Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure and Syllabus of

B.Tech.

Electronics and Telecommunication Engineering

Effective from Academic Year 2020-21

Prepared by: - Board of Studies in Electronics and Telecommunication

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Chairman – BOS **Chairman – Academic Board**

Institute Vision

"To be a globally acclaimed institute in technical education and research for holistic socio-economic development."

Institute Mission

- To ensure that 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, Civil / Defense Services / Govt. Jobs and other areas like Sports and Theatre.
- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
- Promote Research Culture among Students and Faculty through Projects and Consultancy.
- To make students Socially Responsible Citizen.

Department Vision

"To be a centre of academic excellence in Electronics, Telecommunication and related domains through continuous learning and innovation."

Department Mission

- To provide state of art education in Electronics and Telecommunication Engineering to meet current and future needs of society, industry, and academia.
- To strengthen collaborations with industries and institutes of repute to foster research culture among faculty members and students.
- To promote ethically conscious engineers demonstrating sustainable entrepreneurship and professional maturity in a social context.

Program Educational Objectives (PEOs)

Graduates of the program will

1. Have a comprehensive knowledge of Electronics engineering fundamentals to face the challenges of real-life complex problems.
2. Be professionals imbibed with a spirit of leadership, ethical behavior, and societal commitment.
3. Be compliant to constantly evolving technology through lifelong learning.

Program Specific Objectives (PSOs)

E&TC Graduates will have the ability to:

1. Design, develop and analyze complex Electronic Systems for communication, Signal Processing, Embedded Systems, and VLSI applications.
2. Identify and apply domain-specific hardware and software tools to solve real-world problems in Electronics and Communication.

Program Outcomes (POs)

Engineering Graduate will be able to

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

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

3. **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 public health and safety, and the cultural, societal, and environmental considerations.

4. **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.

5. **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 understanding of the limitations.

6. **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.

7. **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.

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

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

10. **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.

11. **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.

12. **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.

Table of Contents

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure of

B.Tech. E&TC Engineering

"Pattern – B20"

Title: Course Structure - B20 **FF No. 653**

Branch: E&TC **Year:** S.Y. **A.Y.:** 2020-21 **Module:** III

Subject Head	Course Code	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)									Credits
			Theory	Lab	Tut	ISA						ESA		Total	
						HA	LB	CP	PPT	GD	MSE	ESE	CVV	100	
S1	MD2201	Data Science	3	2	1	10	10	10	15	15	10	10	20	100	5
S2	MD2202	Applied Electronics	3	2	1	10	10	10	15	15	10	10	20	100	5
S3	MD2203	Mechanical and System Engineering	3	2	1	10	10	10	15	15	10	10	20	100	5
S4	ET2231	Engineering Design-I	0	2	0						30	70		100	1
S5	ET2232	Software Design-I	0	2	0						30	70		100	1
S6	ET2233	Software Development Project - I	0	6	0	-	-	-	-	-	30	70	-	100	3
S6	ET2234	Engineering Design and Innovation - III	0	8	0	-	-	-	-	-	30	70	-	100	4
		Total	**9**	**24**	**3**										**24**

Title: Course Structure – B20 **FF No. 653**

Branch: E&TC **Year:** S.Y. **A.Y.:** 2020-21 **Module:** IV

Subject Head	Course Code	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)									Credits
			Theory	Lab	Tut	ISA						ESA		Total	
						HA	LB	CP	PPT	GD	MSE	ESE	CVV	100	
S1	ET2202	Data Structures	3	2	1	10	10	10	15	15	10	10	20	100	5
S2	ET2230	Computer Architecture and Operating Systems	3	2	1	10	10	10	15	15	10	10	20	100	5
S3	ET2204	Communication Engineering	3	2	1	10	10	10	15	15	10	10	20	100	5
S4	CS2218	Object Oriented Programming	3	2	1	10	10	10	15	15	10	10	20	100	5
S5	ET2237	Software Development Project – II	0	6	0	-	-	-	-	-	30	70	-	100	3
S6	ET2236	Engineering Design and Innovation – IV	0	8	0	-	-	-	-	-	30	70	-	100	4
		Total	**12**	**22**	**4**										**27**

Title: Course Structure **FF No. 653**

Branch: E&TC **Year:** T.Y. **A.Y.:** 2020-21 **Module:** V **Semester - 1**

Subject Head	Course Code	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)									Credits
			Theory	Lab	Tut	ISA						ESA		Total	
						HA	LB	CP	PPT	GD	MSE	ESE	CVV	100	
S1	ET3202	Digital Signal Processing	3	2	1	10	10	10	15	15	10	10	20	100	5
S2	ET3201	Embedded System Design	3	2	1	10	10	10	15	15	10	10	20	100	5
S3	ET3209	Internet of Things	3	2	1	10	10	10	15	15	10	10	20	100	5
S4	ET3242	Engineering Design-I	0	2	0						30	70		100	1
S5	ET3243	Software Design-I	0	2	0						30	70		100	1
S6	ET3237	Software Development Project – I	0	6	0	-	-	-	-	-	30	70	-	100	3
S7	ET3238	Engineering Design and Innovation – III	0	8	0	-	-	-	-	-	30	70	-	100	4
		Total	**9**	**24**	**3**										**24**

Title: Course Structure **FF No. 653**

Branch: E&TC **Year:** T.Y. **A.Y.:** 2020-21 **Module:** VI **Semester - 1**

Subject Head	Course Code	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)									Credits
			Theory	Lab	Tut	ISA						ESA		Total	
						HA	LB	CP	PPT	GD	MSE	ESE	CVV	100	
S1	ET3221	Computer Vision	3	2	1	10	10	10	15	15	10	10	20	100	5
S2	ET3206	Digital Design	3	2	1	10	10	10	15	15	10	10	20	100	5
S3	ET3204	Robotics	3	2	1	10	10	10	15	15	10	10	20	100	5
S4	ET3242	Engineering Design-I	0	2	0						30	70		100	1
S5	ET3243	Software Design-I	0	2	0						30	70		100	1
S6	ET3237	Software Development Project – I	0	6	0	-	-	-	-	-	30	70	-	100	3
S7	ET3238	Engineering Design and Innovation – III	0	8	0	-	-	-	-	-	30	70	-	100	4
		Total	**9**	**24**	**3**										**24**

