College of Engineering, Pune

(An Autonomous Institute of Govt. of Maharashtra, Permanently Affiliated to S.P. Pune University)

Department of Electronics and Telecommunication

Curriculum Structure & Detailed Syllabus (UG Program)

Third Year B. Tech.

(Effective from: A.Y. 2021-22)

Program Education Objectives (PEOs):

Graduates will demonstrate ability to:

1. Solve real-life engineering problems, design and development of innovative and cost-effective products exhibiting a solid foundation in Electronics and Communication Engineering fundamentals to cater needs of society.
2. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.
3. Exhibit professional ethics and values, effective communication, teamwork, multidisciplinary approach, and ability to relate engineering issues to broader social context.

Program Outcomes (POs):

Graduates of Electronics & Telecommunication Engineering by the time of graduation will demonstrate:

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

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

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

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

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understandin2dxg of the limitations.

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

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

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

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

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

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

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

Program specific outcomes (PSOs)

PSO 1: Development of Hardware/Software Co-designs: An ability to apply electronic design principles in the development of hardware/software prototypes and systems with progressive depth of complexity.

PSO 2: Development of Electronics Communication Systems: An ability to deploy conventional & next-gen. techniques/tools for analysis & design of Information and Communication systems.

PSO 3: Development of Signal Processing Applications: An ability to apply algorithmic knowledge of signal processing towards analysis, Recognition, and synthesis of multi-dimensional data.

PEO/ PO-PSO Correlation Matrix

PEO/ PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
PEO-1	√	√	√	√	√	√	√	-	-	-	√	√	√	√	√
PEO-2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO-3	-	-	√	-	-	-	√	√	√	√	√	√	√	√	√

List of Abbreviations

Sr. No.	Abbreviation	Title
1	BSC	Basic Science Course
2	ESC	Engineering Science Course
3	MLC	Mandatory Learning Course
4	SLC	Self-Learning Course
5	HSMC	Humanities/Social Sciences/Management Course
6	LLC	Liberal Learning Course
7	SBC	Skill Based Course
8	IFC	Interdisciplinary Foundation Course
9	IOC	Interdisciplinary Open Course
10	DEC	Department Elective Course
11	PCC	Program Core Course
12	LC	Laboratory Course

T. Y - B. TECH- E & TC CURRICULUM
(Effective from A. Y. 2021-2022)
V-Semester

Sr. No	Course Type/Code	Course Name	Contact Hours			Credits
			L	T	P	
01	BSC / MA-21001	Probability and Statistics for Engineers	2	1	0	3
02	MLC/ ML-21001	Constitution of India	1	0	0	0
03	HSMC/ HS-21001	Entrepreneurship Principles and Process	1	0	0	1
04	HSSC AS(HS)-21001 AS(HS)-21002 AS(HS)-21003 AS(HS)-21004	Humanities and Social Sciences Open Courses-I English Language Proficiency German Language Japanese Language Spanish Language	2	0	0	2
05	SBC/ ET-21001	R and Python Programming Lab	0	0	2	1
06	IFC/ CT(IF)-21001	Data Analytics	1	0	2	2
07	PCC/ ET-21002	Digital Signal Processing	3	0	0	3
08	PCC/ ET-21003	Digital Communication Systems	3	0	0	3
09	PCC/ ET-21004	Configurable Logic and Processor Design	3	1	0	4
10	PCC/ ET-21005	Electromagnetic Waves and Antennas	3	0	0	3
11	LC/ ET-21006	Digital Signal Processing Lab	0	0	2	1
12	LC/ ET-21007	Digital Communication Systems Lab	0	0	2	1
13	LC/ ET-21008	Configurable Logic design Processor Lab	0	0	2	1
		Total Academic Engagement and Credits	**19**	**2**	**10**	**25**

Honors in E&TC

- [ET(HO)-21001] Random Signals and Stochastic Processes

Minor in IOT (Offered by E &TC to other department.)

- [ETC(MI)-21001] Microcontrollers

Interdisciplinary Foundation Course-III
(Offered by E &TC to other department.)

- [ETC(IF)-21001] Internet of Things and Applications

VI-Semester

Sr. No.	Course Type/ Code	Course Name	Contact Hours			Credits
			L	T	P	
1	MLC/ ML-21002	Environmental Studies	1	0	0	0
2	HSSC AS(HS)-21005 AS(HS)-21006 AS(HS)-21007 AS(HS)-21008	Humanities and Social Sciences Open Courses-II Industrial Psychology Personnel Psychology Engineering Economics Finance for Engineers	2	0	0	2
3	SBC/ ET-21009	Mini project	0	1	2	2
4	IOC/ IOC-21010	Interdisciplinary Open Course-I	2	0	0	2
5	PCC/ ET-21010	Data Communication and Networking	3	0	0	3
6	PCC/ ET-21011	Internet of Things	3	0	0	3
7	PCC/ ET-21012	CMOS VLSI Design	3	0	0	3
8	PCC/ ET-21013	Power Electronics and Drives	2	1	0	3
9	DEC	Department Elective-I	3	0	0	3
10	LC/ ET-21014	Data Communication and Networking Lab	0	0	2	1
11	LC/ ET-21015	Internet of Things Lab	0	0	2	1
12	LC/ ET-21016	CMOS VLSI Design Lab	0	0	2	1
13	LC/ ET-21017	Power Electronics and Drives Lab	0	0	2	1
		Total Academic Engagement and Credits	**19**	**2**	**10**	**25**

Department Elective- I

- [ET(DE)-21001] Control Systems
- [ET(DE)-21002] Digital Image Processing
- [ET(DE)-21003] Machine Learning
- MOOCs / Industry Floated Course

Honors in E&TC

- [ET(HO)-21002] Information Theory and Coding

Minor in IOT (offered by E &TC to other dept.)

- [ETC(MI)-21002] Network Protocols

Interdisciplinary Open Course-I

- [IOC-21010] Digital Image Processing Applications

(MA-21001) Probability and Statistics for Engineers

Teaching Scheme
Lectures: 2 hrs. /week
Tutorial: 1 hr/ week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Demonstrate number of methods of summarizing and visualizing data sets, evaluate probabilities of events.
2. Make use of concepts of random variables and associated probability distributions to solve problems, illustrate the central limit theorem.
3. Test for basic statistical inference (t-test, z-test, F-test, $\chi 2$ –test, confidence interval, non-parametric tests).
4. Explain basic principles of regression analysis and perform the same.
5. Demonstrate use of R software for all the above.

Unit1 **(5 hrs)**
Descriptive statistics: Measures of location and variation. Visualization of data: Frequency tables, bar diagrams, histograms, heat maps, other visualization tools. Review on introduction to combinatorics and probability theory.

Unit 2 **(5 hrs)**
Some of the basic probability distributions: Binomial, Poisson, Exponential, and Normal. Central limit theorem

Unit 3 **(4 hrs)**
Introduction to 'R': Introductory R language fundamentals and basic syntax, major R data structures, Using R to perform data analysis, creating visualizations using R.

Unit 4 **(6 hrs)**
Basic statistical inference and hypothesis testing: Estimation, basic tests such as t-test, z-test, F-test, $\chi 2$ –test, Nonparametric tests: Sign test, Wilcoxon signed rank test.

Unit 5 **(4 hrs)**
Regression methods: Simple linear regression and multiple regression

Unit 6 **(4 hrs)**
Engineering applications of statistics (Branch Specific (any 2)): Discussion on reliability and quality control. Introduction to random processes, stochastic processes, Markovchains. Machine learning and data science**.**

Textbooks:

- Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers and Scientists (8th Edition), Pearson Prentice Hall, 2007.
- Tilman M. Davies, The book of R: A first course in Programming and Statistics (1st Edition), No Starch Press, USA, 2016.

Reference Book:

- Ross S.M., Introduction to probability and statistics for Engineers and Scientists (8th Edition), Elsevier Academic press, 2014.
- S. P. Gupta, Statistical Methods, S. Chand & Sons, 37th revised edition, 2008.
- Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications (2nd Edition), Wiley Student edition, 2008.
- Stephens L.J., Schaum's outline of statistics for Engineers, Latest edition, 2019.
- The practice of Business Statistics by Manish Sharma and Amit Gupta, Khanna Publishing Company Private Limited, New Delhi, 2014.

References for R Software:

- Norman Matloff, The Art of R Programming - A Tour of Statistical Software Design, (1st Edition), No Starch Press, USA, 2011.
- Sudha Purohit, Sharad Gore, Shailaja Deshmukh, Statistics using R (2nd Edition), Narosa Publications, 2019.
- Randall Pruim, Foundations and Applications of Statistics - An introduction using R (2nd Edition), American Mathematical Society, 2018.
- Hadley Wickham and Garrett Grolemund, R for Data Science: Import, Tidy, transform, Visualize and Model Data, (1st Edition), O'Reilly Publications, 2017.

(ML-21001) Constitution of India

Teaching Scheme
Lectures: 1 hr./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

Course Outcomes:

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

1. Interpret the Preamble and know the basics of governance of our nation.
2. Identify the different aspects covered under the different important Articles.
3. Apprehend the basic law, its interpretation, and the important amendments.
4. Understand our Union and State Executive better.
5. Recognize the basic that along with enjoying the rights one needs to fulfill one's duties.
6. Summarize and Gain confidence on our Constitution by knowing it better.

Unit1 **(5hrs)**

Understanding the concept 'Rule of Law '
Meaning and history of Constitution.
Introduction to The Constitution of India, understanding its objects.
Preamble to the constitution of India

Unit 2 **(4 hrs)**

Understanding the concept of Human Rights and Fundamental Rights.
Fundamental rights under Part – III, exercise of the Rights, limitations, and important cases.
Prerogative Writs.
Fundamental duties & their significance.

Unit 3 **(4hrs)**

Relevance of Directive principles of State Policy.
Legislative, Executive & Judiciary (Union and State)
Constitutional Provisions for Scheduled Castes, Scheduled Tribes, & Backward classes.
Constitutional Provisions for Women & Children

Unit 4 **(2hrs)**

Emergency Provisions.
Electoral procedure in India
Amendment procedure and few important Constitutional Amendments

Textbooks:

- Introduction to the Constitution of India by Durga Das Basu (Students Edn.) Prentice – Hall EEE, 19th/20th Edn.
- Engineering Ethics by Charles E.Haries, Michael. S.Pritchard and Michael J. Robins Thompson Asia,.

Reference Book:

- M.V. Pylee , An Introduction to Constitution of India , Vikas Publishing

(HS-21001) Entrepreneurship Principles and Process

Teaching Scheme
Lectures: 2 hrs /week

Examination Scheme
Field Work/Assignments-40 Marks
End Sem Exams- 60 Marks

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

1. Discover, develop, and assess different types of Entrepreneurial ventures and opportunities
2. Learn about opportunity and risk analysis.
3. Use the strategies for valuing your own company, and how venture capitalist and angel investors use valuations in negotiating milestones, influence, and control.
4. Pick correct marketing mix and how to position the company in the market by using analytical tools
5. Learn how to sale themselves and the product/service and to handle objections.

