vacuum and matter.

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.

C. Text Books

1. A. Ghatak, "Optics" 6th Edition, Tata McGraw Hill Education India Private Limited, 2017 .
2. David J. Griffiths, "Introduction to Electrodynamics," 4th edition, Pearson Education India Learning Private Limited, 2015.
3. David J. Grifths, "Introduction to Quantum Mechanics," 2nd edition, Pearson Education, 2015.

D. Reference Books

1. A. Beiser, S. Mahajan and S. R. Choudhury, "Concepts of Modern Physics," 7th Edition, McGraw-Hill Education, 2017.
2. F. A. Jenkins & H. E. White, "Fundamental of Optics", 4th Editions, McGraw-Hill Education, 2017.
3. K. Krane, "Modern Physics", Wiley, 2016.
4. Richard P. Feynman, Robert B. Leighton and Matthew sands, "The Feynman Lectures on Physics Vol. 1 to Vol. 3" The New Millennium Edition, 2012.

E. Course Outcomes

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

- CO1. Demonstrate competency and understanding of the basic concepts found in physics.
- CO2. 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.
- CO3. Engineering applications capability to understand advanced topics in engineering.
- CO4. Identify formula and solve engineering problems.
- CO5. Adequately trained to become engineers.
- CO6. Substantially prepared to take up prospective research assignments.
- CO7. Apply quantum mechanics to engineering phenomena
- CO8. Found employment in their field or related area or continue in a professional school.

Name of the Module: Engineering Physics Laboratory
Module Code: PHY-102
Credit Value: 1 {L = 0, T = 0, P = 2}

A. Course Objectives

The objective of the course is:

- Imparting theoretical & 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 develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.
- To learn the usage of various areas of physics like optics, mechanics, electricity and magnetism systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.

B. List of Experiments

Expt. No. 1. Determination of wavelength of light by Newton's ring method.
Expt. No. 2. Determination of surface tension of water.
Expt. No. 3. Determination wavelength of light by using diffraction grating.
Expt. No. 4. Determine the refractive index of the material of prism by using spectrometer.
Expt. No. 5. Determination of Planck’s constant using photocell.
Expt. No. 6. Verification of Stefan’s radiation law.
Expt. No. 7. Verification of Bohr’s atomic orbital theory through Frank-Hertz experiment.
Expt. No. 8. Verification of Biot-Savart’s law.

C. Text Books

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

H. Course Outcomes

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

CO1. Apply the various procedures and techniques for the experiments.
CO2. Apply the mathematical concepts/equations to obtain quantitative results.
CO3. Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO4. Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
CO5. Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoretical problems.
CO6. Understand measurement technology, usage of new instruments and real time applications in engineering studies.

Name of the Module: Engineering Mathematics-II
Module Code: MA-102
Credit Value: 4 {L = 3, T = 1, P = 0}

A. Course Objectives

The objective of the course is:

- 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 modelling for every real-life situation with its solution.
- Giving students theoretical knowledge of vectors with the flavour 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: Surfaces, Differentiation and integration of vector functions, scalar and vector fields, Gradient, Tangents, Normal, Curvature, Directional derivative, Divergence, Curl, Line integral, Surface integral and Volume integral, Green's, Gauss' and Stokes' theorems (without proofs) and their simple applications.

Ordinary Differential Equations: Formulation of Differential equations, Equation of first order and first degree, Exact ODE, Integrating factor, Equation reducible to first order linear ODE, Fundamental Systems and General Solution of Homogeneous equation of Order Two, Wronskian, Method of Reduction of Order, Higher order linear differential equation with constant coefficients, Operator method, Euler's homogeneous equation and reduction to an equation with constant coefficients, Methods of undermined coefficients, Method of Variation of Parameters, Series solutions (Ordinary point)

Partial Differential Equations: First order partial differential equations; solutions of linear and nonlinear first order PDEs; classification of second-order PDEs; method of characteristics; 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).

Laplace & Fourier transform solution of ODE by Laplace and Fourier transform

C. Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 11th edition, 2010.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd edition, 2014.

D. Reference Books

1. Thomas and Finney, Calculus and Geometry (Linear Algebra), 9th edition, 2010.
2. S. L. Ross, Ordinary Differential Equation, Wiley and Sons Ltd., 3rd edition, 2010
3. Boyce and Richard C. Diprima, Elementary Differential Equations and Boundary value Problems, Wiley publications, 9th edition, 2009.
4. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications Inc. 2nd edition, 2013.
5. S. J. Farlow, Partial Differential Equation for Scientists and Engineers, Dover Publications, 1st edition, 1993.
6. Alan Jeffrey, Advanced Engineering Mathematics, Academic Press, 1st edition, 2001.
7. Dennis G. Zilland and Warren S. Wright, Advanced Engineering Mathematics, 4th edition, 2010.

8. Earl Coddington, Norman Levinson, Introduction to Ordinary Differential Equations McGraw Hill Education; 1st edition, 2017.

E. Course Outcomes

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

- CO1. Have strong visualizing capability in their mind about any object.
- CO2. So trained that they will recognize various real life situation/ problem and able to solve them by constructing a differential equation/ mathematical model.
- CO3. Able to find the Laplace and Fourier representation as transforms of functions of one variable.

Name of the Module: Introduction to Environmental Science
Module Code: CY-108
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- . Imparting the knowledge to the students in the area of Environmental Engineering.
- Providing teaching and learning to make students acquainting with advanced science and technology in Environmental Science.
- Injecting the future scope and the research direction in the discipline of Environmental Engineering.

B. Course Content

Environment: environmental gradients and parameters, ecological concepts: structure and function, ecosystem processes, biodiversity, energy transfer (plant → animal →human) ecological pyramid and succession, biogeochemical cycle, tolerance level of organisms; noise pollution: classification and effect; soil pollution: composition and classification, air pollution: chemical pollutants: sources and effects, primary and secondary pollutants, photochemical smog, global environmental problems and climate change: ozone depletion, greenhouse effect, acid rain etc.

Water pollution: sources, physical and chemical characteristics of water, oxygen demanding wastes, advanced water treatment process, waste water: types, domestic treatment process, classification of biological treatment process; activated sludge treatment; hazardous waste: flow chart of hazardous wastes management, physical, chemical, biological and thermal treatment of hazardous wastes, waste products and human health

Introduction to renewable energy and renewable energy sources.

C. Text Books

1. G. Kiely, Environmental engineering, McGraw Hill, New Delhi 2013.
2. G. M. Masters and W. P. Ela, Introduction to environmental engineering and science, PHI Learning/Pearson, New Delhi, 2015.

D. Reference Books

1. A. K. De, Environmental chemistry, 7th Ed., New Age, Kolkata, 2010.
2. N. N. Basak, Environmental engineering McGraw Hill, New Delhi, 2014.
3. R. C. Das and D. K. Behera, Environmental science: principles and practice, PHI Learning, New Delhi, 2008.
4. N.S. Rathore and N. L. Panwar, "Renewable Energy Sources for Sustainable Development", New India Publishing Agency, New Delhi, 2007.

E. Course Outcomes

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

CO1. Gain basic knowledge regarding environment

CO2. Be skilled both to control and maintenance in environmental pollution, waste water treatment and other related activities in Environmental Engineering.

CO3. Substantially prepare to take up prospective research assignments.

Name of the Module: Introduction to Computer Programming
Module Code: CS-112
Credit Value: 2 {L = 2, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- Introducing the basic and fundamental components of computers and programming language.
- Teaching and training of different problems in prior of data structures course.
- Guiding and training students to write efficient coding,
- Guiding & training students to fragment problems into different functions or units.

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.

Introduction to object-oriented programming.

C. Text Books

1. Kerninghan and Ritchie, The 'C' programming language, 2nd Edition, Pearson, 2008.
2. Yashavant P. Kanetkar, Let Us C, 8th, Infinity Science Press, 2008.
3. Balaguruswamy, Programming In ANSI C, 7th Edition, Tata McGraw-Hill Education, 2017

D. Reference Books

1. Yashavant P. Kanetkar, ―Let Us C, 16th Edition, BPB Publication, 2017.
2. Zed A. Shaw, Learn C the Hard Way: Pratical Exercises on Computational Subjects You Keep Avoiding (Like C), 2015.
3. Deepali Srivastava and S.K Srivastava, C in Depth, BPB Publication, 2017.
4. Griffiths David and Dawn Griffiths, Head First C, A Brain Friendly Guide, 2012.
5. Grey Perry and Dean Miller, C Programming Absolute Beginner’s Guide, 3rd Edition, 2013.

E. Course Outcomes

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

- CO1. Understand the basic terminology used in computer programming.
- CO2. Write, compile and debug programs in C language in different operating systems.
- CO3. Design programs involving decision structures, loops and functions.
- CO4. Use and apply the dynamics of memory by the use of pointers in engineering applications.
- CO5. Use and apply the differences between structure oriented and function oriented programming in programming applications.

Name of the Module: Introduction to Computer Programming Laboratory
Module Code: CS-113
Credit Value: 2 {L = 0, T = 0, P = 4}

A. Course Objectives

The objective of the course is:

- 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. List of Experiments

Module l: To write a C program in each case, to find the sum of individual digits of a positive integer, generate the first n terms of the Fibanocci sequence and generate all the prime numbers between 1 and n, where n is a value supplied by the user; to calculate the Sum =1-x 2 /2! +x4 /4!-x 6 /6!+x8 /8!-x 10/10!

Module 2: To write C programs that use both recursive and non-recursive functions, To find the factorial of a given integer and To find the GCD (greatest common divisor) of two given integers; Also, to write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement) and to write a C program that uses functions to perform the Addition of Two Matrices and Multiplication of Two Matrices;

Module 3: To write a C program that uses functions to perform the operations: To insert a sub-string in to a given main string from a given position; To delete n Characters from a given position in a given string; To write a C program to determine if the given string is a palindrome or not; Also to write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn't contain T; To write a C program to count the lines, words and characters in a given text.