Title: Course Structure **FF No. 653**

Branch: E&TC **Year:** T.Y. **A.Y.:** 2020-21 **Module:** V **Semester - 2**

Subject Head	Course Code	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)									Credits
			Theory	Lab	Tut	ISA						ESA		Total	
						HA	LB	CP	PPT	GD	MSE	ESE	CVV	100	
S1	ET3202	Digital Signal Processing	3	2	1	10	10	10	15	15	10	10	20	100	5
S2	ET3201	Embedded System Design	3	2	1	10	10	10	15	15	10	10	20	100	5
S3	ET3209	Internet of Things	3	2	1	10	10	10	15	15	10	10	20	100	5
S4	ET3203	Power Electronics and Drives	3	2	0	10	10	10	15	15	10	10	20	100	4
S5	ET3240	Software Development Project – II	0	6	0	-	-	-	-	-	30	70	-	100	3
S6	ET3244	Engineering Design and Innovation – IV	0	8	0	-	-	-	-	-	30	70	-	100	4
		Total	**12**	**22**	**3**										**26**

Title: Course Structure **FF No. 653**

Branch: E&TC **Year:** T.Y. **A.Y.:** 2020-21 **Module:** VI **Semester 2** **Div(C, D)**

Subject Head	Course Code	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)									Credits
			Theory	Lab	Tut	ISA						ESA		Total	
						HA	LB	CP	PPT	GD	MSE	ESE	CVV	100	
S1	ET3221	Computer Vision	3	2	1	10	10	10	15	15	10	10	20	100	5
S2	ET3206	Digital Design	3	2	1	10	10	10	15	15	10	10	20	100	5
S3	ET3204	Robotics	3	2	1	10	10	10	15	15	10	10	20	100	5
S4	ET3203	Power Electronics and Drives	3	2	0	10	10	10	15	15	10	10	20	100	4
S5	ET3240	Software Development Project – II	0	6	0	-	-	-	-	-	30	70	-	100	3
S6	ET3244	Engineering Design and Innovation – IV	0	8	0	-	-	-	-	-	30	70	-	100	4
		Total	**12**	**22**	**3**										**26**

Title: Course Structure **FF No. 653**

Branch: E&TC **Year:** B.Tech. **A.Y.:** 2020-21 **Module:** VII

Subject Head	Course Code	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)									Credits
			Theory	Lab	Tut	ISA						ESA		Total	
						HA	LB	CP	PPT	GD	MSE	ESE	CVV	100	
S1	MD4203	Business Proposal Writing	2	0	0	10	-	-	-	-	30	30	30	100	2
	MD4204	UIUX Design	2	0	0	10	-	-	-	-	30	30	30	100	2
S2	ET4205	Industrial Automation	2	0	0	10	-	-	-	-	30	30	30	100	2
	ET4230	Natural Language Processing	2	0	0	10	-	-	-	-	30	30	30	100	2
	ET4240	Power Electronics	2	0	0	10	-	-	-	-	30	30	30	100	2
	ET4241	Advanced Communication Engineering	2	0	0	10	-	-	-	-	30	30	30	100	2
	CS4217	Human Computer Interaction	2	0	0	10	-	-	-	-	30	30	30	100	2
	CS4219	Internet of Things	2	0	0	10	-	-	-	-	30	30	30	100	2
	CS4222	Image Processing	2	0	0	10	-	-	-	-	30	30	30	100	2

	IT4201	Design and Analysis of Algorithms	2	0	0	10	-	-	-	-	30	30	30	100	2
	IC4201	Industrial Electronics	2	0	0	10	-	-	-	-	30	30	30	100	2
S3	ET4232	Deep Learning	2	0	0	10	-	-	-	-	30	30	30	100	2
	ET4242	Pattern Recognition	2	0	0	10	-	-	-	-	30	30	30	100	2
	ET4243	Design of Experiments	2	0	0	10	-	-	-	-	30	30	30	100	2
	ET4244	CMOS RF Integrated Circuits	2	0	0	10	-	-	-	-	30	30	30	100	2
	CS4213	Network Security	2	0	0	10	-	-	-	-	30	30	30	100	2
	CS4201	Cloud Computing	2	0	0	10	-	-	-	-	30	30	30	100	2
	IT4202	Computer Vision	2	0	0	10	-	-	-	-	30	30	30	100	2
	IC4215	DCS and Communication Protocols	2	0	0	10	-	-	-	-	30	30	30	100	2
S4	ET4262	Major Project	0	20	0	-	-	-	-	-	30	70	-	-	10
		Total	**6**	**20**	**0**										**16**

Title: Course Structure **FF No. 653**

Branch: E&TC **Year:** B.Tech. **A.Y.:** 2020-21 **Module:** VIII

Subject Head	Course Code	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)									Credits
			Theory	Lab	Tut	ISA						ESA		Total	
						HA	LB	CP	PPT	GD	MSE	ESE	CVV	100	
S1	ET4263	Research Internship	-	40	-	-	-	-	-	-	30	100	-	100	16
	ET4264	Project Internship	-	40	-	-	-	-	-	-	30	100	-	100	16
	ET4265	Industry Internship	-	40	-	-	-	-	-	-	30	100	-	100	16
	ET4266	International Internship	-	40	-	-	-	-	-	-	30	100	-	100	16
		Total	**-**	**40**	**-**	**-**	**-**	**-**	**-**	**-**	**30**	**100**	**-**	**100**	**16**

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

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Syllabus of

Second Year B.Tech.

Electronics & Telecommunication Engineering

"Pattern – B20"

Module - III

FF No.: 654

MD2201: DATA SCIENCE

Course Prerequisites:

1. Linear Algebra Basics
2. Central Tendency & Measures of Dispersion – Mean, Mode, Median
3. Probability
4. Some exposure to programming environment – C programming; Python

Course Objectives:

1. Understand data processing pipeline
2. Perform dimensionality reduction operations
3. Optimize the performance of functions
4. Apply descriptive statistics tools
5. Deduce meaningful statistical inferences
6. Use unsupervised classification algorithms
7. Use supervised classification algorithms
8. Utilize the data science principles for an entire project life cycle as a case study

Credits: 5 **Teaching Scheme** Theory: 3 Hours/Week

Tut: 1 Hours/Week

Lab: 2 Hours/Week

Course Relevance:

The course is offered in S.Y. B.Tech. to all branches of Engineering. Data Science is a multidisciplinary field. It uses scientific approaches, procedures, algorithms, and frameworks to extract knowledge and insight from a huge amount of data. Data Science uses concepts and methods which belong to fields like information technology, Mathematics, Statistics, Computer Science etc. Data Science influences the growth and improvements of the product by providing a lot of intelligence about customers and operations, by using methods such as data mining and data analysis. The course is relevant to all branches of Engineering and beyond since data is generated as an obvious outcome of many processes.