6. Know how an organization operates, their process matrices, start new ventures, winning business plans.

Unit 1 **(3 Hrs)**

Market Research, Types of Companies and Organizations

Introduction to Entrepreneurship, Profile of the Entrepreneur, Market Gap /Opportunity Analysis, Market Research Methods, Defining the Focal Market: Market Segmentation, Industry analyzing– Research /Competitive Analysis. Company/ Organization Types, Legal Aspects, Taxation, Government Liaison, Building the Team, Mergers and Acquisitions

Unit 2 **(4 Hrs)**

Business Finance, Marketing & Digital Marketing

Shares and Stakes, Valuation, Finance Creation (Investors/Financers), Revenue Plans a Projections, Financial Ratios, Business Lifecycle, Break Even. Marketing Basics, Marketi Strategy and Brand Positioning, Plans and Execution Techniques, Marketing Analytics, Onli Marketing

Unit 3 **(3 Hrs)**

Sales & Operations Management

Understanding Sales, Pitching Techniques, Sales strategies, Inside Sales v/s Outside Sales, RF Operational Basics, Process Analysis, Productivity, Quality

Unit 4 **(2 Hrs)**

Start-ups

Start-up Basics, Terms, Start-up Financing, Start-up Incubation, Start-up Incubation, Getting Listed

Text Books:

- David Kidder, The Startup Play book: Secrets of the Fastest Growing Startups From Their Founding Entrepreneurs
- Ed Catmull, Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration
- Bill George and Peter Sims, True North
- Bhargava, S..Transformational leadership: Value based management for Indian Organizations (Ed.). New Delhi: Response-Sage. (2003)
- Cardullo,M.W.P.E..Technological entrepreneurism: Enterprise formation, financing, and growyh. England: Research Studies Press Ltd. (1999)

Reference Books:

- KanungoR.N, Entrepreneurship and innovation: Models for development (Ed.,Vol.2). New Delhi: Sage. (1998)
- Van Nostrand, Verma , J.C.,& Singh ,G..Small business and industry: A hand book for entrepreneurs. New Delhi: Response-Sage. (2002)
- Richard A Brealy & Steward C Myres. Principles of Corporate Finance, McGrawHills, 7thEdn,2004
- Prasanna Chandra, Financial Management: Theory and Practice, TataMcGrawHills, 6thEdn, 2004

Humanities and Social Sciences Open Courses-I

[AS (HS)-21001] English Proficiency Language

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Assignment: 40 marks
End Sem Exam: 60 marks

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

1. Understand concepts of English language and apply them practically.
2. Reproduce meaningful and well-structured sentences for conversation or speech in English.
3. Analyze, comprehend, and write well and effectively produce enhanced formal communication in English.
4. Display their Presentation skills and participate and produce healthy discussions both formally and informally among peers using English.
5. Create impact by acquiring professional skills, confidently face interviews and be better employable and industry ready.

Unit 1 **(8 Hrs)**
English for communication
Basic understanding of language and its need for effective business communication for Engineers, Formal and informal expressions, Vocabulary Building, Business Idioms

Unit 2 **(6 Hrs)**
Presentation Skill Development
Oral Presentations, Basic Mannerisms and Grooming required for professionals, Cross cultural communication, Business Etiquette

Unit 3 **(8 Hrs)**
Business Writing
Writing Mechanics, Note making, Summarizing, Letter &Email Writing, Business Reports, Statement of Purpose

Unit 4 **(6 Hrs)**
Employability Enhancement
Job Readiness, Interview Skills and Mock Interviews

Reference Books:

- Shalini Verma , Business Communication (2nd Edition) , Vikas Publishing House
- Shirley Tailor , Communication for Business: A Practical Approach , Longman
- S. Mishra & C. Muralikrishna , Communication Skills for Engineers , Pearson
- T.M. Farhathullah , Communication Skills for Technical Students , Orient Longman
- Shalini Varma c, Enhancing Employability at Soft Skills , Pearson
- Saran Freeman , Written Communication in English, Orient Longman
- Jaishri Jethwaney , Corporate Communication Oxford University Press
- R. C. Sharma & Krishna Mohan , Business Correspondence and Report Writing, Tata

McGraw Hill

- Essential English Grammar (Intermediate & Advanced) Raymond Murphy (CUP)

[AS (HS)-21002] German Language

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Assignment: 40 marks
End Sem Exam: 60 marks

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

1. Acquire knowledge of facts about Germany and German culture (cultural sensitization).
2. Adapt pronunciation of German letters and greetings.
3. Identify and calculate numerical till 1000.
4. Describe themselves and third person.
5. Construct simple questions or sentences and interact with the teacher and classmates.
6. Comprehend time and time related phrases, illustration of the same in conversations.
7. Handle day to day situations like placing an order in the restaurant or interact with shopkeeper in the supermarket.

Unit 1 **(6 Hrs)**
Guten Tag! (Good day)
Greetings, self introduction and partner introduction, numbers till 100, how to mention telephone number and email address, about countries, nationalities and languages.

Unit 2 **(6 Hrs)**
Freunde, Kollegen und ich (Friends, colleagues and myself)
Hobbys, days of the week, months, seasons and professions, classroom objects and classroom communication

Unit 3 **(6 Hrs)**
Dining out
Understanding German cusine, meal courses, names of the ingredients, conversation with the waiter and in the supermarket.

Unit 4 **(6 Hrs)**
Uhrzeit (Timing)
Mention time, daily routine, making appointments

Unit 5 **(6 Hrs)**
Grammatik (grammar)
Vocab, Verb conjugations, WH-question, verbs, pronounciation, personal pronouns, articles,

Singular and Plural, negation.

Reference Books:

- Dengler.S., Rusch. P., Schmitz.S., & Sieber.T. Netzwerk, Deutsch als Fremdsprache. 2015. Goyal Publishers & Distributors Pvt. Ltd. Delhi, India
- You tube video series "learn German", "easy German" etc.
- Funk.H., Kuhn.C., & Demme.S. Studio d A1. Deutsch als Fremdsprache. 2011. Goyal Publishers & Distributors Pvt. Ltd. Delhi, India.

[AS (HS)-21003] Japanese Language

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Assignments: 40 marks
End Sem Exam: 60 marks

Course Outcomes:

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

1. Acquire knowledge of facts about Japan and Japanese culture,
2. Familiarize with pronunciation of Japanese letters and daily greetings, Accent, Intonation and Japanese writing System Hiragana, Katakana and Kanji
3. Identify numbers, Colors, Years, Months and Days, Time expressions, Directions to read the city map.
4. Describe themselves and third person and family members.
5. Construct simple questions or sentences and interact with the teacher and classmates.
6. Apply Engineering Terminology and Japanese work culture such as Monozukuri, 5S, Kaizen, 3M, 5W1H etc.

Unit 1 **(6 Hrs)**

Introduction to Japanese Language (Nihongo)

Recognize Japanese Characters Hiragana. Can read /write Hiragana script.
Use basic classroom expressions.
Exchange greetings Can thank someone or apologize someone.
Recognize Japanese Characters Katakana Can read /write Katakana script.
Can ask someone to say something again if you don't really understand.

About Me & Food

Give simple self-introduction Can ask and answer where you live and your age.
Can write your name, nationality, date of birth and occupation in Japanese.
Recognize the parts of a business card.
Talk someone briefly about your family using a family photo and answer simple questions such as who is that? Number of family members.
Talk about your favorite foods you like and dislike. Talk about your breakfast.
Can respond when offered a drink. For example, saying what you want to drink.
Can look at menu in a fast-food restaurant and understand what is available.
Can look at different restaurants' signboards and understand what each place is.

Unit 2 **(6 Hrs)**

Home & Daily life

Say what kind of house you live in. Say what you have in your home.
Write an e mail inviting someone to your home. Visit/ Welcome a friend.
Ask /say where to put things in the room. Can read the buttons on an electric appliance.
Can listen to a simple explanation when being shown around a room and understand the layout.
Recognize the name and address on signs. Talk about your daily routine. Say the time you do something. Talk about your schedule at work for the week.
Can listen to short and simple instructions at work and understand what to do.
Can read a simple, handwritten note at work and understand the instructions.
Can ask someone to lend you something at work.
Can look at a list of equipment and confirm if you have all the items.

Unit 3 **(7 Hrs)**

Holidays and Days off 1 and Towns

Can give a simple answer when asked about your hobbies and favorite things to do.
Talk about what you do on your days off.
Can read an event poster and find the important information such as the date, time and place.
Can ask and answer questions about whether you are going to an event etc.
Can say when you are available, when you are inviting someone to something or being invited
Recognize station and Taxi signs.
How to get to particular destination using a map
Can say how you go to work and how long it takes.
Describe places in town and location
Can look at common signs in a station and understand what they mean.

Unit 4 **(6 Hrs)**

Shopping & **Holidays and Days off 2**

Talk about what you want to buy.
Can ask staff in a shopping center etc .Where to go for a certain item and understand the answer .
Can look at discount signs and read the prices.
Make a brief comment on things in a shop.
Can read a short blog / simple e mail
Can talk in simple terms about impressions of the holiday / trip.
Can write a simple post for social media etc. About what you did in holiday.

Reference Books:

- Marugoto A1 Katsudo, Starter Coursebook for Communicative Language Activities.
- Marugoto A1 Rikai Starter, Coursebook for Communicative Language Competences The Japan Foundation
- Minna no Nihongo, Main Textbook Elementary Lesson 1-12
- Minna no Nihongo , Translation & grammatical Notes in English Elementary Lesson 1-12,3A Corporation, Goyal Publishers

[AS (HS)-21004] Spanish Language

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Assignment: 40 marks
End Sem Exam: 60 marks

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

1. Acquire knowledge of facts about Spain and Latin Americaand Spanish culture, pronunciation of Spanish letters and greetings.
2. Identify and calculate numerical till 1000.
3. Describe themselves and third person.
4. Construct simple questions or sentences and interact with the teacher and classmates.
5. Comprehend time and time related phrases, illustration of the same in conversations, Handle day to day situations like placing an order in the restaurant or interact with shopkeeper in the supermarket.

Unit 1 **(6 Hrs)**
¡Hola! (Hello)
Greetings, self introduction and partner introduction, numbers till 100, how to mention telephone number and email address, about countries, nationalities and languages. Hobbys, days of the week, months, seasons and professions, classroom objects and classroom communication.

Unit 2 **(6Hrs)**
La comida (Food)
Understanding Spanish cusine, meal courses, names of the ingredients, converstaion with the waiter and in the supermarket.

Unit3 **(6 Hrs)**
La ropa (clothing)
Clothing, accessory (as per weather), season + weather, vocabulary, Demonstrative pronouns, how to ask about price, numbers till 1000 .

Unit4 **(6 Hrs)**
La hora (Timing)
Mention time, daily routine, making appointments

Unit 5 **(6 Hrs)**
La gramática (grammar)
Vocab, Verb conjugations, WH-question, verbs, pronounciation, personal pronouns, articles, Singular und Plural, negation.

Reference Books:

- Aula internacional Jaime Corpas, Eva García, Agustín Garmendia, Neus Sans Baulenas (contributor), published by Goyal Publisher's and Distributors Pvt. Ltd.

(ET-21001) R and Python Programming Lab

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

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

1. Examine Python syntax and semantics and be fluent in the use of Python flow control and Functions.
2. Learn and implement various Machines Learning algorithm in Python.
3. Implement K-means and estimate the accuracy of clustering algorithm in Python.
4. Demonstrate proficiency in handling data using R.
5. Calculate the efficiency of various predictive modeling methodologies in R.

List of Experiments:

A. Python Programming

1. Write a Python program to calculate the area of triangle by taking inputs from user.
2. Enlist various types of Data Types used in Python.
3. Write a Python program various sorting algorithm (Merge, Selection and insertion sort).
4. Write a Python program to demonstrate the use of tuple, set, and array
5. Write a program to demonstrate various Matrix operations using Python.
6. Evaluate the quality of K-Means clustering algorithm using entropy and Purity in Python.
7. Write a Python program for SVM and compare its performance for various kernels
8. Implement Back Propagation Neural Network (BPNN).