Module 4: To write a C program to generate Pascal's triangle and also to construct a pyramid of numbers; Also to write a C program that uses functions to perform the following operations on singly linked list: Creation, Insertion, Deletion, Traversal;

Module 5: To write C programs that implements stack (its operations) using Arrays, Pointers and that implements Queue (its operations) using Arrays, Pointers;

Module 6: To write a C program that implements the following sorting methods to sort a given list of integers in ascending order using - Bubble sort, Selection sort; Also, to write C programs that use both recursive and non-recursive functions to perform the following searching operations for a Key value in a given list of integers- Linear search, Binary search;

Module 7: To write a C program that implements the following sorting method to sort a given list of integers in ascending order- Quick sort; Also to write a C program that implements the following sorting method to sort a given list of integers in ascending order Merge sort;

C. Text Books

1. Kerninghan and Ritchie, The 'C' programming language, 2nd Edition, Pearson, 2008.
2. Yashavant P. Kanetkar, Let Us C, 8th, Infinity Science Press, 2008.
3. Balaguruswamy, Programming In ANSI C, 7th Edition, Tata McGraw-Hill Education, 2017
4. Yashavant P. Kanetkar, Let Us C, 16th Edition, BPB Publication, 2017.
5. Zed A. Shaw, Learn C the Hard Way: Pratical Exercises on Computational Subjects You Keep Avoiding(Like C), 2015.
6. Deepali Srivastava and S.K Srivastava, C in Depth, BPB Publication, 2017.
7. Griffiths David and Dawn Griffiths, Head First C, A Brain Friendly Guide, 2012.
8. Grey Perry and Dean Miller, C Programming Absolute Beginner’s Guide, 3rd Edition, 2013. C. L. Arora, “Practical Physics”, S. Chand Publications, 2010.
9. G. L. Squires, “Practical Physics”, Cambridge University Press, 2014.

I. Course Outcomes

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

CO1. Understand the basic terminology used in computer programming.

CO2. Write, compile and debug programs in C language in different operating systems.

CO3. Design programs involving decision structures, loops and functions.

CO4. Use and apply the dynamics of memory by the use of pointers in engineering applications.

CO5. Use and apply the differences between structure oriented and function-oriented programming in programming applications.

Name of the Module: Engineering Drawing
Module Code: ME-121
Credit Value: 2.5 {L = 1, T = 0, P = 3}

A. Course Objectives

The objective of the course is:

- 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. List of Experiments

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

Principles of Orthographic Projection (multi view drawing): 1stand 3rdangle projection.

Projections: Points, lines, surfaces and solids.

Projection of sections and intersections of solids; Isometric projection.

C. Text 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.

J. Course Outcomes

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

CO1. Hand letter will improve.
CO2. Perform basic sketching techniques will improve.
CO3. Draw orthographic projections and sections will improve.
CO4. Use architectural and engineering scales will increase.
CO5. Produce engineered drawings will improve.
CO6. Convert sketches to engineered drawings will increase.
CO7. Cope up and become familiar with office practice and standards will increase.
CO8. Handle and become familiar with Auto Cad two dimensional drawings will improve.
CO9. Develop good communication skills and team work will improve.

Name of the Module: Fundamentals of Economics
Module Code: MH-106
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- 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 of Demand- Types of Demand – Determinants of Demand – 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 – Estimation of Cost – Output Relationship, Break Even Analysis-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, National Income: Inflation- meaning, feature, Types, causes, Factors Causing Increases in Demand, Factors Causing Decrease in Supply, Impacts/ 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. Panneerselvam, R., Engineering Economics, Second Edition, New Delhi, PHI Learning Private Limited, 2013.
2. Parvin, K., Fundamentals of Engineering Economics, New Delhi, John, and Wiley, 2012.

D. Reference Books

1. Chan S. P., Fundamentals of Engineering Economics, Fourth Edition, New York, Pearson, 2018
2. Seema, S., Economics for Engineering Students, Second Edition .I.K. International Publishing House, Delhi, 2014.
3. Joel, D., Managerial Economics, Englewood Cliffs, N.J.: Prentice-Hall, 2011
4. Gupta, G.S., Managerial Economics, New Delhi, Tata McGraw Hill Publication, 2010.
5. Diwedi, D.N., Managerial Economics, New Delhi, Pearson Education India, 2012.
6. Varshney, S.C., Managerial Economics, New Delhi Sultan Chand & Sons, 2010

E. Course Outcomes

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

- CO1. Learn the fundamentals of Engineering Economics
- CO2. Understand and use of Economic concepts in making business decision
- CO3. Use economic information to manage the organization
- CO4. Use economic tools with respect to acceptance or rejection of investment proposals
- CO5. Know the current issues relating to economic environment

B. Tech. 2^{nd} Year, Semester III

IIIrd Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	MA-201	Probability and Statistics	3	1	0	4
2	MH-201	Introduction to Human Values and Ethics	3	0	0	3
3	EE-201	Electrical Circuit Analysis	3	0	0	3
4	CS-201	Data Structure and Algorithm	3	0	0	3
5	EC-201	Analog Circuits – I	3	0	0	3
6	EC-202	Digital Logic Design	3	0	0	3
7	CS-203	Data Structure and Algorithm Laboratory	0	0	2	1
8	EC-203	Analog Circuits-I Laboratory	0	0	2	1
9	EC-204	Digital Logic Design Laboratory	0	0	2	1
Contact Hours			18	0	6	
Total Credits						22

Name of the Module: Probability and Statistics
Module Code: MA-201
Credit Value: 4 {L = 3, T = 1, P = 0}

A. Course Objectives

The objective of the course is:

- 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 framework 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, skewness 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 not required).

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

Curve fitting: Linear and Nonlinear

C. Text Books

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

D. Reference Books

1. Sheldon M Ross, Introduction to Probability Models , Academic Press; 14th edition, 2014.
2. Harald Cramer, Random Variables and Probability Distributions, Cambridge University Press; Revised ed., 2014.
3. Murray R. Spiegel, Probability and Statistics, McGraw-Hill, McGraw Hill Education; 3rd edition, 2017.
4. P. L. Mayer, Introductory Probability and Statistical Applications, Oxford & IBH, 2nd, 1970.
5. W. Feller, An Introduction to Probability Theory and Its applications, Vol I, Jon Willy and Sons, 3rd edition, 2008.
6. K.L. Chung, A course of Probability Theory, Academic Press, 3rd edition, 2000.

E. Course Outcomes

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

CO1. 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,

CO2. Add new simulation-style activities to the course in Inference and Probability,

CO3. Will be substantially prepared to take up prospective research assignments.

Name of the Module: Introduction to Human Values and Ethics
Module Code: MH-201
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- Enabling students to acquire and cultivate ethical practices in terms of business, engineering and life in general.

- Developing a sense of moral responsibility in business and enterprise.
- Emphasizing the importance of values and ethics in modern life.

B. Course Content

Universal Human values: Getting to Know Your Students: Aspirations and family expenditures, Purpose of the Course, Gratitude, Competitions and Co-operation: The Full story of Tortoise and Rabbit), Competition and Excellence, Self and Body, Peer Pressure, Self Confidence, Identity and Assumptions, Prosperity, Peer pressure –English, Relationships- Seven Relations, Relationship Vs Transaction, Mulya in Relationships: Trust, Mulya in Relationships: Respect, Anger (if time permits, Nature – Four Orders), NIRMAN: Youth for Purposeful Life, Gandhi Film, Gandhi Film- Points to ponder

Ethics of Profession: Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Profession and Human Values: Values Crisis in contemporary society, Nature of values: Value Spectrum of a good life, Psychological values: Integrated personality; mental health, Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.

Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity, Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

C. Text Books

1. Simon Blackburn Being Good: A Short Introduction to Ethics, Oxford University Press, 2001
2. Peter Singer, The Most Good You Can Do: How Effective Altruism Is Changing Ideas About Living Ethically Yale University Press 2015

D. Reference Books

1. Govindarajan M Professional Ethics and Human Values 2013
2. S. Dinesh Babu, Professional Ethics and Human Values, Firewall Media, 2007
3. R.S. Naagarazan, A Textbook on Professional Ethics and Human Values, New Age International, 2007.

E. Course Outcomes

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

CO1. Understand the importance of values and ethics in business and work places
CO2. Understand the benefits of managing ethics at work place.

Name of the Module: Electrical Circuit Analysis
Module Code: EE-201

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

Introduction: Basic Concepts of Electrical Circuits, Circuit Concepts – R-L-C parameters – Voltage and 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 without initial 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 - Duality and 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 HillEducation, 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:

CO1. Apply network theorems for the analysis of electrical circuits.
CO2. Obtain the transient and steady-state response of electrical circuits.
CO3. Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
CO4. Analyse two port circuit behaviour.

Name of the Module: Data Structure and Algorithm
Module Code: CS-201
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- Designing principles of data structures and learn the concept of analysis of algorithms.
- Understand the basic concepts about linear and non-linear data structure and their various operation.
- Learning essential algorithms for computing.
- Understanding generic data structures for common engineering problems problem.

B. Course Content

Performance of algorithms: Basic concepts; Mathematical Background; Complexity Analysis; space and time complexity, asymptotics 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, dequeue, 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 balancedtreeslikeAVLtreeand2-3tree, tries, red-black tree, Btree, 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, open addressing,
File structures: Introduction, data file types, file organization, file access methods.

C. Text Books

1. S. Sahni, Data Structures, Algorithms, and Applications in C++, Silicon Press, 2/e, 2005.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, MIT Press, 3/e, 2009.
3. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, Data Structures Using C and C++, Prentice Hall, 2/e, 1995.
4. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2007.
5. Seymour Lipschutz, Data Structure, The McGrraw Hill, 2013

D. Reference Books

1. Adam Drozdek, DataStructures and Algorithms in C++, Cengage Learning, 2012, 4thed..
2. Heileman, Data Structures, Algorithms & Object-Oriented Programming, Tata Mcgraw-Hill Publishing Company Limited.
3. Mariappa Radhakrishnan, Data Structures Using C, BPB Publications, 2001.
4. Mark Allen Weiss, Algorithms, DataStructures, and Problem Solving with C++, Addison- Wesley Publishing Company, 1996.
5. Horowitz Ellis & Sartaj Sahni, Fundamentals of Data Structures, Galgotria Publications
6. Aaron M. Tanenbaum, Data Structures using C, Pearson Education.