SECTION-1

Introduction to Data Science

Role of data scientist, introduction to R, R studio; introduction to univariate and multivariate systems, understanding databases, Data Processing - Data collection; Data preparation; Data visualization techniques and inferences - scatter plot, scatter matrix, histogram, box plot.

Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, hypothesis testing, inference for numerical data – t-distribution, paired data, ANOVA, Vector norms, distances & projections, discriminants, least squares, Singular Value Decomposition, Principal Component Analysis, Optimization: constrained and unconstrained, Gradient Descent

SECTION-2

Supervised Learning – line fitting, residuals, correlation; line fitting by least squares regression; outliers in linear regression; Inference for linear regression; Multiple regression; Model selection; Logistic regression, Nearest Neighbor Classification – Knn; Naïve Bayes Classification – Bayesian methods, Bayes algorithm; Classification using decision trees and learners.

Unsupervised Clustering - K-means clustering; Evaluation of model performance – Confusion matrices, sensitivity, specificity, kappa statistics, precision, recall, F-measure, ROC curve, etc.; Methods of cross-validation, Bootstrapping; Meta-learning through ensemble approach – Bagging, boosting, Random Forests strategies.

Applications of Data Science – Predicting default cases in the Banking Industry, Predict passengers' survival in a Ship mishap evaluation technique, Classify Junk emails based on probability, Classify malicious websites, SMS Spam collection data, Gender recognition by voice, Store Item Demand Forecasting:

Predict 3 months of item sales at a different store

List of Tutorials:

1. Data Visualization
2. Distances and Projections
3. Singular Value Decomposition
4. Principal Component Analysis
5. Optimization
6. Normal & Binomial Distribution
7. Hypothesis Testing
8. ANOVA test

9. Linear Regression
10. Logistic Regression
11. Nearest Neighbor Classification
12. Decision Trees based classification
13. Naive Bayes classification
14. Clustering
15. Evaluation of model performance
16. Bagging & Boosting approaches

List of Practicals:

1. Data visualization
2. Unconstrained Optimization
3. Hypothesis Testing
4. Linear regression
5. Logistic Regression
6. Nearest Neighbor classification
7. Naive Bayes classification
8. Clustering
9. Classifier performance using Confusion matrix and other attributes
10. Cross Validation methods

List of Projects:

1. Movie recommendation system
2. Customer Segmentation using Machine Learning
3. Sentiment analysis
4. Uber Data analysis
5. Loan prediction
6. HVAC needs forecasting
7. Customer relationship management
8. Clinical decision support systems
9. Development of machine learning solutions using available data sets (multiple projects)
10. Fraud detection

List of Seminar Topics:

1. Data wrangling
2. Predictive modeling
3. Data analytics in life science (multiple topics)
4. Ensemble modeling techniques
5. Text pre-processing
6. Feature scaling for machine learning
7. Multivariate normal distribution applications
8. Distance metrics and their applications
9. Visualization techniques such as Chernoff's faces
10. Tree based algorithms
11. Ridge regression
12. LASSO

List of Group Discussion Topics:

1. PCA and ICA
2. Hierarchical and nonhierarchical systems
3. Linear - Nonlinear regression
4. Parametric-nonparametric estimation
5. Overfitting and underfitting in the context of classification
6. Linear and Quadratic discriminant analysis
7. Regression v/s classification
8. Classifier performance measures
9. Supervised and unsupervised learning
10. Various clustering approaches
11. Classifiers and classifier combinations
12. Balancing errors in hypothesis testing
13. Standard sampling practices for a successful survey for reliable sample data

List of Home Assignments:

Case Study:

A very large number of resources are available for data generated out of case study. Unique Home assignments will be set up for all groups

Surveys:

Principles of surveying will be implemented by groups to demonstrate use of data science principles in home assignments

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks

Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Textbooks:

1. 'A Beginner's Guide to R' – Zuur, Leno, Meesters; Springer, 2009
2. 'Introduction to Data Science' – Igual, Segui; Springer, 2017
3. 'Mathematics for Machine Learning' – Diesenroth, Faisal, Ong; Cambridge University Press, 2017
4. 'Machine Learning with R' – Lantz, Packt Publishing, 2018

Reference Books:

1. 'Elements of Statistical Learning' - Hastie, Tibshirani, Friedman; Springer; 2011
2. 'Data Science from Scratch' - Grus; Google Books; 2015
3. 'The art of Data Science' - Matsui, Peng; 2016
4. 'Machine Learning for absolute beginners' - Theobald; Google Books; 2017

MOOCs Links and additional reading material:

1. www.nptelvideos.in
2. www.edx.org/course/machine-learning-fundamentals-2
3. www.edx.org/course/foundations-of-data-analysis-part-1-statistics-usi
4. www.coursera.org/learn/statistical-inference/home/welcome
5. www.coursera.org/learn/data-scientists-tools/home/welcome

Course Outcomes:

1. Apply Data processing & data visualization techniques.
2. Implement dimensionality reduction & optimization techniques for enhancing data suitability.
3. Perform Descriptive and Inferential statistical analysis for building reliable predictions.
4. Implement Supervised algorithms for classification and prediction.
5. Implement Unsupervised classification algorithms.
6. Evaluate the performance metrics of supervised and unsupervised algorithms.
7. Demonstrate complete Data Science life cycle with case studies.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	0	0	0	0	0	0	0	0	0	0	0	0
2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
4	3	3	0	0	0	0	0	0	0	0	0	0	0	0
5	3	3	0	0	0	0	0	0	0	0	0	0	0	0
6	3	3	0	0	0	0	0	0	0	0	0	0	0	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO Attainment Level:

CO1: Level 3
CO2: Level 4
CO3: Level 5
CO4: Level 4
CO5: Level 3
CO6: Level 2

Future Courses Mapping:

1. Deep Learning
2. Reinforcement Learning
3. DBMS
4. Big Data
5. Data Mining
6. Information Retrieval
7. Recommendation Systems
8. Cloud Computing – AWS
9. IOT
10. Artificial Intelligence
11. Pattern Recognition
12. Natural Language Processing
13. Computer Vision
14. Machine Vision
15. Fault Diagnosis
16. Optimization
17. Bioinformatics
18. Computational Biology
19. Econometrics
20. Supply Chain
21. Ergonomics

22. Operations Research
23. Nano-informatics

Job Mapping:

Job opportunities that one can get after learning this course

Data Scientist, Data Analyst, AI Engineer, Data Architect, Data Engineer, Statistician, Database Administrator, Business Analyst, Business Intelligence Developer, Infrastructure Architect, Enterprise Architect, Machine Learning Engineering, Machine Learning Scientist

FF No.: 654

MD2202: APPLIED ELECTRONICS

Course Prerequisites:

Concepts of Modern Physics

Course Objectives:

1. To familiarize with working and applications of electronic devices and circuits
2. To introduce various signals, systems, and its analysis
3. To understand concepts of feedback control system and its performance analysis
4. To design basic digital circuits and understand their applications
5. To know basics of power devices, components, and their applications
6. To comprehend fundamentals of communication system

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:

There are numerous electrical and electromechanical systems with embedded electronics for control in use today. An understanding of the principles of electronics and the primary operation of electronic devices and systems can assist an engineer in collaborating on the design and production of various systems.