B. R-Programming

1. Perform R-Studio, R-Package, R-Library etc. installation.
2. Write a R program to display the effect of outliers while calculating various statistical parameters like mean, variance, median and standard deviation.
3. Write a R program to get the statistical summary and nature of the data of a given data frame.

Write a R program for training and visualizing of a decision tree classifier.

Reference Book:

- Mitchell Tom, "Machine learning", New York, NY: McGraw-Hill, ISBN:9780070428072
- Ethem Alpaydin, "Introduction to Machine Learning", PHI, 2005
- Mark Gardener, Beginning R: The Statistical Programming Language, Wiley, 2012, ISBN: 978-1-118-16430-3

[CT (IF)-21001] Data Analytics

Teaching Scheme
Lectures: 1 hrs./week
Laboratory: 2 Hr/week

Examination Scheme
Continuous Lab/Project assessment- 40 marks
Mid sem Exam- 30 Marks
End Sem Exam – 30 marks

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

1. Examine and compare various datasets and features.
2. Analyze the business issues that analytics can address and resolve.
3. Apply the basic concepts and algorithms of data analytics.
4. Interpret, analyze, and validate data using popular data analytics tools.

Unit1 **(2 hrs)**
Fundamentals of Data Analytics
Descriptive, Predictive, and Prescriptive Analytics, Data Types, Analytics Types, Data Analytics Steps: Data Pre-Processing, Data Cleaning, Data Transformation, and Data Visualization.

Unit 2 **(2 hrs)**
Descriptive and Inferential Statistics
Probability distributions, Hypothesis testing, ANOVA, Regression

Unit 3 **(2 hrs)**
Machine Learning Concepts
Classification and Clustering, Bayes' classifier, Decision Tree, Apriori algorithm, K-Means Algorithm, Logistics regression, Support Vector Machines, Introduction to recommendation system.

Unit 4 **(2 hrs)**
Data Analytics Tools
Data Analytics using Python: Statistical Procedures, NumPy, Pandas, SciPy, Matplotlib

Unit5: **(2hrs)**
Data Pre-Processing
Understanding the Data, Dealing with Missing Values, Data Formatting, Data Normalization, Data Binning, Importing and Exporting Data in Python, turning categorical variables into quantitative variables in Python, Accessing Databases with Python

Unit 6 **(2 hrs)**
Data Visualization
Graphic representation of data, Characteristics and charts for effective graphical displays, Chart types- Single var: Dot plot, Jitter plot, Error bar plot, Box-and-whisker plot, Histogram, Two variable: Bar chart, Scatter plot, Line plot, Log-log plot, More than two variables: Stacked plots, Parallel coordinate plot.

Textbooks:

- Anil Maheshwari, "Data Analytics made accessible," Amazon Digital Publication, 2014.
- James R. Evans, "Business Analytics: Methods, Models, and Decisions", Pearson 2012
- Song, Peter X. K, "Correlated Data Analysis: Modeling, Analytics, and Applications", Springer-Verlag New York 2007.

Reference Book:

- Glenn J. Myatt, Wayne P. Johnson, "Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining", Wiley 2009.
- Thomas H. Davenport, Jeanne G. Harris and Robert Morison, "Analytics at Work: Smarter Decisions, Better Results", Harvard Business Press, 2010
- Rachel Schutt, Cathy O'Neil, "Doing Data Science", O'REILLY, 2006.
- Shamanth Kumar Fred Morstatter Huan Liu "Twitter Data Analytics", Springer-Verlag, 2014.

Data Analytics Lab

List of Assignments:

1. Write a NumPy program to generate an array of 15 random numbers from a standard normal distribution.
2. Write a NumPy program to create a two-dimensional array with shape (8,5) of random numbers. Select random numbers from a normal distribution (200,7).
3. Write a Pandas program to add, subtract, multiple and divide two Pandas Series.Sample Series: [2, 4, 6, 8, 10], [1, 3, 5, 7, 9]
4. Write a Pandas program to convert a NumPy array to a Pandas series.
5. Write a Pandas program to create the mean and standard deviation of the data of a given Series.
6. Write a Pandas program to compute the minimum, 25th percentile, median, 75th, and maximum of a given series.
7. Write a Pandas program to get the day of month, day of year, week number and day of week from a given series of date strings.
8. Consider Iris Dataset, load the iris data into a dataframe and perform following basic operations on it:
    a. print the shape of the data, type of the data and first 10 rows and get the number of observations, missing values and nan values.
    b. Use Scikit-learn to print the keys, number of rows-columns, feature names and the description of the Iris data.
    c. create a 2-D array with ones on the diagonal and zeros elsewhere. Now convert the NumPy array to a SciPy sparse matrix in CSR format
    d. basic statistical details like percentile, mean, std etc. of iris data.
    e. Write a Python program to drop Id column from a given Dataframe and print the modified part. Call iris.csv to create the Dataframe.
    f. create a plot to get a general Statistics of Iris data
9. Consider the same Iris Dataset and perform visualization on the same:

a. Write a Python program to create a Bar plot and pie plot to get the frequency of the three species of the Iris data.
b. Write a Python program to create a graph to see how the length and width of Sepal Length, Sepal Width, Petal Length, Petal Width are distributed.
c. Write a Python program to create a joinplot to describe individual distributions on the same plot between Sepal length and Sepal width. Note: joinplot - Draw a plot of two variables with bivariate and univariate graphs.
d. Write a Python program to draw a scatterplot, then add a joint density estimate to describe individual distributions on the same plot between Sepal length and Sepal width.
e. Write a Python program using seaborn to Create a kde (Kernel Density Estimate) plot of sepal length versus sepal width for setosa species of flower.
f. Write a Python program to create a box plot (or box-and-whisker plot) which shows the distribution of quantitative data in a way that facilitates comparisons between variables or across levels of a categorical variable of iris dataset. Use seaborn.
g. Write a Python program to create a Principal component analysis (PCA) of iris dataset.

10. Write a Python program using Scikit-learn to split the iris dataset into 80% train data and 20% test data. Train or fit the data into the model and using the K Nearest Neighbor Algorithm and create a plot of k values vs accuracy.
11. Build a decision tree model that predicts the species of iris from the petal and sepal width and length. Perform model evaluation.
12. Implementing Support Vector Machine (SVM) classifier in Python using the iris features from iris dataset and train an SVM classifier and use the trained SVM model to predict the Iris species type.

Mini Project: Write an application demonstrating your skills in defining a data science problem, writing down the requirements carefully, designing a modular solution with clear separation of data pre-processing and transformation, visualization, model building and model evaluation. The application can use any dataset from Kaggle, UCI etc or a task defined after discussion with the instructor.

(ET-21002) Digital Signal Processing

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Interpret, represent and process discrete/digital signals and systems.
2. Analyze discrete time signals in frequency domain.
3. Learn Discrete Fourier and Fast Fourier Algorithms and their different versions.
4. Design IIR filters for processing of discrete time.
5. Design FIR filters for processing of discrete time.
6. Application of Digital Signal Processing Algorithms for providing solutions for social cause.

Unit1 **(7hrs)**
DSP Preliminaries: Sampling, DT signals, sampling theorem in time domain, sampling of analog signals, recovery of analog signals, and analytical treatment with examples, mapping between analog frequencies to digital frequency, representation of signals as vectors, concept of Basis function and orthogonality. Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

Unit 2 **(7hrs)**
Discrete Fourier Transform: DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, Linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm, Linear filtering using overlap add and overlap save method, Introduction to Discrete Cosine Transform.

Unit 3 **(6hrs)**
Structures for Discrete Time Systems: Block Diagram representation and Signal Flow Graph representation of Linear Constant Coefficient Difference EQUATION, Basic Network Structures for FIR and IIR Systems, Overview of Finite precision Numerical effects

Unit 4 **(7hrs)**
IIR Filter Design: Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by approximation of derivatives, , IIR filter design by impulse invariance method, Bilinear transformation method, warping effect. Characteristics of Butterworth filters, Chebyshev filters and elliptic filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Finite word length effect in IIR filter design.

Unit 5 **(7hrs)**
FIR Filter Design: Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form, Finite word length effect in FIR filter design

Unit 6 **(6hrs)**

Applications and Projects: Address recent trends in DSP algorithms (like FFT, DFT etc) with perspective of research & explore applications of DSP. Project based applications to be designed to find cost time and performance effective solutions to Local problems.

Text Books:

- John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, algorithms and Applications" Fourth edition, Pearson Prentice Hall, 2007.
- A. Oppenheim and R. W. Schafer, Discrete-time Signal Processing, Pearson 2014.

Reference Book:

- Dr. Shaila Apte, "Digital Signal Processing", Wiley India Publication, second edition, 2009.
- Ifaeachor E.C, Jervis B. W., "Digital Signal Processing: A Practical approach", 2nd edition, Pearson Publication, 2002.
- K.A. Navas, R. Jayadevan, 'Lab Primer through MATLAB: Digital Signal Processing " PHI, 2014.
- Li Tan, Jean Jiang, "Digital Signal Processing: Fundamentals and applications" Academic press,2008.
- S. Salivahanan, C. Gnanpriya, "Digital Signal processing", 2nd edition, McGraw Hill,2011.

(ET-21003) Digital Communication Systems

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

Course Outcomes:

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

1. Analyze digital communication receivers in terms of spectral efficiency and error rate
2. Analyze the performance of waveform coding techniques.
3. Explain merits and demerits of different baseband modulation techniques like unipolar and bipolar signalling.
4. Compare bandpass modulation techniques for bit error rate, bandwidth and power requirements
5. Comprehend and correlate information measures of Analog and Discrete sources leading to derivation and application of channel capacity.
6. Apply algorithmic techniques for source coding of diversified types of discrete data

Unit1 **(8 hrs)**

Foundation of Digital Communication: Block diagram of digital communication, introduction to source coding and channel coding, transformation from signal space to vector space, Gram-Schmidt orthogonalization, review of random processes and Gaussian processes, correlation and power spectra, detection of signal in presence of noise, correlators and match filters, signal estimation, maximum likelihood.

Unit2 **(8 hrs)**

Sampling Process and Waveform Coding Techniques: Sampling theorem, Practical difficulties in signal reconstruction, Aliasing effect, Pulse code modulation (PCM), Bandwidth and output SNR analysis of PCM, Uniform and non-uniform quantization, Companded PCM, Differential PCM (DPCM), Delta modulation (DM), Adaptive delta modulation (ADM), Performance comparison of the above systems with PCM.

Unit3 **(6 hrs)**

Baseband shaping for Data Transmission: Discrete PAM Signals, Inter-symbol interference (ISI), Eye pattern, Channel equalization. Detection of binary signals in Gaussian Noise, Detection error Probability for polar, on-off and bipolar signals.

Unit4 **(6 hrs)**

Band pass modulation techniques: Digital Band pass Modulation techniques such as ASK, FSK, BPSK, QPSK, QAM etc, Band pass demodulation in the presence of Gaussian noise. Coherent and non-coherent detection, Error performance for binary system, M-ary signaling and performance, Bit error rate (BER) performance of shift-keying techniques, Introduction to OFDM, Spread spectrum principles (DSSS, FHSS and CDMA)

Unit5 **(6 hrs)**

Information Measures: Discrete Source models – Memoryless and Stationary, Mutual Information, Self Information, Conditional Information, Average Mutual Information, Entropy, Entropy of the block, Conditional Entropy, Information Measures for Analog Sources.