E. Course Outcomes

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

CO1. Understand the basic concepts about linear and non-linear data structure and their various operation.
CO2. Learning essential algorithms for computing.
CO3. Understanding generic data structures for common engineering problems problem.

Name of the Module: Analog Circuits - I
Module Code: EC-201
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

Introduction to Semiconductor: Review of quantum mechanics, Electrons in periodic lattices, E-k diagrams, Quasi particles in semiconductors, Evolution and uniqueness of semiconductor technology, Equilibrium carrier concentration, Thermal equilibrium and wave particle duality, Bond and band models of Intrinsic and Extrinsic semiconductors.

Carrier transport: Random motion drift and diffusion, Excess carriers, Injection level lifetime direct and indirect semiconductors, Procedure for analyzing semiconductor devices, Basic equations and approximations.

P-N Junction: Device structure and fabrication, Equilibrium picture, DC forward and reverse characteristics, Small-signal equivalent circuit, Switching characteristics, Schottky, Homo and hetero-junction band diagrams, I-V characteristics and small signal switching models.
Bipolar Junction Transistor: History, Device structures and fabrication, Transistor action and amplification, Common emitter DC characteristics, Small-signal equivalent circuit, Ebers-Moll model and SPICE model.

Transistor Biasing and Thermal Stabilization: Graphical analysis of transistor circuits, Bypass capacitor, Coupling capacitors, Need for biasing, Operating point, Load line analysis, BJT biasing methods, Stabilization against V_{BE}, Ic, and β, Stability factors, (S, S', S"), Bias compensation, Thermal runaway, Thermal stability, Introduction to FET, biasing methods and analysis.

Transistor Amplifiers: BJT & FET amplifier circuits, Small signal analysis, Hybrid parameters, CE, CB, CS and CD Configuration, Impedance, reflections, Phase splitter
Frequency Response: Low frequency and high frequency response of CE / CS amplifiers, Miller's theorem, High frequency response of CG and cascode amplifiers

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. Kevin F Brennan,"The Physics of Semiconductors" Cambridge Univ. Press., 1999.
3. J. Millman, "Microelectronics", McGraw Hill, 2017.
4. 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:

- CO1. Apply the knowledge of basic semiconductor material physics
- CO2. Characterize semiconductors, diodes, transistors and amplifiers
- CO3. Analyze the characteristics of various electronic devices like diode, transistor etc.
- CO4. Design simple analog circuits

Name of the Module: Digital Logic Design
Module Code: EC-202
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

Number systems: Decimal, Binary, Octal and Hexadecimal systems, Conversion of a number from one base to another, 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.
Combinational logic design using truth table: Minterms and maxterms expressions.
Minimization techniques: 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.
Combinational logic design: 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
Introduction to 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. 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:

CO1. Design and analyse combinational and sequential logic circuits.
CO2. Optimize combinational and sequential logic circuits
CO3. Analyse a memory cell and apply for organizing larger memories

Name of the Module: Data Structure and Algorithm Laboratory
Module Code: CS-203
Credit Value: 1 {L = 0, T = 0, P = 2}

A. Course Objectives

The objective of the course is:

- To demonstrate practical knowledge on Stacks, Queues, Linked lists, Trees Sorting and Hashing Techniques.
- To analyse suitable data structure to solve real world computing problems.
- To design solutions for complex computational problems using linear and non-linear data structures.
- To solve for Complex computational problems by conducting explorative analysis.
- To use C/C++/Python/Java language for implementing linear and non-linear data structures.
- To apply contextual

B. List of Experiments

Expt. No. 1. Write the program to understand the numbers of steps for execution of various algorithms.
Expt. No. 2. Write the program in Array to demonstrate various operation (eg. Searching: Linear & Binary, Inserting, deleting, two dimensional and multidimensional array, etc).
Expt. No. 3. Write the program to implement the various operation in Linked list.
Expt. No. 4. Write the program to implement the various operation in Stack and Queue using static and dynamic memory allocation.
Expt. No. 5. Write the program to perform the operation (Insert, delete, Traverse, Search. Etc.) in non-linear data structure i.e. Tree.
Expt. No. 6. Write the program to perform the various operations in Graph i.e. BES, DFS, Min. Cost Spanning Tree, All Pairs shortest path etc.
Expt. No. 7. Write the program to implement various sorting techniques (like: Bubble, Quick, Insert, Selection, etc...)

C. Text Books

1. S. Sahni, Data Structures, Algorithms, and Applications in C++, Silicon Press, 2/e, 2005.
2. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, Data Structures Using C and C++, Prentice Hall, 2/e, 1995.
3. R. Lafore, Data Structures & Algorithms in Java, 2e, Pearson, 2007
4. GM. T. Goodrich, R. Tamassia, M. H. Goldwasser, Data Structures & Algorithms in Java, 6ed, Wiley, 2014
5. M. T. Goodrich, R. Tamassia, M. H. Goldwasser, Data Structures and Algorithms in Python, Wiley, 2016
6. M. T. Goodrich, R. Tamassia, M. H. Goldwasser, Data Structures and Algorithms in C++, 2ed, Wiley, 2016

D. Reference Books

1. J Gosling, B Joy, G L Steele and G Bracha, The Java Language Specification, 2/e, Addison-Wesley,2000.
2. B Stroustrup, The C++ Programming Language, 3/e, Addison-Wesley Longman ReadingMA,1997.
3. S B Lippman, C++ Primer, 2/e, Addison-Wesley,1991.
4. T Budd, C++ for Java Programmers, Addison Wesley,1999.
5. M C Daconta, Java for C/C++ programmers, John Wiley & Sons,1996.

E. Course Outcomes

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

CO1. Demonstrate practical knowledge on Stacks, Queues, Linked lists, Trees Sorting and Hashing Techniques.
CO2. Analyse suitable data structure to solve real world computing problems.
CO3. Design solutions for complex computational problems using linear and non-linear data structures.
CO4. Solve for Complex computational problems by conducting explorative analysis.

Name of the Module: Analog Circuits-I Laboratory
Module Code: EC-203
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

Expt. No. 1. Study of V-I characteristics of PN junction and Zener diodes.
Expt. No. 2. Study and design of Half wave and Full wave rectifier circuits.
Expt. No. 3. Study of BJT characteristics.
Expt. No. 4. Study of BJT biasing methods.
Expt. No. 5. Study of FET characteristics.
Expt. No. 6. Study of FET biasing methods.

Expt. No. 7. Study of MOSFET inverter.
Expt. No. 8. Study of BJT and FET amplifier circuits

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:

CO1. Plot the characteristics of electronic devices to understand their behavior.
CO2. Characterize and classify diodes and transistors
CO3. Analyze the characteristics of various electronic devices like diode, transistor etc
CO4. Design simple analog circuits

Name of the Module: Digital Logic Design Laboratory
Module Code: EC-204
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

Expt. No. 1.

A. Verification of truth tables of logic gates -OR, AND, NOT, NAND, NOR and Ex-OR.

B. Verification of NAND and NOR as universal gates.

Expt. No. 2.

A. Design and verification of the truth tables of half and Full adder circuit using universal gates only.

B. Design and verification of the truth tables of Half and Full subtractor circuits using universal gates only.

Expt. No. 3.

Minimize the following logic system with SOP/POS by tabular technique & implement the circuit.

i. SOP: $f(A,B,C,D) = m_0 + m_1 + m_2 + m_3 + m_5 + m_6 + m_{10} + m_{13} + m_{15}$
ii. POS: $f(X,Y,Z) = M_0.M_1.M_3.M_7$

Expt. No. 4. Design Gray to Binary and Binary to Gray code Converter & test the circuit.

Expt. No. 5. Design and verify BCD to Excess-3 code converter using logic gates.
Expt. No. 6. Design and test of SR flip-flop using NOR/NAND gates.
Expt. No. 7.
  A. Verification of the truth table of the Multiplexer using IC 74150
  B. Verification of the truth table of the Demultiplexer using IC 74154.
Expt. No. 8. Basic GATEs implementation in HDL
Expt. No. 9. Design and implementation of 3-bit synchronous up/down counter in HDL.
Expt. No. 10. 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:

CO1. Design and analyse combinational and sequential logic circuits.
CO2. Optimize combinational and sequential logic circuits

B. Tech. 2nd Year, Semester IV

IVth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	MH-206	Entrepreneurship	3	0	0	3
2	CS-206	Computer Organization and Architecture	3	1	0	4
3	EC-221	Electromagnetic Field Theory	3	0	0	3
4	EC-222	Signals and Systems	3	0	0	3
5	EC-223	Analog Circuits-II	3	0	0	3
6	EC-224	Analog Communication	3	0	0	3
7	EC-225	Analog Circuits-II Laboratory	0	0	2	1
8	EC-226	Analog Communication Laboratory	0	0	2	1
Contact Hours			18	0	4	
Total Credits						21

Name of the Module: Entrepreneurship
Module Code: MH-206
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- To involve themselves in the business activities
- Starting innovative practices in their entrepreneurial activities.
- Developing their skills on the traits that they want to carry forward.
- Starting activities on Forest based Technology.

B. Course Content

Introduction to Entrepreneurship: Meaning, Role of Entrepreneur, Entrepreneur Process: different approaches, 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 Entrepreneur, Issues & Problems Entrepreneurial Practices.

Importance of Entrepreneurship: Entrepreneurship and Innovations, Converting Innovation to Economic Value which includes, Growth Strategies, value position, Market Segments, Value Chain Structure, Revenue Model, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Issues & Problems Entrepreneurial Practices. Contribution of Entrepreneurs: Towards R&D, creates Wealth of Nation & Self prospect with Challenge. Entrepreneur Carrier: Different Stages, Entrepreneur Development Programmers (EDPs).