SECTION-1
Devices & Circuits: Role of Applied Electronics, Basic Electronic Components, RLC Circuits, Diode Applications, Transistor as an Amplifier, Operational Amplifier Circuits. Signals & Systems: Signals, Systems, Impulse Response & Convolution, Signal Operations , Basic Image Processing Techniques, Transforms. Control Systems: Signal Flow Graphs, Block diagram reduction, System Stability, Bode Plots, Network Theorems, Single & Two Port Networks.

SECTION-2

Digital Electronics **:** Boolean Algebra, Combinational Logic Circuits, Sequential Logic Circuits, Converters

Power Electronics : Power Devices, Power Circuits, Power Supply, SMPS, UPS, Batteries

Communication: Communication System, Analog Communication, Digital Communication, Wireless Communication Basics, Communication Protocols, Mobile Communication

List of Practical:

1. Identification of Electronics components & Devices
2. Study of Series Resonance & Parallel Resonance Circuit
3. Diode as clipper & clamper
4. Common Emitter Amplifier
5. OPAMP Inverting & Non-Inverting Amplifier - Self study
6. Generation of Signals & Signal Operations
7. Implementation of Analog Filter
8. Implementation of Image Pre-processing Techniques
9. Design and evaluation of second order system
10. Design lead / lag compensating network for the given specifications
11. Understand the functioning of logic gates, their implementation and verification of truth tables.
12. Design of code converter
13. Design and implement a Combinational logic circuit for given Boolean equation
14. Design and implement Mod-n Counter using J-K flip flops
15. Design and implement Sequence generator using shift register
16. Combinational logic design using Multiplexers
17. Gate Firing Circuits for SCR's: To trigger an SCR by using R, RC & UJT triggering circuits and observe the output waveforms for different firing angles.
18. To construct a single-phase half-controlled bridge rectifier and to observe the output waveforms with a. R load, b. RL Load, c. RLC Load, using MATLAB
19. Build Double sideband suppressed carrier (DSBSC) modulator and demodulator. Observe spectral components of time-domain signal using Digital Storage Oscilloscope (DSO).
20. Build Frequency modulator (FM).
21. Simulation of Analog communication system.
22. Simulation of Digital communication system.

List of Projects:

1. Design and implement 230V AC Bulb On-Off switch using BJT & Relay
2. Design and Implement OR & AND logic circuits using P-N diodes.
3. Design and Implement NAND & NOR gate using Transistor
4. Design Band Pass Filter using RLC circuit
5. Design and implement Low Pass Filter using OPAMP
6. Function Generator
7. Image Enhancer
8. Automated Inspection System (IP Based)
9. Noise Removal System
10. Spectrum Analyzer
11. Smart Lift Control System
12. On off temperature controller
13. Alcohol Sensing Display With Alarm Project
14. Temperature control in Room
15. Smart Traffic Control System
16. Season Based Automatic Street Lights Switching
17. Display Object Counter On 7 Segment Display
18. Home Automation Using Touch Screen
19. Motion Based Automatic Door Opener
20. Solar lighting system with auto tracking
21. Design Staircase lighting using flip flops
22. Design battery level indicator
23. Design 4 bit error checker/ generator circuit
24. Design parity generator for 3 bits input.
25. Design Digital to Analog Converter circuit using DAC0808
26. Digital IC tester
27. Battery Charger using Controlled Rectifier
28. Precise Illumination Control of Lamp using Thyristors (Intensity control of lighting)
29. Develop a switching/triggering circuit for a power device (SCR / power BJT / power MOSFET / IGBT)
30. Fan Regulator– Speed Control and Rotation Direction Control
31. Solar Lamp
32. Home automation system using Packet Tracer
33. Simulation of Analog/Digital Communication System
34. Pre-emphasis and De-emphasis for FM
35. Design of Anti-aliasing filter
36. Design of Audio System
37. Implementation of Adaptive Delta modulator to avoid slope overload distortion
38. Generation of discrete PAM signal

List of Seminar Topics:

1. Role of impurities in formation of P & N type of Material
2. Zener diode as voltage regulator and avalanche break down
3. CLASS A, CLASS B, CLASS C & CLASS D types of amplifiers
4. Role of Q factor in series resonance and parallel resonance
5. Optoelectronic devices
6. Different Electronics Devices Used in Industries
7. PCB design criteria for RF applications
8. Different types of Heat sinks for Power semiconductor devices
9. Different types of PCB connectors
10. Liquid Crystal Display Device
11. Types of PCB & PCB Design Rules
12. LiDAR Technology
13. OLED Technology
14. Surveillance-camera System
15. RFID Technology
16. Compressed Image Processing
17. Wireless Power Transmission Technology
18. Laplace Transform
19. Fourier Series
20. Fourier Transform
21. Important Attributes of an Image
22. Working of Automatic washing Machine
23. System of Bread Toaster
24. Recent standards used in Control System Industry
25. How Infrared Thermal Gun works?
26. Working of Automatic Tea/ coffee vending machine
27. PLC Based Product Sorting Machine
28. Use of Electronics in Automobile industry
29. Use of Electronics in Chemical Industries
30. Hydraulic Control Systems
31. Fuzzy Controllers
32. Distributed Control Systems
33. Data Acquisition System
34. Pneumatic Control System Components
35. E-P & P-E converters
36. Digital Logic Families
37. Digital Circuit Design using PLA & PAL
38. Different analog to digital (ADC) conversion techniques
39. Different digital to analog (DAC) conversion techniques