Unit6 **(6 hrs)**

Coding Techniques for Discrete Sources: For Memory-less Sources: Fixed length coding, Variable length coding – Prefix codes, Kraft Inequality, Coding Techniques - Huffman, Shannon-Fano, Higher order extensions, Average code length, Coding efficiency For Stationary Sources: Lempel-Ziv encoder and decoder, Introduction to channel coding – Code rate and Redundancy, Linear Block codes

Text Book:

- Bernard Sklar and Pabitra Kumar Ray, "Digital Communications: Fundamentals and Applications", Pearson Education Asia, Second Edition, Nov 2008.
- B.P. Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", (Fourth edition), Oxford University Press, Jan 2011.

Reference Book:

- John G. Proakis and Masoud Salehi, "Digital Communications", Tata McGraw Hill, Fifth Edition, 2014.
- Simon Haykin, "Digital Communications", John Wiley and Sons, April 2013.

(ET-21004) Configurable Logic and Processor Design

Teaching Scheme
Lectures: 3 hrs./week
Tutorial: 1 hr./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

Course Outcomes:

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

1. Design Finite State Machines
2. Write codes using Verilog HDL for FSM
3. Illustrate digital logic design from the perspective of computer architecture.
4. Interpret MIPS Processor
5. Model the digital designs including FSMs to Processor architectures using the knowledge of HDL Language.
6. Use IP cores for early development of product.

Unit 1 **(12 hrs)**

Sequential Logic Design: Top-down approach to Design, Synchronous FSM design (Mealy and Moore Machines), Static Timing analysis, Metastability, clock issues, Synchronizer, Asynchronous FSM Design

Unit 2 **(6 hrs)**

Hardware Description Language: HDL Fundamentals and Design entry by Verilog / System Verilog, Test benches.

Unit 3 **(8 hrs)**

Digital Building Blocks: Arithmetic Circuits: Ripple adder, Carry look ahead adder, Subtractors, Comparators, ALU, Shifters and Rotators, Multipliers etc. **Number Systems**: Fixed point and floating-point number systems, floating point addition. **Sequential BuildingBlocks:** Counters, Shift registers. Memory Arrays, **Logic Arrays:** PAL, PLA, FPGA implementation. HDL representation of single cycle CPU data path and control path

Unit 4 **(6 hrs)**

Instruction set Architecture: Machine Language, Assembly Language, MIPS instruction set, R type I type, J type instructions encoding, MIPS general purpose registers, signed

unsigned instructions, floating point instructions, Addressing modes, Pseudo instructions, Exceptions.

Unit 5 **(8 hrs)**

Micro Architecture: MIPS Micro architecture, Performance analysis, Single cycle Processor: Single cycle CPU data path and control path with exceptions and interrupts, Multi cycle Processor: Multi cycle data path and control path, Pipelined processor: Control path and Data path design and its Hazards, Advanced Micro architectures.

Unit 6 **(4 hrs)**

IP and Prototyping: IP in various forms: RTL Source code, Encrypted source code, soft IP, Hard IP, Physical IP, case studies.

Text Books:

- Stephen Brown and ZvonkoVranesic, "Fundamentals of Digital logic with verilog design", 2003, Mc-Graw hill.
- Zainalabedin Navabi, "Verilog Digital System Design RT Level Synthesis, Testbench and Verification", 2nd edition, 2006, Tata McGraw-Hill Edition
- David Harris and Sarah Harris, "Digital Design and Computer Architecture", 2nd edition, 2013, Morgan Kaufmann.
- Doug Amos, Austin Lesea, Rene Richter, "FPGA based prototyping methodology manual", Xilinx

Reference Books:

- Douglas Smith, "HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog", Doone publications.
- Bob Zeidman, "Designing with FPGAs & CPLDs", CMP Books.
- IEEE standard HDL based on Verilog HDL, published by IEEE.
- Ben Cohen, "Real Chip design and Verification using Verilog and VHDL", VhdlCohen Publishing
- David A. Patterson, John Hennessy, " Computer Organization and Design", ELSEVIER, Morgan Kaufmann
- www.testbench.in

(ET-21005) Electromagnetic Waves and Antennas

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Analyze the transmission lines and estimate voltage and current at any point on transmission line for various load conditions.
2. Use the Smith Chart as a tool for transmission line calculations and analysis.
3. Determine the solution to the real-life plane wave problems for various boundary conditions using concepts of electromagnetic wave propagation.
4. Analyze the field equations for the wave propagation in special cases such as lossless, low loss and lossy dielectrics medium.
5. Visualize TE and TM mode patterns of field distributions in rectangular waveguide.
6. Characterize the radiation of an antenna and antenna array in terms of pattern, directivity, gain, bandwidth and radiation resistance.

Unit 1 **(9hrs)**

Transmission Lines: Introduction, Concept of distributed elements, Equations of voltage and current, standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Unit 2 **(7hrs)**

Uniform Plane Waves: Maxwell's equations. Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Unit 3 **(7hrs)**

Plane Waves at Media Interface: Plane wave in arbitrary direction, Boundary conditions, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Reflection from conducting boundary.

Unit 4 **(6hrs)**

Guided Waves: Waves in Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic (TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Waves in Rectangular waveguides.

Unit 5 **(7hrs)**

Antennas: Introduction to Antenna basics and characteristics, Effective aperture, Friis Transmission formula, general concept of dipole antenna. Short dipole and loop antenna, Slot antennas, Babinet's principle.

Unit 6 **(6hrs)**

Antenna Arrays: Introduction to Arrays, Two - element and N - element uniform linear arrays, Array Factor calculations, Broadside array, End fire array and Phased array.

Text Books:

- Shevgaonkar, R. K., "Electromagnetic waves", Tata McGraw-Hill Education, 2006.
- Balanis, Constantine A., "Antenna theory: analysis and design", John wiley& sons, 2016.

Reference Books:

- Nathan Ida, "Engineering Electromagnetics", 2nd Edition, Springer.
- Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.
- Ramo, S., Whinnery J. R., and van Duzer. T, "Fields and Waves in Communication Electronics", 3rd Edition, John Wiley & Sons.

(ET-21006) Digital Signal Processing Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term work - 50 Marks
Practical – 50 marks

Course Outcomes:

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

1. Verify & demonstrate basic concepts of digital signal processing.
2. Analyze the signals in time & frequency domain.
3. Design of digital filters for specific applications.
4. Implement Multirate signal processing techniques.

List of Experiments:

1. Generation of Basic Signals using C/Python and MATLAB.
2. Verification of sampling theorem.
3. Verification of linear convolution in C/Python and MATLAB using two finite sequences.
4. Implementation of circular convolution in C/Python and MATLAB.
5. Find DFT for a signal & plot the spectrum.
6. Linear & circular convolution using DFT & IDFT.
7. Design a filter to remove noise from noisy signal.
8. Design of FIR filter in C/Python and MATLAB.

9. Design of IIR filter in C/Python and MATLAB.
10. Design moving average & median filter.
11. Implement up sampling & down sampling of signals.

(ET-21007) Digital Communication Systems Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term work - 50 Marks
Practical – 50 Marks

Course Outcomes:

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

1. Analyse and compare digital modulation techniques in terms of bandwidth, requirements, data rate and constellation diagram.
2. Compare the performance of different keying techniques such as ASK, FSK and PSK.
3. Implement binary block coding techniques for error detection and correction in software.

List of Experiments:

1. Conversion of analog signal to digital signal by sampling and reconstruction.
2. Multiplexing the signal using PCM-TDM system.
3. Bandwidth reduction technique: Differential PCM system.
4. Bandwidth reduction technique: Delta Modulation (DM) system.
5. Analysis of noises in Adaptive Delta Modulation (ADM) system.
6. Data compression techniques: Companding of signal using A law and Mu law.
7. Demonstration of advantages and disadvantages of Data formatting (Line Codes)
8. Analyse data compaction by Shift Keying Techniques - ASK, FSK, BPSK & QPSK
9. Data security using Direct Sequence Spread Spectrum (DS-SS).
10. Error detection and correction of Linear Block Codes: Encoder and Decoder.

(ET-21008) Configurable Logic and Processor Design Lab

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Term work - 50 Marks
Practical – 50 marks

Course Outcomes:

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

1. Use Verilog HDL to implement Boolean functions, combinative and sequential functions in FPGA.
2. Identify the structure and operation of CPLD and FPGA.
3. Design Processor using Verilog HDL.

4. Implement digital logic circuits using FPGA and understand all three paradigms of implementation of digital logic circuits using fixed function ICs, programmable logic and ASIC.

List of Experiments:

1. HDL code and its implementation: MUX / DEMUX, Full Adder, magnitude comparator, encoder / decoder, priority encoder, parity generator, Code converters, D FF, Shift registers (SISO, SIPO, PISO, bidirectional), Synchronous Counters.
2. HDL code for Sequence generator / detectors, Synchronous FSM – Mealy and Moore machines.
3. HDL code for Vending machines - Traffic Light controller, ATM, Elevator control.
4. Realization of single port SRAM in Verilog.
5. HDL code for UART, SPI, I2C and Arbiter.
6. HDL code for generic building blocks like decoder, adder, shifter, register file and ALU used by any micro architecture.
7. HDL code for single cycle Processor data path and control path.
8. HDL code for MIPS instruction memory, data memory.

VI-Semester

(ML-21002) Environmental Studies

(Adopted from the 'Ability Enhancement of Compulsory Courses: Environmental Studies' as prescribed by the Expert Committee of University Grants Commission as per directives of Hon'ble Supreme Court)

Teaching Scheme
Lectures: 1 hr./week

Examination Scheme
Periodic Assignments & Tests
Assignments: 2 hours/week

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

1. Comprehend Sustainable Development Goals for present generation.
2. Appreciate environmental resources, functioning of an ecosystem, significance of biodiversity and environmental challenges.
3. Analyze the status of environment with respect to precautionary mechanisms and control measures.
4. Appreciate the role of an engineer for better tomorrow.

Unit1 **(2hrs)**
Multidisciplinary nature of environmental studies:
Definition, scope, and importance, Need for public awareness.

Unit2 **(8 Hrs)**
Natural Resources: Renewable and non-renewable resources:
Natural resources and associated problems.
Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-. utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles

Unit 3 **(6 Hrs)**
Ecosystems
Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure, and function of the following ecosystem: -Forest ecosystem, Grassland ecosystem, Desert

ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4 **(8 Hrs)**

Biodiversity and its conservation

Introduction – Definition: genetic, species and ecosystem diversity, Bio geographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National, and local levels, India as a mega-diversity nation, Hot sports of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 5 **(8 Hrs)**

Environmental Pollution

Definition, Cause, effects and control measures of: -Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management : floods, earthquake, cyclone and landslides.

Unit 6 **(7 Hrs)**

Social Issues and the Environment

From Unsustainable to Sustainable development, Urban problems related to energy, Water. conservation, rain water harvesting, watershed management, Resettlement, and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, and holocaust. Case Studies, Wasteland reclamation, Consumerism, and waste products. Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, public awareness.

Unit 7 **(6 Hrs)**

Human Population and the Environment

Population growth, variation among nations, Population explosion – Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment, and human health, Case Studies.

Unit8 **(5 Hrs)**

Field work

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural, Study of common plants, insects, birds, Study of simple ecosystems-pond, river, hill slopes, etc.