Characteristics of Entrepreneurship: Risk taker, Perceptive, Curious, Imaginative, Persistent, Goal setting, and Hardworking, Research & Management Skill, Organizing & Controlling, Soft skills and Feasibility. Women Entrepreneurship: Opportunities, promotion

Hurdles and Prospects of women Entrepreneurs, Factors & Models of Entrepreneurial Development. Social Entrepreneurial Initiative: Solving social problems through opportunity identification, idea generation techniques, Business plan, Strategic Plan etc.

C. Text Books

1. Desai, Vasant, Small-Scale Industries and Entrepreneurship. Himalaya Publishing House, Delhi. 2008
2. Kaulgud, Aruna Entrepreneurship Management. Vikas Publishing House, Delhi. 2003
3. Cynthia, L. Greene. Entrepreneurship Ideas in Action. Thomson Asia Pvt. Ltd., Singapore. 2004

D. Reference Books

1. Timmons, Jerry A., and Spinelli, Stephen, 2009. New Venture Creation: Entrepreneurship for the 21st Century, 8th Edition, Boston, MA: Irwin McGraw-Hill
2. Barringer Entrepreneurship: Successfully Launching New Ventures, Pearson Education Publishing 2015
3. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001
4. Donald F. Kuratko, Entrepreneurship: Theory, Process, Practice Cengage Learning 2017

E. Course Outcomes

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

CO1. Start their venture more scientifically.

CO2. Start their venture by linking with the financial institutions.

Name of the Module: Computer Organization and Architecture
Module Code: CS-206
Credit Value: 4 {L = 3, T = 1, P = 0}

A. Course Objectives

The objective of the course is:

- Helping the students to develop an understand the nature and characteristics of the organisation and design of the modern computer systems,
- Focusing on the organisation & operation of the CPU

B. Course Content

Fundamentals of Computers: Digital computers, layers in computer system, types of computers, history of computers

Data representation and computer arithmetic: Data types, complement, fixed point representation, floating point representation, multiplication and division of sign and unsigned integers.

Micro operation and design of arithmetic logic unit: Register transfer micro-operation, bus transfer, memory transfer, arithmetic micro-operation, logic micro-operation, logic unit, shift unit, design of arithmetic and logic unit.

Instruction set: Instruction code, register, computer instruction, timing and control, instruction cycle, instruction formats, CPU organization, instruction length, addressing standard, addressing mode, instruction set, RISC, CISC.

Design of control unit: hardware control design, micro programmed control.

Memory organization: memory hierarchy, main memory, cache memory, virtual memory.

Input-output organization: peripheral device, I/O interface and I/O driver, synchronous and asynchronous data transfer, modes of data transfer, priority interrupt, DMA, input- output processor.

Parallel processing: performance measurement of computer, parallel computer structure, general classification of computer architecture, pipelining, vector processing, multiprocessor system, flow computers.

C. Text Books

1. W. Stallings, Computer Organization and Architecture: Designing for Performance, 8th Ed., Pearson Education India.2010.
2. D. A. Patterson and J. L. Hennessy, Computer Organization and Design, 4th Ed., Morgan Kaufmann, 2008.
3. A. S. Tanenbaum, Structured Computer Organization, 5th Ed., Prentice Hall of India,2009.

D. Reference Books

1. M. M. Mano, Computer System Architecture, Pearson Education.
2. C. Hamacher, Z. Vranesic, Computer Organisation, Tata McgrawHill, 2011.
3. M. Jain, S.Jain, V. Pillai, Computer Organization and System Software, BPB Publications, 2003.
4. P. Pal Chaudhuri, Computer Organisation & Design, PHI Learning Private Ltd., 2009.
5. J. P.Hayes, Computer Architecture & Organisation, McGraw Hill, 1998
6. T. K. Ghosh & A. J. Pal, Computer Organization & Architecture, TataMcGraw-Hill,
7. M. Rafiquzzaman, Computer Architecture, Prentice Hall of India.

E. Course Outcomes

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

- CO1. Understand the nature and characteristics of the organisation and design of the modern computer systems.
- CO2. Focusing on the organisation & operation of the CPU.

Name of the Module: Electromagnetic Field Theory
Module Code: EC-221
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- To expose the students to the rudiments of Electromagnetic theory and wave propagation essential for subsequent courses on microwave engineering, antennas and wireless communication

B. Course Content

Electrostatics: Sources and effects of electromagnetic fields, Coordinate systems, Vector fields, Gradient, Divergence, Curl, theorems and applications, Coulomb's Law, Electric field intensity, Field due to discrete and continuous charges, Gauss's law and applications. Electric potential, Electric field and equipotential plots, Uniform and non-uniform field, Utilization factor, Electric field in free space, Conductors, Dielectrics, Dielectric polarization, Dielectric strength, Electric field in multiple dielectrics, Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

Magnetostatics: Lorentz force, Magnetic field intensity (H), Biot–Savart's law, Ampere's circuit law, H due to straight conductors, Circular loop, Infinite sheet of current, Magnetic flux density in free space, Conductors, Magnetic materials, Magnetization, Magnetic field in multiple media, Boundary conditions, Scalar and vector potential, Poisson's equation, Magnetic force, Torque, Inductance, Energy density, Applications.

Features of electromagnetic waves: Magnetic circuits, Faraday's law, Transformer and motional EMF, Displacement current, Maxwell's equations (differential and integral form), Relation between field theory and circuit theory, Applications, Electromagnetic wave generation and equations, Wave parameters: Velocity, Intrinsic impedance, Propagation constant, Waves in free space, Lossy and lossless dielectrics, Conductors, Skin depth, Poynting theorem and vector, Plane wave reflection and refraction, Standing wave, Applications.

Guided Waves: Waves between parallel planes, TE and TM waves, Characteristics of TE and TM 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. David J. Griffiths, "Introduction to Electrodynamics", Pearson, 2015.
2. John David Jackson, "Classical Electrodynamics", Wiley, 2007.
3. E.C. Jordan & G. Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 1995.

D. Reference Books

1. P. C. Rakshit, D. Chattopadhyay, "Electricity and Magnetism", New Central Book Agency, 2011.
2. M N O Sadiku, "Elements of Electromagnetics", Oxford University Press, 2008.
3. Staelin, Morgenthaler, Kong, "Electromagnetic Waves", Pearson, 1993.
4. Hayt, Buck, "Engineering Electromagnetics", McGraw Hill, 2017.
5. Inan, "Engineering Electromagnetics", Pearson, 2010.

E. Course Outcomes

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

CO1. Recognize and classify the basic Electrostatic theorems and laws and to derive them.
CO2. Discuss the behavior of Electric fields in matter and Polarization concepts.
CO3. Classify the basic Magneto static theorems and laws and infer the magnetic properties of matter.
CO4. Summarize the concepts of electrodynamics & to derive and discuss the Maxwell's equations.
CO5. Students are expected to be familiar with Electromagnetic wave propagation and wave polarization.

Name of the Module: Signals and Systems
Module Code: EC-222
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.VanVeen “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:

CO1. Analyse the spectral characteristics of continuous-time periodic and a periodic signal using Fourier analysis.
CO2. Classify systems based on their properties and determine the response of LSI system using convolution.
CO3. Analyze system properties based on impulse response and Fourier analysis.
CO4. Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
CO5. Understand the process of sampling and the effects of under sampling

Name of the Module: Analog Circuits-II
Module Code: EC-223
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

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.

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

C. Text Books

1. J. Millman and Halkias, Integrated Electronics, TMH, 2nd Edition, 2010
2. 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:

CO1. Apply the knowledge of basic BJT and diode-based circuits
CO2. Characterize wave shaping circuits
CO3. Analyze the characteristics of oscillators, power amplifiers and feedback circuit
CO4. Design of test circuits for real time applications

Name of the Module: Analog Communication
Module Code: EC-224
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:

CO1. Understand the basics of communication system and analog modulation techniques
CO2. Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
CO3. Apply the basic knowledge of electronic circuits and understand the effect of Noise in communication system and noise performance of AM system
CO4. Understand the effect of noise performance of FM system.
CO5. Understand TDM and Pulse Modulation techniques.

Name of the Module: Analog Circuits-II Laboratory
Module Code: EC-225
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

Expt. No. 1. Study and Implement RC Low Pass and High Pass Filter Circuits.
Expt. No. 2. Study and Implement RC Integrator Circuits.
Expt. No. 3. Study and Implement RC Differentiator Circuits.
Expt. No. 4. Study and Implement RC-Phase shift and wien-bridge oscillator.
Expt. No. 5. Study and Implement Class A/B/AB/C amplifier
Expt. No. 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:

CO1. Design and implement filters
CO2. Design and implement integrators and differentiators.
CO3. Design and implement oscillators, power amplifiers and feedback circuit

Name of the Module: Analog Communication Laboratory
Module Code: EC-226
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

Expt. No. 1. Study of Amplitude Modulation & Demodulation.
Expt. No. 2. Measurement of output power with varying modulation index an AM signal.
Expt. No. 3. Study of voltage-controlled oscillator (VCO) using IC 4046.
Expt. No. 4. Study the performance of a phase locked loop.
Expt. No. 5. Study of Frequency Modulation and Demodulation System.
Expt. No. 6. Study of pre-emphasis & de-emphasis

Expt. No. 7. Study of Double Side Band Suppressed Carrier (DSB-SC) Modulation & Demodulation Technique.
Expt. No. 8. Study of Single Side Band Suppressed Carrier (SSB-SC) Modulation & Demodulation Technique
Expt. No. 9. Study functioning of Superheterodyne AM Receiver.
Expt. No. 10. Measurement of Noise Figure using a noise generator.
Expt. No. 11. Study the characteristics of Pulse Amplitude Modulation & Demodulation.
Expt. No. 12. Study the characteristics of Pulse Width Modulation & Demodulation.
Expt. No. 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", (2^{nd} 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:

CO1. Characterize analog modulation techniques
CO2. Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
CO3. Understand TDM and characterize Pulse Modulation techniques.