40. Role of Memory Devices in Embedded Systems
41. Algorithmic state machines and sequential logic circuits
42. Switch capacitor
43. Hazards in digital circuits
44. Alphanumeric codes
45. Field Programmable Gate Arrays (FPGA)
46. Digital integrated circuits Characteristics: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margins
47. Advances in Analog-to-Digital Converters over the Last Decade
48. Hybrid Electric Vehicles
49. Applications of Power Diodes
50. Role of Power Electronics in Renewable Energy Deployment
51. Insulated-gate bipolar transistor (IGBT)
52. Role of Power Electronics Technology to Energy Efficiency and CO2 Reduction
53. Industrial Laser power supply
54. Traction control of Electric Vehicles
55. Electric Bikes
56. Subway and locomotive propulsion
57. Power control of welding arc furnace
58. How new technologies are affecting health (Physical and mental)
59. various Wireless technologies that could make 5G faster
60. Effect of Mobile phones on health
61. Harnessing technology for better mental health services
62. Cognitive radio
63. Software defined radio
64. Applications of Radar in defense
65. Working of Jio fiber
66. Bluetooth Applications
67. MANETs and VANETs

List of Group Discussion Topics:

1. Role of Surface mount technology in electronic circuits
2. Types of Diodes and their applications
3. Role of MOSFET in the electronics switching circuits
4. Characteristics of ideal OPAMP
5. 555 Timer IC and its applications
6. Can PCB be considered as a graph (Data Structures)?
7. Display Technology
8. Photo Sensing Devices
9. Solid state relay Vs Electromechanical relay
10. Role of electronics in mechanical & Allied industries
11. Next Generation Photo Voltaic
12. Next Generation MOSFETS (e-GaN MOSFET)
13. Convolution in Image Processing
14. 5G Communication - System Perspective
15. Significance of Impulse Response
16. Fourier Series vs Fourier Transform
17. Applications of Laplace Transform
18. Convolution Integral
19. Impulse Response vs Step Response
20. Significance of LTI System
21. Causality of LTI System
22. Linear System vs Non-linear System
23. Analog System vs Digital System
24. Stability criterion for Control Systems
25. Process controller
26. Open loop and closed loop systems
27. Applications of Electronics in Boilers
28. Sensors used in Automobile industries
29. Modelling a mechanical system for system analysis
30. Modelling a Electrical system for system analysis
31. Applications of Bode plot in System Stability
32. Intelligent Controller
33. Automation in production industries
34. Role of digital electronics in the field of consumer electronics
35. Role of digital electronics in the field of Communication
36. Importance of Military grade integrated circuits
37. Edge triggered & level triggered digital circuits
38. Applications of digital electronics in mechanical systems
39. What is Digital in Digital Electronics?

40. What is Analog in Analog Electronics?
41. How does digital technology improve our lives?
42. Digitization: Pros & Cons
43. Journey of television from CRT to LED
44. Application Specific Integrated Circuits (ASICs)
45. History of Microprocessor
46. Energy Storage Technologies / Techniques
47. Linear Regulated Power Supply and SMPS
48. Pros and Cons of Power Electronics Converters
49. Smart Electric Grid
50. Motor Drives - Types and Applications
51. Role of Power Electronics in Climate Change
52. Materials used in Power Electronics for improved performance and efficiency
53. Power electronics in biomedical field
54. Miniaturization of Power electronics devices - Challenges
55. Role of Circuit Breakers - Types and Applications
56. Digital Revolution in communication systems - Pros and Cons
57. Effects of noise and distortion on analog and digital signal
58. Effect of sampling rate, bit rate on audio quality
59. Use of Satellites in Disaster Management in India
60. Submarine Communication for Global Internet Connectivity
61. Internet of Things
62. Wi-Fi-- Security and Privacy
63. Wireless Sensor Networks
64. Wireless Connectivity - Anytime anywhere
65. Connected Cars

List of Home Assignments:

Design Topics:

1. Design Voltage multiplier circuit using diodes and capacitors
2. Design of transistorized regulated power supply
3. Design of RLC Impedance matching circuit
4. Design of A stable multivibrator using OPAMP
5. Design of Audio Amplifier
6. Satellite For Amateur Radio
7. Face Detection System
8. Detection of Breathing
9. Pitch Recognition System
10. Denoising Audio Signal
11. Design PID controller for Flow Control loop

12. Design PI controller for Level Control loop
13. Design PID controller for Temperature Control loop
14. Design PID controller for DC motor speed control
15. Design Token Number Display System
16. Design Talking Token Number Display System using CMOS key encoder and seven segment display and Speech encoder
17. Design water level controller using logic gates & relays.
18. Design LED chaser
19. Design Digital Voltmeter using ICL7107 and 7 Segment Display
20. UPS / Emergency Lighting Systems
21. Electric-door openers
22. Induction Cooking
23. AC Regulator
24. Battery Supplied Vehicle - Power Supply
25. Design a BPSK modulation/demodulation system
26. Design Pulse Amplitude modulation system.
27. Design Pulse Code modulation and demodulation.
28. Design Delta modulation and demodulation.
29. Design Quadrature phase shift keying modulation and demodulation.
30. Design frequency shift keying modulation and demodulation

Blog Topics:

1. Transistor Parameter Models
2. FET Vs BJT
3. Role of semiconductor devices in Power Electronics
4. Future of the nanoelectronics
5. Safety standards in electronics industries.
6. Quantum Physics
7. 7G Communication System
8. Wireless Power Transmission System
9. Plastic Solar Cell System
10. Nanotechnology in Electronics
11. Haptic Technology
12. Steady state response of any process loop
13. Will addition of poles / zeros affect the performance of the system?
14. Will addition of poles / zeros affect the stability of the system?
15. How can a PID controller improve the performance of the system?
16. Different control schemes and criterion for selection of appropriate contact scheme
17. Handling digital devices
18. Significance of number systems
19. Impact of digital electronics on industry development

20. Low power ADCs
21. Low Pin Count Microcontrollers
22. High Frequency considerations in Power Electronics
23. VAR compensation
24. Voltage Dip Restorer
25. Regenerative Braking
26. Multilevel Inverters
27. Are we ready for the Information war?
28. 24 Hour Connectivity - Boon or Curse
29. Personal data security
30. Radar for Car Safety
31. GPS Applications
32. Mission Shakti

Survey Topics:

1. Transistors and their packaging
2. Applications of RLC circuits in industries
3. Different Types of Oscillators used in industries
4. Worldwide Fabrication Lab scenario
5. Solar Power Energy generation in India using PV Cells
6. Remote Sensing Methods
7. Electronic Systems in Healthcare
8. Electronics Systems in Defense
9. Morphological Operators in Image Processing
10. Biggest Systems in the World
11. Different types of PLCS
12. Comparisons on PI, PID and PD controller.
13. Different types of open loop processes used in industry
14. Different types of closed loop processes used in industry
15. IEEE Papers
16. Digital Integrated Circuits manufacturing companies across the world and their turnover (min 3)
17. Use of Successive Approximation Register ADC in advanced microcontrollers
18. Effects of Power Quality issues on digital circuits
19. Use of Microcontrollers in different areas w.r.t industry 4.0
20. Active Power Devices
21. High voltage DC Transmission (HVDC)
22. Electric Drives
23. Flexible AC transmission systems (FACTS)
24. Battery energy storage system (BESS)
25. Adverse effects of 5G technology