Reference Book:

- Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.,Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
- Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
- Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
- Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001,
- Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
- De A.K., Environmental Chemistry, Wiley Eastern Ltd.
- Down to Earth, Centre for Science and Environment (R)
- Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
- Hawkins R.E., Encyclopedia of Indian Natural History, Bombay NaturalHistory Society, Bombay (R)

Humanities and Social Sciences Open Courses-II

[AS (HS)-21005] Industrial Psychology

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Assignment/Test: 40 Marks
Final Assessment: 60 Marks
Field Visit/Expert Lecture Report: 20 Marks
Mini-Project Report: 40 Marks

Course Outcomes:

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

1. Determine the psychological factors that influence individual differences at work and appraise the role of research.
2. Explain the concepts of motivation and job satisfaction at work and utilize the elements of organizational culture for enhancing group/team behavior.
3. Evaluate the relevance & functioning of leadership & diversity in workforce and acknowledge the multicultural factors influencing workplace behavior.
4. Illustrate the process of recruitment & selection and Experiment with the information required to sustain employability.
5. Interpret the nuances of Human Factors in Engineering and Analyze its role in their disciplines.
6. Measure the behavioral findings from self-lead projects and propose corrective actions to improve quality of workplace behavior.

Unit 1 **(6 hrs)**

Basics of Industrial Psychology (IP)

Difference between IP & Business Programs; Major fields & Employment in IP

Brief History- Scientific Management, Time and Motion Study, Hawthorne Studies, World War I & II Research in Social Sciences

Individual Differences at Work: Personality, Intelligence, Emotional Intelligence, Creativity & Innovation, Perception & Attitudes

Unit 2 **(8 Hrs)**

People at Work

Motivation & Job Satisfaction- Employee Predisposition, Expectations, Goals, Incentives& Equity; Job Characteristic Theory (Diagnostic Model)

Understanding Groups & Teams- Group dynamics, Factors affecting Group performance; Understanding work teams, Types of teams, Team development, Issues with teamwork

Leadership (Co-Teaching 4 hrs)- Leader characteristics, Leader & situation, Leader & follower; Specific leadership skills, Introduction to Organizational Development (OD)

Diversity- Multiculturalism- Hofstede's theory, Diversity dynamics

Unit 3 **(8 Hrs)**

Human Factors Engineering (HFE)

Introduction & Brief History of HFE; Essentials of HFE

Person-Machine Systems- Basic Human Factors: Sensory systems, Perception, Cognition, Information Processing approach, Memory, Decision Making

Workspace Designs- General Principles, designing work areas; Machine Displays &Controls; Physical work environment & Anthropometry; Managing workplace strain through Ergonomics (Self-study)

Current trends in HFE- Use of artificial intelligence, cognitive engineering, sociotechnical systems, etc.

Unit 4 **(6 Hrs)**

Managing People at Work

Job Analysis- Brief Background, Types & Importance; Job description

Recruitment & Selection- Overview, Process, Evaluation

Gearing for Selection- Interviews & Job Search Skills

Performance Appraisal (Co-Teaching 2 hrs): Steps in the Evaluation Process; Appraisal Interview

Text Books:

- Aamodt, M.G. (2013). Industrial Psychology. Cengage Learning: Delhi.
- Wickens, C. D.; Lee, J. D., Liu, Y. & Gordon Becker, S. E. (2015). An Introduction to Human Factors Engineering. 2nd Edition. Pearson Education: New Delhi.
- Landy, F. J. & Conte, J. M. (2010). Work in the 21st Century: An Introduction to Industrial and Organizational Psychology. 2nd Edition. Wiley India: New Delhi.

References:

- Matthewman, L., Rose, A. & Hetherington, A. (2009). Work Psychology. Oxford University Press: India.
- Schultz, D. & Schultz, S. E. (2013). Psychology and Work Today: An Introduction to Industrial and Organizational Psychology. 7th Edition. Pearson Education: New Delhi.
- Schultz, D. & Schultz, S. E. (2002). Psychology and Work Today. Pearson Education: New Delhi.

[AS (HS)-21006] Personnel Psychology

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Assignment: 70 marks
End Sem Exam: 30 marks

Course Outcomes:

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

1. Acquire organizational concepts and will recognize their own personality attributes suitable for corporate world.
2. Realize the importance of motivation and apply motivational principles to their lives.
3. Experience group dynamics and apply those principles in their lives.
4. Grasp and apply different techniques to maintain mental health.

Unit 1 **(6 Hrs)**

Introduction- Understanding own personality and corporate world: Basic concepts in Organizational set up and its importance, Know own personality attributes. Preparing for corporate world, work ethics, and self- management

Unit 2 **(6 Hrs)**

Motivation: Motivational theories for self- motivation and motivating others at work place, Approaches to work

Unit 3 **(8 Hrs)**

Group dynamics: Group behavior and leadership, Effective group behavior, Leadership and management principles, virtual teams and Performance appraisal

Unit 4 **(6 Hrs)**

Mental health at work place: Occupational stress and conflict and strategies for its management, Emotional Intelligence, spiritual Intelligence

****The course contents different psychometric tests, case studies and classroom activities and based on this content students have to maintain Personal Profile Journal.**

Text Books

- Khana S.S.- (2016) Organizational Behavior (Text and Cases), Chand and company Pvt. Ltd. Delhi.
- Rae Andr'e :- (2008) organizational behavior. Dorling Kindersley (India) Pvt. Ltd.
- Wallace H.and Masters L.- (2008) Personality development, Cengage Learning India Pvt. Ltd.

Reference books:

- Robbins S, JudgeA, Vohra N:- (2013)Organizational behavior.(15thed) Pearson Education,Inc.
- Singh Kavita:- (2010) Organizational behavior-Text and cases. Dorling Kindersley

[AS (HS)-21007] Engineering Economics

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Assignment/Test: 40 marks
End Sem Exam: 60 marks

Course Outcomes:

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

1. Demonstrate understanding of economic theories and policies.
2. Identify economic problems and solve it by applying acquired knowledge, facts and techniques in the available framework.
3. Categorize, classify and compare economic situations and draw inferences and conclusions.
4. Adapt to changing economic atmosphere and propose alternative solutions to the problems.

Unit 1 **(6 Hrs)**

Introduction to Economics:

Definitions, basic concepts of economics: Cost, efficiency and scarcity, Opportunity Cost
Types of economics: Micro Economics, Macroeconomics and Managerial Economics.
Difference between micro economics and macroeconomics. Application of Managerial economics

Unit 2 **(8 Hrs)**

Micro Economics Analysis

Demand Analysis, Supply Analysis, Theories of Utility and Consumers Choice, Cost analysis, Competition and Market Structures. Application of micro economics theories

Unit 3 **(8 Hrs)**

Macro Economic Analysis

Aggregate Demand and Supply, Economic Growth and Business Cycles, inflation, Fiscal Policy, National income, theory of Consumption, savings and investments, Commercial and Central banking. Use of macroeconomic theories.

Unit 4 **(8 Hrs)**

International Economics

Balance of Trade and Balance of Payments, Barriers to Trade, Benefits of Trade / Comparative Advantage, Foreign Currency Markets/Exchange Rates, Monetary, Fiscal and Exchange rate policies, Economic Development.
Application of exchange rate policies

Reference Books:

- N. Gregory Mankiw , Macroeconomics, 2018
- Paul Keat , Philip Young , Managerial Economics: Economic Tools for Today's Decision Makers: 2013
- Misra and Puri, Principles Of Macro Economics:., Himalaya publishing house, New Delhi, 2009
- A. koutsoyiannis , Macmillan, Modern Microeconomics, London
- S. Pindyck and daniel L. rubinfeld, Microeconomics Robert:, Pearson education Inc. New Delhi
- K. N. Verma, Micro economics:

[AS (HS)-21008] Finance for Engineers

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Assignment: 40 marks
End Semester: 60 marks

Course Outcomes:

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

1. Comprehend basics of accounting, cost concepts, will be able to read Financial statements of companies.
2. Enable them to understand critical financial principles and to enable them to integrate & analyze financial information necessary for Business Decision Making.
3. Establish relationship between Risk & Return, time value of money, sources of finance & working capital.
4. Appreciate the digital platform of future finance, cryptocurrency, the terms associated with Financial Markets such as Money market, capital market, SEBI & other Regulatory authorities

Unit 1 **(6 Hrs)**

Introduction to Accounting & Finance

Basic elements of financial accounting, cost concepts, preparation of Profit & Loss Account & Balance Sheet & concept of Budgetary control

Unit 2 **(6 Hrs)**

Read & interpret Financial Statements.

As per Schedule III of Companies Act 2013, Financial statement analysis, concept of cash flow statement.

Unit 3: **(8 Hrs)**

Break-even analysis, Risk & Return relationship, time value of money, sources of finance & working capital.

Unit 4 **(4 Hrs)**

Digital Platform such as Net Banking, Cryptocurrency, Algorithm based stock exchange trading, Basics of Money market, capital market, Commodities market, IPO & Regulatory authorities

****Pedagogy:** Lectures and PPTs, Use of basic Excel tools for preparation of final accounts, Annual Reports of companies.

Reference Books:

- C Rama Gopal, Accounting for Managers –Accounting for Management, New Age International Publishers (2012)
- Prasanna Chandra, Financial Management – Theory and Practice - Mc Graw Hill Publication

(SBC/ ET-21009) Mini Project
[D-S-P-T: Design – Simulate – Prototype – Test]

Teaching Scheme	**Examination Scheme**
Tutorial: 1 hr./week	Term-work: 50 Marks
Practical: 2 hrs./week	Practical: 50 Marks

Course Outcomes:

At the end of the laboratory work, students will demonstrate the ability to

1. Identify a problem statement either from a rigorous literature survey or the industry requirements analysis.
2. Design a solution for the identified problem by applying acquired technical knowledge.
3. Simulate, Develop and Test the Prototype with a standard solution/ process.
4. Learn to work in a team and coordinate within the group for timely completion of targeted work.

5. Demonstrate an ability to present their project work through a comprehensive Report and Presentation.

Guidelines:

- The mini project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
- The mini project may be a complete hardware or a combination of hardware and software.
- Mini Project should cater to a small system required in laboratory or real life.
- It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
- After interactions with course coordinator and based on comprehensive literature survey/ Industry requirements analysis, the student shall identify the title and define the aim and objectives of mini project.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
- The student is expected to exert on design, development, and testing of the proposed work as per the schedule.
- Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
- Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
- The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

(ET-21010) Data Communication and Networking

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

Course Outcomes:

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

1. Develop the understanding of the protocols at Application layer.
2. Apply the congestion and flow control mechanisms for Connection oriented transport.
3. Implement routing tables and subnetting at network layer.

4. Develop understanding of various Data link layer concepts and components.
5. Calculate the blocking probability in circuit switched and packet switched networks.
6. Illustrate the wireless network technologies.

Unit1 **(8 hrs)**

Introduction to computer networks and the Internet: Layering concepts, Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming.

Unit2 **(6 hrs)**

Transport layer: Connectionless transport - User Datagram Protocol (UDP), Connection-oriented transport – Transmission Control Protocol (TCP), Issues in Resource Allocation, Congestion control Mechanisms, Flow Control mechanisms, Congestion avoidance mechanisms, Quality of Service.

Unit3 **(8 hrs)**

Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, IPV4, IPV6 Routing algorithms, IP addresses and sub-netting, Control protocols: ICMP, DHCP, NAT, Broadcast and Multicast routing

Unit4 **(6hrs)**

Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, LAN Addressing: ARP,RARP, Ethernet, Hubs, Switches

Unit5 **(6hrs)**

Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and *n*-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Statistical Multiplexing.