B. Tech. 3rd Year, Semester V

Vth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EE 305	Linear Control Systems	3	0	0	3
2	EE-307	Power Electronics	3	0	0	3
3	EC-301	Linear Integrated Circuits	3	0	0	3
4	EC-302	Digital Communication	3	0	0	3
5	EC-303	Microprocessor and Interfacing	3	0	0	3
6	EC-304	Digital Signal Processing	3	0	0	3
7	EC-305	LIC Laboratory	0	0	2	1
8	EC-306	Digital Communication Laboratory	0	0	2	1
9	EC-307	Microprocessor and Interfacing Laboratory	0	0	2	1
10	EC-308	Digital Signal Processing Laboratory	0	0	2	1
11	EC-390	Internship - I	0	0	0	0
Contact Hours			18	0	8	
Total Credits						22

Name of the Module: Linear Control Systems
Module Code: EE-305
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- Impart theoretical and practical knowledge to the students in the area of process control engineering
- Introduce basic characteristics of feedback control systems
- Familiarize students with FRA and State Variable Analysis

B. Course Content

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.

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.

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response. Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.

Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.

Analog and Digital implementation of controllers. Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems. Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

C. Text Books

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

D. Reference Books

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009
3. B. S. Manke, "Linear Control Systems with MATLAB applications", Khanna Publishers, 12th Edition, 1986.

E. Course Outcomes

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

- CO1. Understand the modelling of linear-time-invariant systems using transfer function and state-space representations.
- CO2. Understandthe concept of stability and its assessment for linear-time invariant systems.
- CO3. Design simple feedback controllers.

Name of the Module: Power Electronics
Module Code: EE-307
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- Understand advanced topics of power electronics
- Introduce improved power quality ac-dc converters
- Acquire knowledge of power quality mitigation devices

B. Course Content

Power semiconductor devices: Introduction: Concept of Power Electronics, scope and applications, desired Characteristics of controllable switches Power semiconductor switches and their characteristics: Power Diode, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO.

Thyristor: Rating and protection, Methods of SCR commutation, Gate Drive Circuit, Series and Parallel operation.

DC-DC Converters: Introduction, Control Strategies, Buck converter, Boost Converter, Buck-Boost converter, Analysis of buck converter, Special Types of DC-DC converters-CUK and SEPIC converter, Switched Mode power Supply (SMPS).

Phase Controlled Converters: Single phase half wave-controlled rectifier with various loads, Effect of freewheeling diode. Single phase fully controlled and half controlled bridge converters with various loads. Performance Parameters of single phase uncontrolled and controlled converters. Three phase half wave converters, three phases fully controlled and half controlled bridge converters, Effect of source impedance, Single phase and three phase dual converters.

AC Voltage Controllers: Principle of On-Off and phase controls, Single phase ac voltage controller with resistive and inductive loads, sequence control, Introduction to Matrix converter.

Cyclo-Converters: Basic principle of operation, single phase to single phase, three phases to single phase output voltage equation

Inverters: Single phase and Three phase bridge inverters, VSI, CSI, Voltage control of single-phase inverters, Series and Parallel inverter-Analysis of basic series inverter, Modified series inverter, Half bridge series inverter, PWM Techniques, Introduction to Multi level inverter.

Applications: Speed control of AC and DC motors. HVDC transmission. Static circuit breaker, UPS, static VAR controller.

C. Text Books

1. M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson India, 4th Edition, 2018.
2. Ned Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008.

D. Reference Books

1. P.S. Bhimbra, "Power Electronics", Khanna Publishers.
2. P.C. Sen, "Power Electronics", McGraw Hill Education (India) Pvt. Ltd.
3. V.R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications", Oxford University Press,2007.
4. M.S. Jamil Asghar, "Power Electronics", Prentice Hall of India Ltd., 2004

E. Course Outcomes

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

CO1. Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics and characteristics of linear and non-linear devices.

CO2. Compare the performance of basic power semiconductor devices any analyze their circuit performance.

CO3. Analyze and Identify power converters for particular system application.

CO4. Recognize the role of power electronics in different renewable energy applications and their importance in different emerging research areas.

Name of the Module: Linear Integrated Circuits
Module Code: EC-301
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

Differential & Multistage Amplifiers: BJT differential pair, DC offset, Common mode rejection, Differential operation with current mirror load, Common mode gain and CMRR, Multistage behaviour, Basic introduction to op-amp.

Basics of Operational Amplifiers: Basic information about op-amps, Ideal operational amplifier, General operational amplifier stages, DC & AC performance characteristics, Slew rate, Open and closed loop configurations.

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.

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

Waveform Generators & PLL: Sine-wave generators, Multivibrators and triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC555, IC voltage regulators, Three terminal fixed and adjustable voltage regulators, IC 723 general purpose regulator, Monolithic switching regulator. Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, Application of PLL for AM detection, FM detection, FSK modulation and demodulation and frequency synthesizing.

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. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata Mc Graw-Hill, 2007.
2. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.

D. Reference Books

1. D. Roy Choudhury, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. B. S. Sonde, "System design using Integrated Circuits", 2nd Edition, New Age Pub, 2001
4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.
5. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India,1996.
6. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education, 2004.
7. S. Salivahanan & V. S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2008.

E. Course Outcomes

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

- CO1. Design op-amp circuits to perform arithmetic operations.
- CO2. Analyze and design linear and non-linear applications using op-amps.
- CO3. Explain and compare the working of multi vibrators using special application IC 555 and general-purpose op-amp.
- CO4. Classify and comprehend the working principle of data converters.
- CO5. Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

Name of the Module: Digital Communication
Module Code: EC-302
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:

CO1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.

CO2. Perform the time and frequency domain analysis of the signals in a digital communication system.

CO3. Select the blocks in a design of digital communication system.

CO4. Analyze performance of spread spectrum communication system.

Name of the Module: Microprocessor and Interfacing
Module Code: EC-303
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:

CO1. Students will have the thorough understanding of the evolution of microprocessor

CO2. Students will get to know the interfacing knowledge to get a kick start in embedded world

CO3. Students will get the idea of doing lively embedded design projects

Name of the Module: Digital Signal Processing
Module Code: EC-304
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:

CO1. Classify different signals and systems and perform time domain analysis of LTI DTS.
CO2. Compute Convolution, Correlation of the signals
CO3. Find DFT of a given signal through Fast Fourier Transform Techniques
CO4. Design FIR and IIR type digital filters
CO5. Identify filter structures and evaluate the coefficient quantization effects

Name of the Module: LIC Laboratory
Module Code: EC-305
Credit Value: 1 {L = 0, T = 0, P = 2}

A. Course Objectives

The objective of the course is:

- To design and study circuits based on Op-amp and other ICs

B. List of Experiments

Expt. No. 1. Study the characteristics of Operational Amplifiers (IC741)
Expt. No. 2. 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
Expt. No. 3. Waveform Generation using Op-Amp (IC741).
Expt. No. 4. Applications of Timer IC555.

Expt. No. 5. Design of Active filters.
Expt. No. 6. Study and application of PLL IC's

C. Text Books

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata Mc Graw-Hill, 2007.
2. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.

D. Reference Books

1. D.Roy Choudhury, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
2. B. S. Sonde, "System design using Integrated Circuits" , 2nd Edition, New Age Pub, 2001
3. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.
4. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, 1996.

E. Course Outcomes

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

CO1. Design op-amp circuits to perform arithmetic operations.
CO2. Analyze and design linear and non-linear applications using op-amps.
CO3. Explain and compare the working of multi vibrators using special application IC 555 and general-purpose Op-amp.
CO4. Classify and comprehend the working principle of data converters.
CO5. Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

Name of the Module: Digital Communication Laboratory
Module Code: EC-306
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

Expt. No. 1. Study of pulse code modulation and demodulation
Expt. No. 2. Study of delta modulation and demodulation
Expt. No. 3. Study of pulse data coding techniques for NRZ formats
Expt. No. 4. Study of amplitude shift keying modulator and demodulator

Expt. No. 5. Study of frequency shift keying modulator and demodulator
Expt. No. 6. Study of phase shift keying modulator and demodulator
Expt. No. 7. Study of quadrature phase shift keying modulator and demodulator
Expt. No. 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",(2^{nd} Edition), McGraw Hill, New Delhi.

E. Course Outcomes

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

CO1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
CO2. Perform the time and frequency domain analysis of the signals in a digital communication system.
CO3. Select the blocks in a design of digital communication system.
CO4. Analyze performance of time division multiplexing in communication system.

Name of the Module: Microprocessor and Interfacing Laboratory
Module Code: EC-307
Credit Value: 1 {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

Expt. No. 1. Introduction to 8085 / 8086 Kit and Peripheral Boards.
Expt. No. 2. Program set for Architecture Operations.
Expt. No. 3. Program set for Logical and Decimal.
Expt. No. 4. Program set for Subroutines and Delay.
Expt. No. 5. Program set for Program Control.
Expt. No. 6. Interfacing with 8255.
Expt. No. 7. Interfacing with 8279.
Expt. No. 8. Interfacing with 8253.

Expt. No. 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

CO1. Students will have the thorough understanding of the evolution of microprocessor

CO2. Students will get to know the interfacing knowledge to get a kick start in embedded world

CO3. Students will get the idea of doing lively embedded design projects

Name of the Module: Digital Signal Processing Laboratory
Module Code: EC-308
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

Expt. No. 1. To analyze various properties of discrete signals and verify them on MATLAB.

Expt. No. 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.

Expt. No. 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.

Expt. No. 4. To study various properties of discrete time Fourier transform and verify these properties on various signals on MATLAB.

Expt. No. 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.

Expt. No. 6. To analyze fast Fourier algorithms and see how it can efficiently be used to calculate discrete Fourier transforms.

Expt. No. 7. To design and simulate Chebychev and Butterworth filters and analyze their responses on MATLAB.

Expt. No. 8. To design and simulate Infinite Impulse Response (IIR) filters and Finite Impulse Response (FIR) filters and analyzes their responses on MATLAB.