26. Is India ready for Industry 4.0?
27. Evaluation of performance of 5G
28. How radio mirchi Works? - A Technical Perspective
29. Indian satellite program
30. Best satellite internet provider 2020

Case Study Topics:

1. Process carried out at fabrication LAB
2. Different soldering techniques
3. Transition from vacuum tubes to solid state devices
4. Electronics used in boiler
5. Data centers and their cooling
6. Biometric Voting Machine
7. Speech Signal Analysis
8. Weapon Detection System
9. Intensity Modulation Technique
10. Voice based Security System
11. Different control system and control strategies used in dairy industry
12. Control System at Pharmaceutical industry
13. Control System at Thermal Power plant
14. Control System at Water Purification plant
15. Control System at Sugar factory
16. Evolution of Automation in Indian Industries
17. Simulation based digital circuit design
18. Integrated Circuits: SSI, MSI, LSI, VLSI, ULSI
19. Digital electronics in Vehicular communication (Protocols, Circuits)
20. Transition from electromechanical systems to Electronics systems
21. Application of Power Electronics in Automotive Power Generation
22. SMPS Applications in the Powertrain System- The power train systems of HEVs, electric vehicles and ICE need the following SMPS conditioners such as: Regenerative braking (AC/DC), On-board charger (AC/DC), Dual-battery system (DC/DC), Traction motor (DC/AC)
23. Electric Locomotives
24. Aircraft power system / Space Shuttle Power Supply
25. Hybrid Electric Vehicles
26. GMRT
27. PA System / Home Theatre System
28. Missile Guidance System
29. Air Traffic Control
30. Satellite Service for Crop Management in India
31. 2G Spectrum distribution in India during 2005

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Textbooks:

1. Varsha Agrawal Anil K. Maini, Electronic Devices and Circuits, Wiley, Kindle Edition
2. Thomas L Floyd: Electronic Devices (Conventional Current Version), Pearson,10th Edition
3. Nagrath Gopal - Control System Engineering
4. Norman Nise - Control Systems Engineering, Sixth Edition, Wiley
5. R.P. Jain, ―Modern Digital Electronics‖, TMH, 2012, ISBN–13: 978-0-07- 066911-6.
6. M D Singh, K B Khanchandani; Power Electronics; 2 nd Edition; TMH.
7. M. H. Rashid; Power Electronics Circuits, Devices and Applications; 3 rd Edition; PHI
8. Simon Haykin,Principles of Communication Systems , John Wiley, 2nd Ed
9. Louis E Frenzel, Principles of Electronic Communication Systems, Tata McGraw Hill Publications, Third Edition.
10. H. Taub and D. Schilling, Principles of Communication Systems , TMH, 2003.
11. Simon Haykin, Digital Communications, John Wiley,2005
12. Theodore S. Rappaport, Wireless Communications: Principles and Practice Pearson Education India, 2009

Reference Books:

1. Robert L. Boylestad, Electronic Devices and Circuit Theory, Pearson; 11 edition
2. Mahmood Nahvi & Joseph A. Edminister, Schaum's Outline of Electric Circuits, McGraw-Hill Education; 6 edition
3. Katsuhiko Ogata - Modern Control Engineering, Prentice Hall
4. Anil K. Maini : Digital Electronics: Principles And Integrated Circuits 1st Edition, ISBN: 978-0-470-51051-3
5. N. Mohan, T. M. Undeland and W.P. Robbins; Power Electronics: Converters, Applications, and Design; 3rd edition; John Willey and Sons, Singapore.
6. P. C. Sen; Modern Power Electronics; S. Chand and Co, New Delhi.
7. B.P. Lathi, Communication Systems, BS Publication, 2006.
8. B. Sklar, Digital Communication, Pearson, Second Edition.

9. Simon Haykin, Analog & Digital Communications, Wiley Publications.
10. Wayne Tomasi, Electronic Communication Systems, Fourth Edition.
11. Simon Haykin, Digital Communications, Wiley Publications, Fourth Edition.

MOOCs Links and additional reading material:

1. Introduction to Electronics: https://www.coursera.org/learn/electronics
2. Linear Circuits 2: AC Analysis: https://www.MOOC-list.com/course/linear-circuits-2-ac-analysis-coursera
3. https://www.udemy.com/share/101GL4/ (Electrical Engineering : Introduction to Signals and Systems)
4. https://www.udemy.com/share/101Yzu/ (Signal processing problems, solved in MATLAB and in Python)
5. NPTEL: Digital Circuits By By Prof. Santanu Chattopadhyay, IIT Kharagpur, https://swayam.gov.in/nd1_noc19_ee51/preview
6. NPTEL: Courses-Electrical Engineering-NOC Fundamentals of Power Electronics https://nptel.ac.in/courses/108/101/108101126/

Course Outcomes:

1. Build basic circuits using different electronic devices
2. Classify various signals and systems for different applications
3. Illustrate performance analysis of feedback control system
4. Construct digital circuits for various applications
5. Choose the appropriate power devices and circuits for its applications in power electronics
6. Describe various communication systems

CO PO Map:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	1	3	2	1	2	3	2	2	3	3	2
2	2	2	3	1	3	2	1	2	3	2	2	2	3	2
3	3	3	2	1	2	2	1	2	3	2	2	2	3	2
4	3	3	3	1	3	2	1	2	3	2	2	3	3	2
5	3	3	3	2	3	2	3	2	3	2	2	2	3	2
6	2	2	2	1	2	2	2	2	3	2	2	3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Future Courses Mapping:

Industrial Electronics, Industrial Automation, Robotics, Wireless Communication, Mechatronics, Hybrid/Electric Vehicles, Energy Harvesting, Digital Signal Processing

Job Mapping:

This course will help the students to build foundation for interdisciplinary job opportunities in the field of

1. Automation,
2. Robotics,
3. Automobiles,
4. Communication etc

FF No.: 654

MD2203: MECHANICAL & SYSTEM ENGINEERING

Course Prerequisites: Concepts of physics

Course Objectives:

1. To introduce the Mechanical and Industrial Engineering discipline and its applications to students.
2. Develop capacities in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.
3. To develop an ability to design a system, component, or process to meet desired needs within realistic constraints
4. To impart knowledge on selection of suitable manufacturing process for the typical component
5. To understand the application of various Mechanical Measurement techniques in engineering applications.
6. This course provides a solid foundation in core mechanical and industrial engineering disciplines, critical thinking and problem-solving skills

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:

Mechanical and System Engineering has a strong flavor of design and hands-on experience. The course includes a study of a number of engineering topics to design systems relevant to the contemporary industries. The areas introduced are design philosophy, Heat Transfer, Manufacturing Science, System Engineering.