Unit6 **(6hrs)**

Wireless Networks: Wireless Local Area Networks using Wi-Fi (IEEE 802.11a/b/g), Wireless Personal Area Networks using Bluetooth (IEEE 802.15) and ZigBee (IEEE 802.15.4), Wireless Ad-Hoc/ Multihop Networks

Text books:

- J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition
- L. Peterson and B. Davie, "Computer Networks – A Systems Approach" Elsevier Morgan Kaufmann Publisher, 5th Edition.
- T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall

Reference books:

- S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education.
- B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition.
- Andrew Tanenbaum, "Computer networks", Prentice Hall.
- D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall.
- William Stallings, "Data and computer communications", Prentice Hall.

(ET-21011) Internet of Things

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Illustrate the fundamentals of IoT such as paradigms, architectures, possibilities, and challenges.
2. Identify suitable hardware and interfaces for IoT deployments.
3. Compare IoT protocols for communication.
4. Develop cloud computing model and service options.
5. Illustrate data analytics and security for IoT.
6. Design an IoT application in form of a prototype.

Unit1 **(6hrs)**

IoT Introduction and Fundamentals: Deciphering the term IoT Applications where IoT can be deployed Benefits/Challenges of deploying an IoT, IoT components: Digital Signal Processing, Data transmission, Choice of channel (wired/wireless), back-end data analysis. Understanding packaging and power constraints for IoT implementation.

Unit2 **(8hrs)**

Signals, Sensors, Actuators, Interfaces : Introduction to sensors & transducers, Introduction to electrodes & biosensors, Static and dynamic characteristics of sensors, Different types of sensors, Selection criteria's for sensors / transducers, Commercial IoT sensors / transducers, Signal conditioning modules of IoT system , Energy and power considerations, Introduction to actuators, Different types of actuators, Interfacing challenges, Specification sheets of sensors / transducers, Specifications of actuators, Modules of data acquisition system, Wireless sensor node structure, positioning topologies for IoT infrastructure.

Unit3 **(8hrs)**

Communication and Networking in IoT : Review of Communication Networks, Challenges in Networking of IoT Nodes, range, bandwidth Machine-to-Machine (M2M) and IoT Technology Fundamentals, Medium Access Control (MAC) Protocols for M2M Communications Standards for the IoT Basics of 5G Cellular Networks and 5G IoT Communications, Low-Power Wide Area networks (LPWAN)Wireless communication for IoT: channel models, power budgets, data rates.

Networking and communication aspects: IPv6, 6LoWPAN, COAP, MQTT, Operating Systems need and requirements for IoT.

Unit4 **(6hrs)**

Modern networking: Cloud computing: Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud, Hypervisors, Comparison of Cloud providers, Cloud and Fog Ecosystem for IoT Review of architecture

Unit5 **(6hrs)**

IoT Data analytics and Security: OLAP and OLTP, NoSQL databases, Row and column Oriented databases, Introduction to Columnar DBMS CStore , Run :Length and Bit vector Encoding, IoT Data Analytics. Cryptographic algorithms, Analysis of Light weight Cryptographic solutions IoT security, Key exchange using Elliptical Curve Cryptography, Comparative analysis of Cryptographic Library for IoT.

Unit6 **(6hrs)**

IoT Applications: IoT applications like Home Automation, Precision Agriculture, Smart vehicles, Smart Grid, Industry 5.0.

Textbooks:

- ArshdeepBahga and Vijay Madisetti , "Internet of Things, a hands on approach" , Universities Press (India)Pvt. Ltd. 2017, ISBN: 978-81-7371-954-7.
- RajkumarBuyya, Amir VahidDastjerdi, "Internet of Things Principles and Paradigms"Copyright © 2016 Elsevier Inc., ISBN: 978-0-12-805395-9.

Reference Books:

- William Stallings, " Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" Publisher: Addison-Wesley 2015 ISBN: 9780134175393
- Andrew Minteer, "Analytics for the Internet of Things (IoT)"
- Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols"
- Gaston C. Hillar, "Internet of Things with Python"
- Kai Hwang, Min Chen, "Big-Data Analytics for Cloud, IoT and Cognitive Computing"

(ET-21012) CMOS VLSI Design

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

Course Outcomes:.
At the end of this course students will demonstrate the ability to

1. Illustrate / Infer / Interpret the importance of manufacturing process of CMOS based integrated circuits, energy band diagrams of MOS, scaling technology and the secondary effect in MOSFETs.
2. Model MOS transistors, its small geometry effects and interconnect wire for performance analysis.
3. Evaluate impact of technology scaling on Robustness, performance, and energy/power dissipation of CMOS Inverter.
4. Design / formulate / estimate simple and complex combinatorial logic circuit for optimized area, speed, power, glitch free and reduced supply voltages.
5. Choose the right clocking scheme according to the functionality, speed and power of a circuit.
6. Build the blocks of a system with design trade-offs.

Unit 1 **(7 Hrs)**

Introduction to VLSI, Manufacturing process of CMOS integrated circuits, CMOS n-well process design rules, packaging integrated circuits, trends in process technology. MOS transistor, Energy band diagram of MOS system, MOS under external bias, derivation of threshold voltage equation, secondary effects in MOSFETS.

Unit 2 **(7 Hrs)**

MOSFET scaling and small geometry effects, MOS capacitances, Modelling of MOS transistors using SPICE, level I II and equations, capacitance models. The Wire: Interconnect parameters: capacitance, resistance and inductance. Electrical wire models: The ideal wire, the lumped model, the lumped RC model, the distributed RC model, The transmission line model, SPICE wire models.

Unit 3 **(7 Hrs)**

MOS inverters: Resistive load inverter, inverter with n type MOSFET load, CMOS inverter: Switching Threshold, Noise Margin, Dynamic behavior of CMOS inverter, computing capacitances, propagation delay, Dynamic power consumption, static power consumption, energy, and energy delay product calculations, stick diagram, I C layout design and tools.

Unit 4 **(7 Hrs)**

Designing Combinational Logic Gates in MOS and CMOS: MOS logic circuits with depletion MOS load. Static CMOS Design: Complementary CMOS, Ratioed

logic, Pass transistor logic, BI CMOS logic, pseudo nMOS logic, Dynamic CMOS logic, clocked CMOS logic CMOS domino logic, NP domino logic, speed and power dissipation of Dynamic logic, cascading dynamic gates.

Unit 5 **(7 Hrs)**

Designing sequential logic circuits: Timing metrics for sequential circuits, classification of memory elements, static latches and registers, the bistability principle, multiplexer based latches, Master slave Edge triggered register , static SR flip flops, dynamic latches and registers, dynamic transmission gate edge triggered register, the C^2MOS register, Pulse registers, sense amplifier based registers, Pipelining, Latch verses Register based pipelines, NORA-CMOS.

Unit 6 **(7 Hrs)**

Case Studies: Designing arithmetic building blocks or memory and array structures.

Text Books:

- Jan M Rabaey, AnanthaChadrakasan, Borivoje Nikolic, " Digital integrated circuits a design perspective" , Pearson education.
- Sung MO Kang Yusuf Leblebici, "CMOS digital integrated circuits", Tata McGraw Hill Publication.

Reference Books:

- Neil E Weste and Kamran Eshraghian, "Principle of CMOS VLSI Design", Pearson education.

(ET-21013) Power Electronics and Drives

Teaching Scheme
Lectures: 2 hrs./week
Tutorial: 1 hr/ week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

Course Outcomes:

At the end of the course students will demonstrate the ability to

1. Build and test circuits using power devices such as SCR, IGBT and MOSFET.
2. Analyze controlled rectifier, DC to DC converters, DC to AC inverters.
3. Design Buck and Boost convertors
4. Design and comparison of different types of invertors.
5. Design SMPS and UPS.
6. Analyze the motor drive used Electric vehicles.

Unit 1 **(5hrs)**

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and Schottky diodes as freewheeling and feedback diode.

Unit 2 **(5hrs)**

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current, Effect of source impedance, Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Unit 3 **(4hrs)**

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper. Concept of Buck and Boost converter.

Unit 4 **(5hrs)**

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters.

Unit 5 **(4hrs)**

Applications: Overview of Switching Power Supplies, Analysis of fly back, forward converters for SMPS. Resonant converters-need, concept of Zero-Voltage and Zero-Current Switching. Block diagram, configuration, salient features, and battery selection of UPS.

Unit 6 **(5hrs)**

Drives for Electric Vehicles: Separately excited DC motor drive. Brushed DC motor drives, induction motor (IM) drives, permanent magnet (PM), brushless DC (BLDC) motor drives, and switched reluctance motor (SRM) drives. Comparisons between four types of electric motor drives.

Text Books:

- Muhammad H. Rashid, "Power electronics" Prentice Hall of India.
- Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
- Chomat, Miroslav, " New Applications of Electric Drives", BoD–Books on Demand, 2015.

Reference Books:

- P. C. Sen., "Modern Power Electronics", edition II, S. Chand & Co.

- V. R. Moorthi, "Power Electronics", Oxford University Press.
- Cyril W., Lander," Power Electronics", edition III, McGraw Hill.
- G. K. Dubey, S. R. Doradla, "Thyristorised Power Controllers", New Age International Publishers.
- SCR manual from GE, USA.

(ET-21014) Data Communication and Networking Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term work - 50 Marks
Oral – 50 marks

Course Outcomes:
At the end of the laboratory work, students will demonstrate the ability to

1. Explain the fundamental underlying principles of layered network architecture.
2. Comprehend the congestion, routing protocols at various network layers.
3. Design a network considering the QOS parameters.
4. Analyze the performance of various communication protocols and networks.
5. Implement flow control and congestion in the network.
6. Illustrate the interfacing of components in the existing networks.

List of Experiments:

1. To implement PC to PC communication using serial port – Emulation of TALK and Simple File Transfer
2. To install and study network simulation tool NS2
3. To simulate networks and analyze performance in NS2
4. To implement congestion control algorithms using NS2
5. To capture packets using Wireshark and analyze them at all the layers of network.
6. To implement Dijkstra's shortest path algorithm for routing table updation.
7. To write C/C++ code for socket programming to implement file transfer.
8. To implement 1-bit sliding window protocol in C/C++
9. Case study of existing networks and components, ways to connect to internet.

(ET-21015) Internet of Things Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term work - 50 Marks
Practical – 50 marks

Course Outcomes:
At the end of the laboratory work, students will demonstrate the ability to

1. Develop programming ability using Python.
2. Explore to the interconnection and integration of the physical world and the cyber space.
3. Design & develop IOT building blocks and networks

List of Experiments:

Experiments based on Python Programming:

1. a. Study and Install Python in Linux and WAP for data types in python.
   b. Write a Program for arithmetic operation in Python.
   c. Write a Program for looping statement in Python.
2. WAP for Encryption in python
3. WAP for Decryption in Python.

Experiments based on Hardware:

1. Study and Install IDE of Arduino and different types of Arduino.
2. Write program using Arduino IDE for Blink LED.
3. Study the Temperature sensor and Write Program for monitor temperature using Arduino.
4. Study and Implement RFID, NFC using Arduino.
5. Study and implement MQTT protocol using Arduino.
6. Study and Configure Raspberry Pi.
7. WAP for LED blink using Raspberry Pi.
8. Study and Implement Zigbee Protocol using Arduino / Raspberry Pi.
9. Web server-controlled LED.
10. Integration of PIR/ Gas sensor with webserver.
11. Temperature monitoring on web server.
12. Study case: Home Automation, Industry related monitoring, Robot control, IoT based Agriculture.