Expt. No. 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:

CO1. Write a code to obtain Z-transform and Inver Z-transform

CO2. Analyse frequency spectrum of any signal

CO3. Design and implement digital FIR & IIR filter

B. Tech. 3rd Year, Semester VI

VIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-306	Computer Networking	3	1	0	4
2	EC-321	Information Theory and Coding	3	0	0	3
3	EC-322	Instrumentation and Measurement	3	0	0	3
4	EC-323	Microcontrollers and Embedded Systems	3	0	0	3
5	EC-324	Microwave Engineering	3	0	0	3
6	EC-325	VLSI Design	3	0	0	3
7	EC-326	Instrumentation and Measurement Laboratory	0	0	2	1
8	EC-327	Microcontrollers and Embedded System Laboratory	0	0	2	1
9	EC-328	Microwave Engineering Laboratory	0	0	2	1
10	EC-329	VLSI Design Laboratory	0	0	2	1
11	EC-391	Internship – II	0	0	0	0
Contact Hours			18	1	8	
Total Credits						23

Name of the Module: Computer Networking
Module Code: CS-306
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The Objective of the course is:

- Understanding the state-of-the-art in network protocols, architectures, and applications.
- Examining and studying of different protocols in OSI and TCP/IP.
- Understanding of network addressing, mapping etc.
- Understanding error control flows control packet recovery etc.
- Understanding the structure of LAN, WAN and MAN.
- Understanding internetworking of devices.

B. Course Content

Basic: Introduction to Networking and its origin, layered task, Protocol stack, OSI model, TCP/IP model and brief functionality.

Physical layer and media: Data, Signals, Transmission, Digital transmission- digital to digital conversion, Analog to digital conversion, bandwidth utilization and spread spectrum.

Circuit and Packet Switching:- Switched Networks, Circuit-Switching Networks, Switching Concepts, Routing in Circuit-Switched Networks, Control Signalling, Packet-Switching Principles, Routing, Congestion Control, X.25 282. , structure of a switch.

Data link layer: Error correction and Detection, Data link control- framing, flow and error control, Noise less channels- Simple Protocols, Stop and wait protocol, Noisy channel protocol- Stop and Wait ARQ, Go and Back N ARQ, Selective Repeat Automatic Repeat Request, HDLC-Configuration and Transfer mode, Multiple Access- Random Access, Control access, Channelization, Wired Network (IEEE 802.3), Wireless Network (IEEE 802.11), Virtual LAN, Virtual Circuit Networks-Frame relay and ATM LAN etc.

Network Layer: Logical Addressing, Internet Protocol (IP), Address mapping, Error reporting, and multicasting- ARP, RARP, BOOTP, DHCP, ICMP, IGMP, Network Address Translators (NAT) Network Delivery-Delivery, Forwarding and Routing, Unicast routing protocol- Intra & inter domain routing, RIP, OSPF, BGP

Transport layer: Process to Process delivery- Connection oriented and connectionless service, UDP, TCP, SCTP, error and flow controls, Congestion control and Quality of service- Open loop congestion control, Closed loop congestion control, Congestion control in TCP and in frame relay Quality of service-flow characteristics, flow cases, different techniques to improve QoS, RSVP.

Application layer: Name Space, Domain in Namespace, Distribution of name space, DNS- generic, country and inverse domain, Resolution: Resolver, Mapping name to Address, Mapping address to names, recursive resolution. Remote logging- telnet, Electronic mail-SMTP, POP, IMAP and file transfer- FTP architecture, commands of FTP. WWW and HTML-Architecture, web documents, HTTP, Webservices. Uniform Resource Locators (URL) and Universal Resource Identifier (URI). Multimedia protocols- RTP, RTCP.

C. Text books

1. William Stallings, Data and Computer Communications, Eighth Edition, Pearson Prentice Hall, 2016, ISBN 0132433109.
2. Behrouz A. Fourouzan, Data Communications and Networking, Tata McGraw-Hill Education, 2006, ISBN 0070634149, 9780070634145.
3. Andrew S. Tanenbaum, Computer Networks‖, 4/e, Pearson education, 2003, ISBN 8131701980, 9788131701980

D. Reference books

1. James F. Kurose and Keith W. Ross, Computer Networking – A Top-Down Approach Featuring the Internet, 3/e, Pearson Education India, 2005, ISBN 8177588788, 9788177588781.
2. S. Keshav, An Engineering Approach To Computer Networking: ATM Networks, The Internet, And The Telephone Network, Pearson education, 2002, ISBN 8131711455, 9788131711453.
3. Halsall, Data Communication, Computer Networks and Open Systems, Pearson, 2003, ISBN 8178080982, 9788178080987.
4. W.R.Stevens, Kevin R. Fall, TCP/IP Illustated, Volume 1, 2/e, Addison-Wesley, ISBN 0132808188, 9780132808187.

5. Gary R. Wright, W. Richard Stevens , TCP/IP Illustrated, Volume 2, Addison-Wesley Professional, 1995, ISBN 0321617649, 9780321617644.
6. Douglas Comer, Internet working with TCP/IP: Principles, protocols, and architecture illustrated, Prentice Hall, 2006, ISBN 0131876716, 9780131876712.
7. Sam Halabi, Internet Routing Architectures, Pearson Education India, 2008, ISBN 8131725944, 9788131725948.
8. Larry L. Peterson and Bruce S. Davie, Computer Networks: A System Approach,5, revised, Elsevier, 2011, ISBN 0123850606, 9780123850607.

E. Course Outcomes

At the end of the course student will be able

CO1. Understanding of network addressing, mapping etc.
CO2. Understanding error control flows control packet recovery etc.
CO3. Understanding the structure of LAN, WAN and MAN.
CO4. Understanding internetworking of devices.

Name of the Module: Information Theory and Coding
Module Code: EC-321
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

CO1. Students will be introduced to the basic notions of information and channel capacity

CO2. Students will be introduced and equipped with the convolutional and block codes, decoding techniques

CO3. Students will understand how error control coding techniques are applied in communication systems.

CO4. Students will understand the basic concepts of cryptography.

Name of the Module: Instrumentation and Measurement
Module Code: EC-322
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The Objective of the course is:

- To build a solid foundation about basics of measurement techniques.
- To understand the measurement parameters and criteria of measurement.
- To build a solid foundation of the Moving coil, Moving Iron, dynamometer, Wattmeter.
- To understand various measurement techniques of CRO.
- To understand different signal conditioning methods.

B. Course Content

Introduction: Introduction to instrumentation; Static characteristics of measuring devices; Error analysis, standards and calibration; Dynamic characteristics of instrumentation systems;

Electromechanical indicating instruments: AC/DC current and voltage meters, ohmmeter; Loading effect; Measurement of power and energy; Instrument transformers; Measurement of resistance, inductance and capacitance; AC/DC bridges; Transducers classification; ***Measurement of non-electrical quantities***: Displacement, strain, temperature, pressure, flow, and force

Signal Conditioning: Instrumentation amplifier, isolation amplifier, and other special purpose amplifiers, Electromagnetic compatibility, Shielding and grounding, Signal recovery, Data transmission and telemetry, Data acquisition system;

Modern Electronic Test Equipment: oscilloscope, DMM, frequency counter, wave/ network/ harmonic distortion/ spectrum analyzers, logic probe and logic analyzer; programmable logic controller; Virtual instrumentation.

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

After finishing this course students will be able to:

CO1. Clear understanding & utilization of major test instruments.
CO2. Design and develop different instruments.
CO3. Measure their performances to apply in particular systems.
CO4. Know about different Transducers and actuators.
CO5. Understand the measurement techniques of various parameters by CRO.

Name of the Module: Microcontrollers and Embedded Systems
Module Code: EC-323
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.

F. 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.

D. Course Outcomes

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

CO1. Understand microcontrollers and embedded systems
CO2. Use microcontroller in different applications
CO3. Understand ARM processor family, Raspberry Pi and Arduino processor

Name of the Module: Microwave Engineering
Module Code: EC-324

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:

- CO1. Recognize the limitations of existing vacuum tubes and solid-state devices at microwave frequencies
- CO2. 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
- CO3. Analyse microwave & RF circuits.
- CO4. Know in depth of the theory and the technology of microwave components, devices, diodes, tubes and sources
- CO5. Have clear understanding of the microwave circuit measurement & communication system design; and understand EMI & EMC

Name of the Module: VLSI Design
Module Code: EC-325
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 device physics: 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, 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 and super buffer design.

Combinational MOS Logic Circuits: CMOS logic circuits, Complex logic circuits, CMOS transmission gates, Pseudo-nMOS, Sequential MOS logic circuits, Behaviour of bi-stable elements, Latch, Clocked latch and flip-flop circuits.

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

Single Stage Amplifiers: Common source stage, Source follower and common gate.

Differential Amplifiers: Single ended and differential operations, Basic differential pair.

Current Mirror: Basic current mirror, Cascode current mirror- large signal and small signal analysis. Operational amplifiers: One stage op-amps, Two stage op-amps.

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

Overview of 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. J. M. Rabaey, A. Chandrakasan and B. Nikolic, “Digital Integrated Circuits”, 2/e, PHI, 2003.

D. Reference books

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, Oxford University Press, 2004
2. S. Palnitkar, “Verilog HDL- A Guide to Digital Design and Synthesis”, 2/e, Pearson, 2007.

E. Course Outcomes

Upon completion of the subject, the student will have:

CO1. An ability to design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits.

CO2. An ability to extract the analog parasitic elements from the layout and analyze the circuit timing using a logic simulator and an analog simulator.

CO3. An ability to build a cell library to be used by other chip designers.