SECTION-1

Materials and Material Selection: Types of Materials, Properties of materials, Effect of alloying elements, Application of materials in mechanical, chemical, electronics and software industry, Selection of Material, Basic Heat Treatment Processes

Manufacturing Processes: Casting, welding, Brazing, Soldering, Material forming, Sheet Metal working, Surface treatments, Machining Processes, Advanced Machining Processes like Additive manufacturing, Photo chemical Machining and Laser Beam Machining etc., Automation and Types of Automation, Introduction to Computer Integrated Manufacturing

Mechanical Measurement: Engineering Measurements, Measurement Errors, Uncertainties of Measurement, Temperature Measurement, Pressure Measurement, Force measurement, Strain Measurement, Torque Measurement, Velocity Measurement Flow Measurement Torque Measurement, Vernier calipers, Micrometer or Screw Gauge, Dial Gauge or Dial Indicator, Spirit Level, Concept of Geometric dimensioning and tolerancing.

Design Philosophy: Engineering Design, Product Development Process, Problem, Types of Design, Phases of Engineering design, Definition and Need Identification to Detailed Design, Ergonomic and Aesthetic Aspects in Design, Design for Manufacturing

SECTION-2

Operations Strategy: Manufacturing vs Service Operations, Concept of Process as applied to manufacturing and services, SIPOC (Supplier-Input-Process-Output-Customer), Process Choices in Manufacturing: Project, Job Shop/Job Order, Batch, Mass/Assembly, Continuous Process

Quality Assurance: Quality – Concept, Definitions, Quality attributes for products & services, Cost & Value of quality, Inspection – 100% vs Sampling, Statistical Process Control, TQM, Six Sigma Concept – Measurements, DMAIC & DMADV, 7 QC Tools – Check sheets, Histogram, Fishbone diagram, Pareto diagram, Scatter Diagram

Logistics & Supply Chain Management: Logistics Management, Functions – Transportation, Warehousing, Inventory Management, Material handling & Packaging, Order (Information) Processing, Supply Chain – Types: Product SC, Service Spares SC, Service SC, Sustainable SC – Green SC, Reverse Logistics

Project Management: Projects – Definition, Characteristics, Classification, Project Life Cycle Phases – Concept/Initiation, Feasibility, Planning & Organization, Implementation, Clean-up & Shut Down Phase, Project Planning – Project Charter, Statement of Works, Network Analysis – PERT/CPM

List of Tutorials:

In the tutorial students are expected to present a technical seminar (PPT) relevant to Mechanical and System Engineering (MSE). Also, students (in a group of 4/5 students) are expected to discuss any technical novel topic related to Mechanical and System Engineering**.**

List of Practical:

1. Tension test on Mild Steel and Aluminum
2. Brinell hardness test on different materials
3. Demonstration on Lathe Machine, Milling and drilling Machine
4. Demonstration of CNC Lathe Machine Operation
5. Demonstration of various welding methods
6. Coordinate Measuring machine
7. Laser Beam Machining
8. 3D Printing Machine
9. Injection Molding Machine
10. Study of basic measuring instruments, Vernier Caliper, Micrometer, Dial Indicator, Profile Projector etc.
11. Experiment on profile projector and vision measuring system
12. Case study on Product Design Philosophy
13. Use of 7 quality tools implementation (using MS Excel)
14. Use of Statistical process Control (SPC) for manufacturing/Service industry (using MS Excel)
15. Implementation of Define and Measure phase of Six Sigma to manufacturing/Service industry (using standard templates made in MS Excel)
16. Case studies on Operation strategies
17. Implementation of Project Management concepts for managing projects (using MS Excel)

List of Projects:

1. Material selection
2. New material development
3. Smart materials usage
4. Manufacturing process selection for complex parts
5. Use of manufacturing for simple parts
6. Model for measurement system
7. Model for measuring instrument
8. New Product Design for customer satisfaction
9. Operation strategy of manufacturing / service industry
10. Implementation of Six sigma (At least first two phases i.e. Design and Measure) for manufacturing and service industry

11. Use of seven quality tools for improvement of product or service quality
12. Implementation of Statistical Process Control (SPC) for manufacturing or service industry
13. Supply chain management study for a manufacturing/service industry
14. Analysis of logistics management of a manufacturing/service industry
15. Implementation of Project Management concepts for a manufacturing/service industry
16. Use of software for project management

List of Seminar Topics:

1. Composite Materials and their applications
2. Additive Manufacturing
3. Design for Manufacturing
4. Laser Beam Machining
5. Photo chemical Machining
6. PCB Manufacturing
7. Manufacturing of semiconductor devices
8. Selection of material
9. Alloying materials
10. Materials used for Automobile applications
11. Materials used for Aerospace and space applications
12. Energy Management
13. Nonrenewable Energy Sources
14. Pollution and remedial measures for it
15. Heat Treatment of materials
16. Coordinate Measuring Machine
17. Non-contact type inspection methods
18. Geometric dimensioning and tolerancing
19. SIPOC for manufacturing industry
20. SIPOC for service industry
21. DIMAC
22. DMADV
23. Surface treatments
24. Six sigma and its applications
25. Use of 7 quality tools
26. Statistical Process control for manufacturing industry
27. Statistical Process control for service industry
28. Cost of quality and value of quality
29. Quality Philosophy
30. Introduction to logistics and supply chain Management
31. Applications of SCM in various sectors

32. Types of SCM
33. Project Management Basics
34. Use of Network analysis for project Management
35. Use of CPM/PERT for project Management
36. Product Life cycle management
37. Automation and Robotics
38. Metal Matrix composite processing
39. Recent trends in quality Management
40. Total Quality Management
41. Smart Materials
42. Shape Memory Alloys
43. Friction Stir Welding
44. Incremental Sheet Forming
45. CNC Machine
46. Virtual Manufacturing

List of Group Discussion Topics:

1. Methods of force measurement
2. Force sensing technology
3. Surface modification technology
4. Application and use of carbon fiber reinforced plastic
5. Effect of nonmetallic alloying elements
6. Materials used in electronic industry
7. Modern trends in heat treatment technology
8. Use of simulation in manufacturing
9. Electro chemical machining
10. Electro beam machining
11. Water jet machining
12. Thermodynamic laws - real life applications
13. Measurement of heat transfer rate
14. Laser metrology
15. Virtual gauging
16. Design for inspection
17. Electronic gauges
18. Gauging automation
19. Use of nanotechnology in material science
20. Use of computers in design and development process. including CAE, CAM.
21. Use of highly reliable plastic materials in engineering.
22. Emerging integration of mechanism with electronics.