(ET-21016) CMOS VLSI Design Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term work - 50 Marks
Practical – 50 marks

Course Outcomes:
At the end of the laboratory work, students will demonstrate the ability to

1. Illustrate Digital Circuit design using CMOS.
2. Build blocks of a system to solve engineering problems.
3. Use EDA tools like Cadence, Mentor Graphics and other open source software tools like NGSPICE through lab exercises.

List of Experiments:

1. DC and Transient analysis of NMOS and PMOS Transistor using NGSPICE.
2. DC and Transient analysis of CMOS Inverter using NGSPICE.
3. Design of five stage ring oscillator using NGSPICE.
4. DC and Transient analysis of CMOS Inverter using Cadence EDA Tool.
5. Schematic to Symbol generation using Cadence EDA Tool.
6. Schematic to Layout of CMOS Inverter using Cadence EDA Tool.
7. Post Layout simulation of CMOS Inverter and Parasitic Extraction.
8. Design of all basic gates and /or Combinatorial circuits using Cadence EDA Tool.
9. Design of six Transistor SRAM cell using Cadence EDA Tool.
10. Design of Sequential circuits using Cadence EDA Tool

(ET-21017) Power Electronics and Drives Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term work - 50 Marks
Practical – 50 marks

Course Outcomes:
At the end of the laboratory work, students will demonstrate the ability to

1. Design and implement various triggering and turn off circuits for power devices as, SCR, Power MOSFET, IGBT.
2. Interpret the efficiency and switching losses in power converter.
3. Analyze active, reactive and RLE loads, regulation characteristics in SMPS and drives.
4. Understand and implement various applications in power electronics.

List of Experiments:

1. Test the characteristics of SCR, Triac and Diac.
2. Test the characteristics of Power MOSFET and IGBT.
3. Analyze R, RC triggering methods for a SCR.

4. Implement UJT triggering method for a SCR.
5. Implement Forced Commutation methods: class C and class D.
6. Test SCR converters and reactive loads.
7. Design Line commutated converters: Inverter operation and measurement of overlap angle.
8. Implement Parallel capacitor commutated (Type A/Class D)Step down chopper.
9. Test Step up chopper.
10. Build and test two quadrant Type C/Type D and four quadrant Type E chopper.
11. Implement Single phase PWM inverter: measurement of frequency Vs output for resistive and inductive loads. .
12. Find Regulation characteristics of DC Motor, demonstration of ramp up/ ramp down and field failure protection.

Departmental Elective – I

[ET(DE)-21001] Control Systems

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Model a physical system and express its internal dynamics and input-output relationships by means of block diagrams, mathematical model and transfer functions.
2. Explain the relationships between the parameters of a control system and its stability, accuracy, transient behavior.
3. Determine the stability of a system and parameter ranges for a desired degree of stability.
4. Plot the Bode, Nyquist, Root Locus diagrams for a given control system and identify the parameters and carry out the stability analysis.
5. Model and analyze the control systems using state space analysis

Unit1 **(6hrs)**

System Modeling: Introduction to control system- Basic elements in control system, Open and closed loop control systems, Differential equation representation of physical systems, Transfer function, Mathematical modeling of electrical and mechanical systems (Translational and Rotational), Analogous system, Block diagram representation of systems, Block diagram reduction techniques, Signal flow graph, Applications case study.

Unit2 **(7 hrs)**

Time Domain Analysis: Type and Order of the Control Systems, Types of Standard

Inputs , Response of First Order System to Step, Ramp and Parabolic Inputs , Second order system – step response analysis- steady state error – generalized error coefficients , Effect of adding a zero to system- Principle of PI, PD and PID compensation. Practical Applications

Unit3 **(6 hrs)**

Stability: Concept of Stability, Absolute, Relative , Marginal and Unstable Stability analysis in S Plane , Dominant Poles and Zeros , Routh-Hurwitz Criterion , Concept of Root Locus, Applications in Practical systems

Unit 4 **(8 hrs)**

Frequency Domain Analysis: Frequency response, Frequency domain specifications, Correlation between time domain and frequency domain specifications, Bode plot, Stability analysis using Bode plot, transfer function from bode plot, Polar plot, Nyquist stability criterion, recent advancement from research perspective

Unit 5 **(7 hrs)**

Digital Control Systems: Introduction, Advantages over analog control system, Sampled Data Control System, Transfer Function of Digital Control System, Step Response (First & Second Order Systems only), Introduction to Digital PID Controller, Introduction to PLC: Block schematic, PLC addressing, any one application of PLC using Ladder diagram. Concept of Offset P, PI , PD and PID Characteristics

Unit6 **(6 hrs)**

State Space Analysis: Advantages of State Space Analysis over Classical Control, Concept of State, State Variables and State Model, State Space Representation using State Model, State Transition Matrix and its properties, Solution of State Equations for LTI System , Concept of Controllability and Observability.

Text Book:

- I.J.Nagrath, M. Gopal, **"**Control Systems Engineering**"**, Fifth Edition, New Age International, New Delhi, 2007.

Reference Books:

- Benjamin C.Kuo, "Automatic Control Systems", Seventh Edition, PHI Learning New Delhi, 1997.
- Katsuhiko Ogata, "Discrete Time Control Systems", Second Edition, PHI Learning New Delhi, 2006.
- R.Anandanatarajan, P. Ramesh Babu, "Control Systems Engineering", Second edition, Scitech Publications Pvt. (India) Ltd, 2008.

[ET(DE)-21002] Digital Image Processing

Teaching Scheme

Lectures: 3 hrs./week

Examination Scheme

Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

Course Outcomes:

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

1. Model and analyze the control systems using state space analysis.
2. Illustrates concept of digital image processing & utilize time domain and frequency.
3. domain image enhancement techniques.
4. Distinguish and apply different image segmentation techniques.
5. Interpret image compression methods & standards.
6. Adapt hands-on experience in using software tools for processing of digital images for various real time applications.

Unit1 **(6hrs)**

Introduction to image processing: Fundamental steps in digital image processing, Elements of visual perception, Image sensing and acquisition, Basic Concepts in Sampling and Quantization, representing digital images, representation of colour image.

Unit2 **(7 hrs)**

Image Enhancement: Some basic gray level transformations, Histogram Processing, Histogram modification, Image subtraction, spatial filtering, Sharpening Spatial filters, use of first and second derivatives for enhancement; LoG, Image Enhancement in the Frequency Domain, Gaussian filters, homomorphic filtering, pseudo colouring: intensity slicing, Gray level to colour transformation.

Unit3 **(7 hrs)**

Image Segmentation: Some Basic Relationships between pixels, point, line and edge detection, Gradient operators, Canny edge detection, Edge linking and boundary detection. Hough transform, Chain codes, boundary segments, skeletons, Boundary descriptors, Fourier descriptors

Unit 4 **(7 hrs)**

Threshold based Image Segmentation: The role of illumination, global thresholding, adaptive thresholding, use of boundary characteristics for histogram improvement and local thresholding, Region-based segmentation, region-based segmentation, region growing, region splitting and merging.

Unit 5 **(8 hrs)**

Image Compression: Data redundancies, elements of information, variable-length coding uniform and non-uniform Quantizers, predictive coding, Transform coding, Image compression standards.

Unit6 **(5 hrs)**

Applications of Image Processing : Explore recent trends & applications of image processing in real time scenario.

Text Book:

- Gonzalez & Woods, "Digital Image Processing", Second Edition, Pearson Education, 2003
- A.K.Jain, "Fundamentals of Digital Image Processing", 1st edition, Prentice Hall India, 1988.

Reference Books:

- R.Anandanatarajan, P. Ramesh Babu, "Control Systems Engineering", Second edition, SciTech Publications Pvt. (India) Ltd, 2008.
- Milan Sonka et al, "Image Processing, Analysis and Machine Vision", Second Edition, Thomson Learning, 2001
- Pratt W.K, "Digital Image Processing", Third Edition, John Wiley & Sons, 2001

[ET(DE)-21003] Machine Learning

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Grasp and develop algorithms for linear, logistic, and multivariate regression.
2. Design and implement linear and nonlinear classifiers based on SVM, Neural networks and Decision trees.
3. Utilize ensemble and graphical techniques for improvement in regression and classification performance.
4. Identify and implement clustering techniques for moderate to large size data.
5. Evaluate and interpret the results of the machine learning algorithms.

Unit1 **(6 hrs)**

Introduction to probability and linear algebra: Review of Probability Theory and Linear algebra, Convex Optimization, relationship between AI, ML, and DL

Unit2 **(6 hrs)**

Introduction to Statistical Decision Theory, Regression: Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Logistic Regression, Partial Least Squares Classification: Linear Classification, LDA

Unit3 **(8 hrs)**

Introduction to Perceptron and SVM, Neural Networks: Introduction, Early Models, Perceptron Learning, Back-propagation, Initialization of neural network, Training and Validation, Parameter Estimation

Unit4 **(8 hrs)**

Introduction to Bayesian Learning, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naive Bayes classifier

Unit5 **(6 hrs)**

Decision Trees - Stopping Criterion and Pruning, Loss function, Categorical Attributes, Multiway Splits, Missing values, Instability, Regression Trees. Bootstrapping and Cross Validation, Class Evaluation, Measures, ROC curve, MDL, Ensemble methods, Committee Machines and Stacking.

Unit6 **(8 hrs)**

Partitional clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-Based Clustering, Gaussian Mixture Models, Expectation Maximization, Learning Theory, Re-enforcement Learning

Text Books:

- Hastie, T. R. Tibshirani, and J. G. Friedman, "The Elements of Statistical Learning: Data Mining, Inference and Prediction", New York, NY: Springer, ISBN:9780387952840
- EthemAlpaydin, "Introduction to Machine Learning", PHI, 2005.

Reference Books:

- Bishop Christopher, "Neural Networks for Pattern Recognition", New York, NY: Oxford University Press, ISBN: 9780198538646
- Mitchell Tom, "Machine learning", New York, NY: McGraw-Hill, ISBN:9780070428072
- Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani "Introduction to Statistical Learning", Springer, 2013.

Department of Electronics and Telecommunication Engineering
College of Engineering, Pune
Honors in E & TC

SEM-V

[ET(HO)-21001] Random Signal and Stochastics Process

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Calculate probabilities for individual, joint, and conditional probabilities by applying probability laws and theorems.
2. Evaluate Mean, Variance, Moments, MGF of random variable and its other properties.
3. Characterize random variables with its distributions and random process for the analysis of random phenomenon.
4. Apply probabilistic analysis, estimation and detection theory in communication and signal processing domain.
5. Analyze & apply statistical model like Principal Component Analysis (PCA), Independent Component Analysis (ICA) to solve practical engineering problems.

Unit 1 **(4 hrs)**

Probability: Review of probability, Joint, Conditional and Total Probability, Bayes' theorem, and applications.

Unit 2 **(8 hrs)**

Random Variables: Definition of a Random Variables, Discrete continuous, and mixed random variables, Probability Distribution Function, Probability mass function, Probability density and cumulative distribution functions, Expectation, Variance, Moments, Moment generating function, Chebyshev inequality.

Unit 3 **(8 hrs)**

Distributions: Discrete Distribution Bernoulli, Binomial, and Poisson, Continuous Distribution: Uniform, Exponential, and Normal distributions, Central limit theorem. Joint Distributions: Joint, marginal, and conditional distributions, Correlation, Covariance, and Independence

Unit 4 **(8 hrs)**

Random Processes: Definitions Random Processes, Classification of Random Processes, Random sequence, Markov Process and Markov chain.