Name of the Module: Instrumentation and Measurement Laboratory
Module Code: EC-326
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

Expt. No. 1. Instrument workshop – observe the construction of PMMC, Dynamometer, Electro thermal and Rectifier type instrument, Oscilloscope and digital multimeter.
Expt. No. 2. To calibrate moving iron and electrodynamometer type ammeter/voltmeter by potentiometer
Expt. No. 3. To calibrate dynamometer type wattmeter by potentiometer
Expt. No. 4. Study of voltage shunt and series ammeter behavior.
Expt. No. 5. To calibrate A. C. energy meter
Expt. No. 6. Measure the resistivity of material using Kelvin double bridge
Expt. No. 7. Measurement technique of power using instrument transformer
Expt. No. 8. Measurement technique of in polyphase circuits
Expt. No. 9. Measurement technique of frequency by Wien bridge using oscilloscope
Expt. No. 10. Measurement technique of by Anderson bridge
Expt. No. 11. Measurement technique of capacitance by De Sauty bridge
Expt. No. 12. To study of static characteristic (accuracy, precision, hysteresis, repeatability, linearity) of a measuring instrument.
Expt. No. 13. To study of dynamic characteristic (fidelity, speed of response)
Expt. No. 14. To acquaintance with basic structure of DMM and measurement of different electrical parameters.
Expt. No. 15. To statistical analysis of errors in measurement using computer simulation
Expt. No. 16. To study of advanced A/D converter along with its associate circuitry
Expt. No. 17. To study of advanced D/A converter
Expt. No. 18. Realization of data acquisition system
Expt. No. 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

CO1. Know calibration of different measurement instruments

CO2. Know the techniques of measurement
CO3. Be able to perform statistical analysis of errors in measurement using computer simulation

Name of the Module: Microcontrollers and Embedded System Laboratory
Module Code: EC-327
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

Expt. No. 1. To study development tools/environment for ATMEL microcontroller programs and architecture
Expt. No. 2. Generate square wave of desire frequency using Timer, PWM.
Expt. No. 3. Interface seven segments with Arduino and display 0-9 on it.
Expt. No. 4. Control joint movement of Robot arm by using Gallio.
Expt. No. 5. Using Proteus design suit, develop IoT circuits to control different switches.
Expt. No. 6. Model-based design using uKeil
Expt. No. 7. Interfacing Raspberry Pi with camera module.
Expt. No. 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:

CO1. Understand microcontrollers and embedded systems
CO2. Use microcontroller in different applications
CO3. Understand ARM processor family, Raspberry Pi and Arduino processor

Name of the Module: Microwave Engineering Laboratory
Module Code: EC-328
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

Expt. No. 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.

Expt. No. 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.

Expt. No. 3. By the use of the slotted line. To determine the unknown frequency. To determine the Voltage Standing Wave Ratio (VSWR) and Reflection Coefficient.

Expt. No. 4. By use of slotted waveguide. To observe how the load impedance affects the VSWR. To determine when a waveguide is properly terminated.

Expt. No. 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

CO1. Clear understanding & utilization of matching stub and reflex klystron.
CO2. Clear understanding and utilisation of waveguide.
CO3. Clear understanding of smith chart.

Name of the Module: VLSI Design Laboratory
Module Code: EC-329
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 of digital VLSI chip design using the simpler VLSI technology

B. List of Experiments

Expt. No. 1. Study and characterization of I/V plot of NMOS and PMOS
Expt. No. 2. Design of CMOS inverter to study voltage transfer characteristic plot and to determine critical points.
Expt. No. 3. Delay estimation of CMOS inverter and to study the effect of design parameters on delay.
Expt. No. 4. Design and study of basic gates and adders with timing diagram.
Expt. No. 5. Design and study of latch and clocked latch with timing diagram.
Expt. No. 6. Design of CMOS differential amplifier with different gate size and input with different slew rate for the generation I/V plot.
Expt. No. 7. Design and study of common source, source follower and common gate amplifiers in order to understand input output characteristics.
Expt. No. 8. Design of study differential amplifier with input output plots and to understand the difference from single stage amplifiers
Expt. No. 9. Layout of basic gates, adders, latch, clocked latch and to observe the performance in pre and post layouts.
Expt. No. 10. Design of adders and subtractor using behavioral level in Verilog.
Expt. No. 11. 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. J. M. Rabaey, A. Chandrakasan and B. Nikolic, “Digital Integrated Circuits”, 2/e, PHI, 2003.

D. Reference books

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, Oxford University Press, 2004
2. S. Palnitkar, “Verilog HDL- A Guide to Digital Design and Synthesis”, 2/e, Pearson, 2007.

E. Course Outcomes

Upon completion of the subject, the student will have:

- CO1. An ability to design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits.
- CO2. An ability to extract the analog parasitic elements from the layout and analyze the circuit timing using a logic simulator and an analog simulator.
- CO3. An ability to build a cell library to be used by other chip designers.

B. Tech. 4th Year, Semester VII

VIIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	OE-XXX	Open Elective	3	0	0	3
2	EC-401X	Elective-I	3	0	0	3
3	EC-402	Wireless Communication	3	0	0	3
4	EC-403	Antenna and Wave Propagation	3	0	0	3
5	EC-404	Antenna and Wave Propagation Laboratory	0	0	2	1
6	EC-490	Internship – III	0	0	0	2
Contact Hours			12	0	2	
Total Credits						15

Name of the Module: Wireless Communication
Module Code: EC-402
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 study the recent trends adopted in cellular systems and wireless standards.
- To provide an overview of Wireless Communication networks area and its applications in communication engineering.
- To appreciate the contribution of Wireless Communication networks to overall technological growth.
- 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:

CO1. Understand the cellular system design and technical challenges.
CO2. Analyse the Mobile radio propagation, fading, diversity concepts and the channel modelling.
CO3. Analyse the design parameters, link design, smart antenna, beam forming and MIMO systems.
CO4. Analyse Multiuser Systems, CDMA, WCDMA network planning and OFDM Concepts.
CO5. Clearly know the principles and applications of wireless systems and standards

Name of the Module: Antenna and Wave Propagation
Module Code: EC-403
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. 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. S Y Liao, "Microwave Devices and Circuits", Prentice Hall of India.
6. Matthew M Radmanesh, "Radio Frequency and Microwave" Electronics Illustrated, Pearson Education Asia.
7. David M Pozar, "Microwave Engineering", John Willy & Sons. Inc.
8. Peter A Rizzi, "Microwave Engineering – Passive Circuits", Prentice Hall of India.
9. M L Sisodia, "Microwave Active Devices – Vacuum and Solid State", New Age Int. Publication.
10. M N O Sadiku, "Elements of Electromagnetics", Oxford University Press.
11. K C Gupta, "Microwave Engineering" New Age Int. Publication, New Delhi.
12. M I Skolnik, "Introduction to Radar Systems", Tata McGraw Hall.
13. S. K. Ray et al, "Microwave Semiconductor Devices", Prentice Hall of India, New Delhi

E. Course Outcomes

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

CO1. Understand and utilize antenna as required in different communication systems.

CO2. Know about EM wave propagation effects & pattern in different media.

Name of the Module: Antenna and Wave Propagation Laboratory

Module Code: EC-404

Credit Value: 1 {L = 0, T = 0, P = 2}

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

Expt. No. 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.

Expt. No. 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.

Expt. No. 3. To investigate the Radiation Pattern of Printed antennas

Expt. No. 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.

Expt. No. 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.

Expt. No. 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.

Expt. No. 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. S Y Liao, “Microwave Devices and Circuits”, Prentice Hall of India.
6. Matthew M Radmanesh, “Radio Frequency and Microwave” Electronics Illustrated, Pearson Education Asia.

7. 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:

CO1. Understand and realize antenna structures for practical communication systems

CO2. Understand and utilize antenna radiation pattern.

Name of the Module: Optical Communication
Module Code: EC-401A
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. P. Bhattacharya, “Semiconductor Optoelectronic Devices”, Pearson.
2. Franz and Jain, “Optical Communication System”, Narosa Publications, New Delhi, 1995.
3. Gerd Keiser, “Optical Fiber Communications”, McGraw Hill Education; Fifth edition
4. Endel Uiga, “Optoelectronics”, Prentice Hall
5. 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:

CO1. Recognize and classify the structures and types of Optical fiber.
CO2. Discuss the channel impairments like losses and dispersion.
CO3. Classify the optical sources and detectors and discuss their principle.
CO4. Be familiar with different optical devices such as Optical isolators, polarizer, Circulators, Attenuators, Oscillators, Filters
CO5. Familiar with Design considerations of fiber optic systems.
CO6. 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.

Name of the Module: Wireless Sensor Network
Module Code: EC-401B
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- To understand wireless sensor nodes and wireless sensor network
- To understand the challenges in wireless sensor network
- To understand the architecture and applications of sensor network
- To understand the infrastructure establishment of sensor network
- To understand the taxonomy of routing in WSN

B. Course content:

Introduction: Constraints and Challenges, Opportunities and Challenges in Wireless Sensor Networks, Advantages of Sensor Networks (Energy Advantage and Detection Advantage), Sensor Network Applications, Smart Transportation, Collaborative Processing, Key Definitions

Sensor Network Architecture and Applications: Introduction, Functional Architecture for Sensor Networks, Sample Implementation Architectures, Classification of WSNs, Characteristics, Technical Challenges, and Design Directions, Technical Approaches, Coverage in Wireless Sensor Networks, Location in Wireless Sensor Networks, Data Gathering and Processing

Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Localization Services

Sensor Network Platforms and Tools: Individual Components of SN Nodes, Sensor Network Node, WSNs as Embedded Systems, Sensor Node Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms, Node-Level Simulators, Programming beyond Individual Nodes: State-Centric Programming.

Taxonomy of Routing Techniques: Routing Protocols, Future Directions, Applications/Application Layer Protocols, Localization Protocols, Time Synchronization Protocols, Transport Layer Protocols, Network Layer Protocols, Data Link Layer Protocols

C. Text Books:

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: An Information Processing Approach, Morgan Kaufmann, 2004.
2. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge University Press
3. Mohammad Ilyas, Imad Mahgoub, Hand book of Sensor Networks, CRC Press, 2005.

D. Reference Books:

1. C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati, "Wireless Sensor Networks, Springer.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley Inter Science.

E. Course Outcomes

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

CO1. Identify the components of Wireless Sensor Networks
CO2. Understand the challenges in network coverage and routing for energy efficiency
CO3. Define node Architecture for specific applications
CO4. Program sensor network platforms using specialized operating system
CO5. Recognize upcoming challenges in Sensor Networks

Name of the Module: Image Processing
Module Code: EC-401C
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- To understand digital image processing systems and its elements.
- To understand digital image fundamentals
- To understand various steps involved in image enhancement
- To understand image compression and segmentation

B. Course Content:

Introduction: Digital Image Representation, Fundamental Steps in Image Processing, Elements of Digital Image Processing Systems.