Unit 5: **(6 hrs)**

Estimation and Detection: Maximum Likelihood Estimation (MLE), Least square estimation and Bayesian estimation. Hypothesis testing and Bayesian detection.

Unit 6 **(8 hrs)**

Applications: Linear Regression**,** Principal Component Analysis (PCA), Independent Component Analysis (ICA).

Textbooks:

- S. Palaniammal " Probability and Random Process " PHI Learning, 2015.
- Mourad Barkat "Signal Detection and Estimation" Artech House Publishers,2005.
- Athanasios Papoulis, S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", Tata Mc. Graw-Hill, 4th Edition,2017.

Reference Book:

- William W. Hines, Douglas C. Montgomery, David M. Goldsman, Connie M. Borror, "Probability and Statistics in Engineering", Wiley, 4th Edition,2003
- Henry Stark, John W. Woods, "Probability and Random Process with Applications to Signal Processing", Pearson Education, 3rd Edition,2002.
- Ross S.M., "Introduction to probability and statistics for Engineers and Scientists" ,8th Edition, Elsevier Academic press, 2014.
- Murray Spiegel , John J Schiller., "Schaum's outline of Probability and statistics for Engineers", 2019.

SEM-VI

[ET(HO)-21002] Information Theory and Coding

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Design, implement and compare coding techniques for the memory-less discrete sources.
2. Evaluate differential entropy of continuous stationary sources and utilize it estimating bounds of rate distortion function.
3. Demonstrate coding of analog sources with scalar and vector quantization followed by entropy coding.
4. Design and Implement binary block coding techniques for error detection and

correction on binary symmetric channel.

5. Design and implement binary convolutional coding techniques for error correction on binary symmetric channel.
6. Estimate error detection and correction capabilities of block and convolutional channel codes.

Unit1: (4 hrs)

Information Measures: Discrete Source models – Memoryless and Stationary, Mutual Information, Self-Information, Conditional Information, Average Mutual Information, Entropy, Entropy of the block, Conditional Entropy, Information Measures for Analog Sources

Unit 2 : (8 hrs)

Coding Techniques for Discrete Sources: For Memory-less Sources: Fixed length coding, Variable length coding – Prefix codes, Kraft Inequality, Coding Techniques - Huffman, Shannon-Fano, Higher order extensions, Average code length, Coding efficiency For Stationary Sources: Lempel-Ziv encoder and decoder, Software implementation of these techniques using appropriate data structures.

Unit 3 : (6 hrs)

Coding Techniques for Analog sources: Optimum quantization, Distortion, Measures, Rate distortion function (RDF), Distortion rate function (DRF), RDF and DRF for Gaussian Source, Upper and Lower bounds on RDF/DRF, Scalar quantization – Uniform, Non-Uniform, Vector quantization, K-means algorithm, Coding techniques taxonomy.

Unit 4 : (10 hrs)

Channel Capacity and Block Codes: Channel models – Discrete and Waveform, Channel capacity, Introduction to channel coding – Code rate and Redundancy, Linear Block codes - Vector spaces and subspaces, Generator matrix, Systematic codes, Parity check matrix, Syndrome Testing, Error Correction, Implementation of encoder and decoder, Cyclic codes – Encoding in systematic form, circuit for dividing polynomials, Systematic encoding, and error detection with linear feedback shift registers.

Unit 5: (6 hrs)

Error Detection and Correction Capability of Block Codes-Weight and distance of binary vectors, minimum distance of a linear code, Error detection and correction capability, Erasure correction, Usefulness of the standard array, Estimating code capability, Error detection vs. correction trade-offs, Block codes examples such as Hamming codes, Golay codes.

Unit 6 : (8 hrs)

Convolutional codes: Convolutional encoding – Connection representation, State representation, Tree Diagram, Trellis Diagram, Convolutional decoding – Maximum

likelihood decoding, Algorithms such as Viterbi, Sequential, Feedback, Viterbi decoder implementation, Distance properties, Minimum free distance.

Text Books:

- Bernard Sklar and Pabitra Kumar Ray, "Digital Communications: Fundamentals and Applications", Pearson Education Asia, Second Edition
- John G. Proakis and Masoud Salehi, "Digital Communications", Tata McGraw Hill, Fifth Edition

Reference Book:

- Salvatore Gravano, "Introduction to Error Control Codes", Oxford University Press, First Edition.
- B. P. Lathi, "Modern Digital and Analog Communication Systems", Oxford press, Third Edition
- Simon Haykins, "Digital Communication", Wiley, Second Edition

Department of Electronics and Telecommunication Engineering
College of Engineering, Pune

Minor in IOT

SEM-V

[ETC(MI)-21001] Microcontrollers

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Understand architecture of Microprocessor and microcontroller.
2. Interface peripherals with microcontrollers
3. Write a program using microcontroller boards.
4. Design Smart system using microcontroller.
5. Compare microcontroller boards.

Unit1 **(6 hrs)**
Microprocessor Microcontroller architecture
Introduction of Microprocessor Microcontroller, Architecture and Role of microcontroller in Embedded System and Internet of Things (IoT)

Unit 2 **(6 hrs)**
Microcontrollers in IOT
Microcontrollers used in IoT open-source environment, design issues, operating conditions and requirements, platform details.

Unit 3 **(6 hrs)**
Microcontroller
AVR microcontroller, Overview of Architecture, Programming model, Pipelining, Interrupt structure and peripheral connectivity, assembly code, c code

Unit 4 **(6 hrs)**
Introduction to Arduino
Architecture of Arduino board. Software and development tools for the platform Arduino-AVR microcontroller.

Unit 5: **(6 hrs)**
Arduino Interfacing and Programming
Embedded C, Interfacing of Arduino Uno with LED, LCD, Keypad, PIR Sensor, Light Sensor, Temperature Sensor, Bluetooth, Case Studies: Home Automation, Displaying Sensor data

on LCD.

Unit 6 **(6 hrs)**

Hardware Platforms for IoT application Development

Arduino Uno, Arduino Mega, ESP8266, Raspberry Pi, STM32, Intel Galileo, Beagle Bone, Comparison of these boards

Textbooks:

- AVR Microcontroller and Embedded Systems: Using Assembly and C, By Mazidi, Naimi, Naimi, First Edition, Pearson
- Internet of Things with Arduino Blueprints, by Pradeeka Seneviratne, Packt Publishing Limited, 27 October 2015

Reference:

- http://www.mouser.in/applications/open-source-hardware-galileo-pi/

SEM-VI

[ETC(MI)-21002] Network protocols

Teaching Scheme
Lectures: 3 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

Course Outcomes:

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

1. Understand various types of networks and their topologies.
2. Describe the functions of each layer in OSI and TCP/IP model.
3. Explain the functions of Application layer and Presentation layer paradigms and Protocols.
4. Explain data transmission, network layer, session and application layer protocols and their role in IoT networks.
5. Provide overview of popular protocols and standards helping IoT device applications.

Unit1 **(6 hrs)**

Introduction to Networks

Need of Networks, Types of Networks: Computer Networks, Wireless Sensor Networks, Adhoc Networks, Internet of Things Networks, LAN, Man, WAN, VAN, Topologies of

Networks: Star, Bus, Mesh, Tree, Hybrid, Network Architecture: Client –Server, Peer to peer, Connection media: Cable, air interface.

Unit 2 **(6 hrs)**

Network layering

Need of Layering in networks, Application Layer, Session Layer, Presentation Layer, Transport Layer, Network Layer, Data Link layer, Physical layer, OSI Reference model, TCP/IP model

Unit 3 **(6 hrs)**

Network protocols at layers

Need of Protocols at various layers, Protocols at Application Layer: HTTP, FTP, DNS, P2P, Protocols at Transport Layer: TCP and UDP, Protocols at Network Layer: IPV4, IPV6, Routing Protocols, Management Protocols, Protocols at Data link layer and Physical layer

Unit 4 **(6 hrs)**

Introduction to Internet of Things

Introduction to protocols for Internet of Things, role, requirements, specifications of protocols in IoT environment, IoT ecosystem, Layering concept in IoT, IoT Network Architecture, Drivers Behind New Network Architectures, The oneM2M IoT Standardized Architecture the IoT World Forum (IoTWF) Standardized Architecture, A Simplified IoT Architecture the Core IoT Functional Stack, IoT Data Management and Compute Stack

Unit 5 **(6 hrs)**

IoT Protocols

LoRa protocol for physical layer, Protocols for data link layer: IEEE 802.11 ah, IEEE 802.15.4 e, WiFi, Bluetooth, Bluetooth Low energy, Z-wave, Zigbee, Wireless HART, Protocols for Network layer: RPL, 6LoWPAN- IPv6 over Low power Wireless Personal Area Networks, IP as the IoT Network Layer: Optimizing IP for IoT, From 6LoWPAN to 6Lo, Header Compression, Fragmentation, Mesh Addressing, Mesh-Under Versus Mesh-Over Routing, Protocols of application layer: MQTT and COAP

Unit 6 **(6 hrs)**

Security and Management Protocols for IoT

Security Issues in the IoT, Security Mechanisms Overview, Lightweight Cryptography, IoT Management layer protocols

Textbooks:

- Behrouz A. Forouzan,"Computer Networks",4th edition, McGraw-Hill
- Andrew Tanenbaum, Computer Networks,5th Edition,Pearson
- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of

Things, Cisco Press

Reference Book:

- David Boswarthick ,Omar Elloumi Olivier Hersent ,"The Internet of Things: Key Applications and Protocols, Wiley, 2015.
- H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.

(IOC-21010) Interdisciplinary Open Course-I

Digital Image Processing Applications

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam – 60 marks

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

1. Demonstrate knowledge of the Digital Image Processing Systems.
2. Use different digital image processing algorithms.
3. Describe various segmentation techniques for image analysis.
4. Identify and analyze the applications of image processing in various domains of industry.

Unit1 **(4hrs)**

Fundamentals of signal processing: Introduction to signals & systems, Concept of time domain & frequency domain representation of signals, 2D signals, 2D systems, convolution & correlation.

Unit 2 **(4hrs)**

Introduction to image processing: Fundamental steps in digital image processing, image sensing and acquisition, Basic Concepts in Sampling and Quantization, representing digital images.

Unit3 **(6hrs)**

Image Enhancement: Some basic gray level transformations, Histogram Processing, Histogram modification, Image subtraction, spatial filtering, Sharpening Spatial filters, use of first and second derivatives for enhancement; LoG, Gaussian filters, pseudo coloring: intensity slicing, gray level to colour transformation.

Unit4 **(4hrs)**

Image Segmentation : Some Basic Relationships between pixels, point, line and edge detection, Gradient operators, Canny edge detection, Edge linking and boundary detection, Chain codes, boundary segments.

Unit5 **(3hrs)**

Threshold based Image Segmentation: The role of illumination, global thresholding, adaptive thresholding local thresholding, region-based segmentation, region growing, region splitting and merging.

Unit6 **(4hrs)**

Object Recognition and Case studies: Introduction to Object Recognition- patterns and pattern classes, recognition based on decision – theoretic methods, case studies – image analysis, application of image processing in industries.

Text Books:

- S. Sridhar, "Digital Image processing", Oxford University Press, Second Edition, 2018.
- A. K. Jain, "Fundamentals of Digital Image Processing", 1st edition, Prentice Hall India, 1988

Reference Book:

- Gonzalez & Woods, "Digital Image Processing", Second Edition, Pearson Education, 2003

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