Digital Image Fundamentals: Elements of Visual Perception, A Simple image model, Sampling and Quantization, Neighbourhood of Pixels, Pixel Connectivity, Labeling of Connected Components, Distance Measures, Arithmetic and Logic Operations, Image Transformations, Perspective Transformations, Stereo Imaging.

Image Enhancement: Spatial Domain Methods, Frequency Domain Methods, Point processing, Intensity Transformations, Histogram Processing, Spatial filtering, Smoothing Filters, Sharpening Filters, Enhancement in the Frequency Domain, Low Pass Filtering, High Pass Filtering, Homomorphic filtering, Pseudo-Color Image Enhancement.

Image Compression: Fundamentals of Compression, Image Compression Model, Error free Compression, Lossy Predictive Coding, Transform Coding.

Image Segmentation: Detection of Discontinuities, Line Detection, Edge Detection, Edge Linking and Boundary Detection, Thresholding, Threshold Selection on Boundary Characteristics, Region Growing, Region Splitting and Merging, Use of motion in Segmentation.

Image Representation and Description: Chain Codes, Polygonal Approximations, Signatures, Skeleton, Boundary Descriptions, Shape Numbers, Fourier descriptors, Moments, Topological Descriptors.

Image Recognition and Interpretation: Elements of Image Analysis, Pattern and Pattern Classes, Minimum Distance Classifier, Matching by Correlation, Bayes Classifier, Neural Network Training Algorithm, Structural methods.

C. Text Books:

1. Rafael C Gonzalez and Richard E Woods, Digital Image Processing, Pearson Education Asia, New Delhi, 2000.
2. B. Chanda, D. Dutta Majumder, Digital Image Processing and Analysis, PHI, New Delhi, 2000.
3. A.K. Jain, Fundamentals of Digital Image Processing, PHI, New Delhi, 2001.

D. Reference Books:

1. Alan C. Bovik, Handbook of image and video processing, Elsevier Academic press, 2005.
2. S. Sridhar, Digital Image processing, Oxford University press, 2011
3. Milan Sonka et al, Image Processing, Analysis and Machine vision, Brookes/Cole, Vikas Publishing House, 1999.

E. Course Outcomes:

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

CO1. Understand the need for image transforms and their properties.

CO2. Choose appropriate technique for image enhancement both in spatial and frequency domains.

CO3. Identify causes for image degradation and apply restoration techniques
CO4. Compare the image compression techniques in spatial and frequency domains
CO5. Select feature extraction techniques for image analysis and recognition

Name of the Module: Machine Learning
Module Code: EC-401D
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- To be able to formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To understand the basic theory underlying machine learning

B. Course content:

Introduction: Introduction to Machine Learning, Examples of Machine Learning applications - Learning associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis (VC) Dimension.

Probably Approximately Correct (PAC) Learning, Noise, Learning Multiple classes, Model Selection and Generalization, Dimensionality reduction- Subset selection, Principle Component Analysis

Classification: Cross validation and re-sampling methods- K- fold cross validation, Boot strapping, Measuring classifier performance- Precision, recall, ROC curves, Bayes Theorem, Bayesian classifier, Maximum Likelihood estimation, Density functions, Regression.

Decision Trees: Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART), Neural Networks- The Perceptron, Activation Functions, Training Feed Forward Network by Back Propagation.

Kernel Machines: Support Vector Machine- Optimal Separating hyper plane, Soft-margin hyperplane, Kernel trick, Kernel functions. Discrete Markov Processes, Hidden Markov models, Three basic problems of HMMs- Evaluation problem, finding state sequence, Learning model parameters, Combining multiple learners, Ways to achieve diversity, Model combination schemes, Voting, Bagging, Booting.

Unsupervised Learning: Clustering Methods - K-means, Expectation-Maximization Algorithm, Hierarchical Clustering Methods, Density based clustering.

C. Text Books:

1. Gopinath R, Ajay Ravi, "An introduction to machine Learning", Springer, 2019
2. M. Gopal, "Applied Machine Learning", Mc Grew Hill, 2019
3. Paul Wilmott**, "**Machine Learning: An Applied Mathematics Introduction", Panda Ohana Publishing, 2019.

D. Reference Books:

1. Ethem Alpaydin, An introduction to machine Learning, The MIT Press; 2014
2. Richard S. Sutton, Reinforcement Learning: An Introduction, A Bradford Book, 1998.

E. Course Outcomes:

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

CO1. Apply knowledge of computing and mathematics to machine learning problems and algorithms.

CO2. Analyse a problem and identify the computing requirements appropriate for its solution.

CO3. Design, implement and evaluate an algorithm to meet desired needs.

CO4. Apply mathematical foundations, algorithmic principles and computer science theory to the modelling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.

B. Tech. 4th Year, Semester VIII

VIIIth Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-421X	Elective-II (Swayam/ NPTEL)	3	0	0	3
2	EC-422X	Elective-III (Swayam/ NPTEL)	3	0	0	3
3	EC-491	Grand Viva	0	0	4	2
4	EC-499	Project and Dissertation	0	0	20	10
Contact Hours			6	0	24	
Total Credits						18

Name of the Module: Internet of Things
Module Code: EC-405A
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

CO1. The students will be thorough about the technology behind the IoT and associated technologies

CO2. The students will be able to use the IoT technologies in practical domains of society

CO3. The students will be able to gain knowledge about the state-of-the-art methodologies in IoT application domains.

Name of the Module: Nanotechnology
Module Code: EC-405B
Credit Value: 3 {L = 3, T = 0, P = 0}

A. Course Objectives

The objective of the course is:

- To introduce students with diversified backgrounds to the expanding nano-world.
- To effectively encouraged not only students but local professionals to participate in design proposals and to pursue further nanotechnology studies.

B. Course Content

Introduction: Definition of nanotechnology, History of Nanotechnology and Overview of nanomaterials, Bonding in atoms, atomic structure and giant molecular solids. Main features of nanomaterials; types of nanostructures (0D, 1D, and 2D structures electronic conduction, system classification confined to one, two or three dimension and their effect on properties, top-down and bottom-up processes; and main chemical/physical/electrical/optical properties of nanomaterials.

Fabrication and Synthesis of Nanomaterials (Bottom up, Top Down): Fabrication of Nanomaterials by bottom-up and top-down approaches; self-assembly of nanostructures; and examples for nanotechnology application,Spin coating, lithography, deposition, PVD, etching, and material modification methods, processes and equipment. Epitaxy-different types of Epitaxy: Lattice mismatch - Liquid Phase Epitaxy (LPE) -Molecular Beam Epitaxy (MBE)-Chemical vapour deposition (CVD) - Atomic layer deposition (ALD) Compound semiconductor nanostructures: growth of compound semiconductors, superlattices, self-assembled quantum dots.

Characterization Tools: Methods for characterizing the nanomaterials: Scanning Electron Microscopy (SEM), electro probe microanalysis (EPMA), transmission electron microscopy (TEM) including energy dispersive X-ray (EDX) analysis, electron energy loss spectroscopy (EELS), Auger electron spectroscopy (AES), low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED), Atomic force microscopy (AFM), scanning tunneling microscopy (STM) and scanning tunneling spectroscopy (STS).

Photons as probes:Light microscopy including confocal and two photon microscopy, X-ray diffraction (XRD), X-ray fluorescence(XRF), X-ray absorption spectroscopy (XAS), infrared spectroscopy (IR), Raman spectroscopy (Raman), Luminescence, Cathodeluminescence and X-ray photo electron spectroscopy (XPS).

Application: Nanotechnology for Healthcare and Medicine, Energy Harvesting, Storage and Conversion, Electro-Optic-Mechanical devices: OLEDs, OTFTs, Nanoelectronics and photonics devices.

C. Text Books

1. Zishan Husain Khan, "Emerging Trends in Nanotechnology", 2021, Springer

D. Reference Books

1. Guozhong Cao. Ed Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific Series in Nanoscience and Nanotechnology, 2011.
2. John H. Davies, “The Physics of Low Dimensional Semiconductors: An Introduction”, Cambridge University Press, 1998.
3. Edward L. Wolf, “Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience”, 2nd Ed., Wiley-VCH, 2006.
4. John Mongillo, “Nanotechnology”, Greenwood Press, 2007.
5. Rainer Waser, “Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices”, Wiley-VCH, 2003.
6. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, “Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications”, Cambridge University Press, 2008.
7. W. Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds), “Handbook of nanoscience, Engg. and Technology”, CRC Press,2002.
8. G. W. Hanson “Fundamental of Nanoelectronics” Pearson Education, 2009

E. Course Outcomes

CO1. Identify and understand various top-down and bottom-up approaches for nanomaterial synthesis.
CO2. Understand and apply vacuum technology for nanomaterial synthesis.
CO3. Know various deposition techniques at the atomic and molecular level.
CO4. Acquire knowledge about structure and properties of thin films.
CO5. Learn the advanced concepts in various vapour deposition techniques.
CO6. Synthesise and deposit nanomaterials by various methods.

Name of the Module: Spoken Language Processing
Module Code: EC-405C
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. Duda, R., Hart, P. & Stork, D., Pattern classification, John Wiley (2nd ed.), 2000.
5. 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.
6. Bishop, M. C., Pattern Recognition and Machine Learning, Springer, 2006.

E. Course Outcomes

CO1. Understand statistical approaches and some of the major techniques used for spoken language processing.
CO2. Understand weight finite state transducers;
CO3. Apply the above approaches to speech processing applications.

Name of the Module: Robotics and Automation
Module Code: EC-405D
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

CO1. Perform kinematic and dynamic analyses with simulation.

CO2. Design control laws for a simple robot.

CO3. Integrate mechanical and electrical hardware for a real prototype of robotic device.

CO4. Select a robotic system for given industrial application.