23. Liberal use of instrumentation in mechanical systems
24. 3D printing in industrial scale
25. Micro Electro - Mechanical Systems
26. Computer aided manufacturing
27. Just in time production
28. Lean production
29. E-Supply chain management
30. Automation and operation strategy
31. Shifting from B2B model to B2B2C model
32. Business process management
33. Six sigma for continuous business growth
34. Quality circle
35. The Toyota production system
36. Taguchi Method
37. Zero defect program
38. QFD
39. Green Supply chain management
40. Closed loop supply chain
41. Forecasting product returns
42. Effect of SCM on BIG data and AI
43. Impact of Industry 4.0 on SCM
44. Resilient supply chain
45. Sustainability issues in supply chain
46. Block supply chain
47. AI and Project management
48. IOT and project management
49. Risk analysis in Project Management
50. Role of computer in Project Management

List of Home Assignments:

1. Stress strain relationship for various ductile materials
2. Stress strain relationship for various brittle materials
3. System and types of forces
4. Stress, strain and their types
5. Basics of Factor of Safety in design and engineering
6. Engineering materials and their properties
7. Alloys and Composite materials
8. Materials for various Engineering applications
9. Selection of material for various industrial applications

10. Heat treatment of engineering materials
11. Selection of manufacturing processes for various industrial applications
12. Joining processes and their applications
13. Deformation processes and their applications
14. Sheet metal operations
15. Conventional and non-conventional machining processes
16. Casting Processes and their applications
17. Additive manufacturing: concept and applications
18. Thermal machining processes
19. Chemical and electrochemical machining processes
20. Mechanical machining processes
21. Geometric dimensioning and tolerancing
22. Industrial automation: History and development
23. Computer integrated manufacturing
24. Heat transfer concept and applications
25. Laws of thermodynamics
26. Power generating and power absorbing devices.
27. Manufacturing and service industries and operations
28. SIPOC diagram
29. Types of production systems
30. Quality assurance and its role in industries
31. Quality, its cost and value
32. Quality control and SPC
33. Total Quality Management
34. Six Sigma: Concept and methodology
35. Applications of 7 QC tools
36. Logistics Management and its functions
37. Supply chain Management and types of supply chain
38. Project Management
39. Project life cycle
40. Network Analysis
41. Project charter

Design Topics:

1. Design of simple components for manufacturability
2. Establishing part dimensions based on stress strain calculations
3. Development of SIPOC diagram for various processes
4. Data collection, design of control charts for variables and their interpretation
5. Six Sigma: Define and measure phase
6. Problem solving using 7 QC tools

7. Engineering Design Principles
8. Design for Manufacturing
9. Design for Assembly
10. Asthetic Considerations in Design
11. Ergonomic considerations in Design
12. Design for Quality
13. Design for Six Sigma
14. Quality Function Deployment

Case Study:

1. Case study on material selection for electronic industry, chemical industry, aerospace and automobile industry etc.
2. Case study on selection of manufacturing process for given component
3. Difficult to cut materials and effective strategies to manufacture for the same
4. Complex part measurement using measuring instruments
5. Case study on CMM
6. Design thinking case study
7. Case study on selection of operation strategy
8. Use of DMAIC for product company
9. Use of DMAIC for service industry
10. Supply chain management case study
11. Logistics management of industry
12. Project management case study

Blog Topics:

1. New materials for manufacturing industry
2. Materials for industry 4.0
3. Smart Materials
4. New product development
5. Micro Machining
6. Advance machining Processes
7. Robotics and Automation
8. 3 D Metal printing
9. Supply chain management and block chain
10. Quality need of hour
11. Lean Six sigma
12. Project management tools and techniques

Surveys Topics:

1. Manufacturing processes in Industry

2. Use of Materials for industry applications
3. Effectiveness of CMM
4. Operation strategies of manufacturing companies
5.Operation strategies for service industry
6. Quality control in the era of industry 4.0
7. Machine vision usages
8. In line gauging
9. Supply chain methods used for manufacturing and service industry
10. Project management principles and its execution

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Text Books:

1. G. Shanmugam and S. Ravidran ; Basic Mechanical Engineering; Tata McGraw Hill Publications
2. S. Ramamrutham; Strength of Materials; 15th Edition, Dhanpat Rai Publishing Company
3. Beer P. Johnson, E. Russell Johnstn Jr., John T. Dowolf, David F. Mazurek; Mechanics of Materials, 2nd edition, McGrawHill publications.
4. P. N. Rao; Manufacturing Technology; Vol I & II; Tata McGraw Hill Publications
5. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
6. V Raghavan; Material Science and Engineering, Prentice Hall of India, New Delhi.
7. P. K. Nag; Engineering Thermodynamics; Tata McGraw Hill Publications.
8. Amitava Mitra, “Fundamentals of Quality Control & Improvement; 2nd edition”, Pearson Education 2002.
9. Sunil Chopra & Peter Meindl, “Supply Chain Management - Strategy, Planning & Operation”, Pearson Education.

Reference Books:

1. Gere and Temoshenko, "Mechanics of Material", 4th Edition, CBS Publishers
2. V.B.Bhandari, "Elements of Mechanical Engineering", Tata McGrawHill Publications
3. R. K. Jain, "Production Technology", Khanna Publishers
4. Chaudhari, Hajra, "Elements of workshop technology Vol I and II; Media promoters and Publishers
5. J. M. Juran & F. M. Gryna, "Quality Planning and Analysis", 5th Edition, McGraw-Hill, 1993
6. Raghuram, "Logistics & Supply Chain Management: Cases and Concepts"
7. Y Cengel and Boles, "Thermodynamics - An Engineering Approach", Tata McGraw Hill Publications

MOOCs Links and additional reading material:

1. www.nptelvideos.in
2. https://swayam.gov.in/nd1_noc20_me67/preview:Fundamentals of manufacturing processing
3. https://www.coursera.org/learn/mechanics-1:Stresses and strains
4. https://www.coursera.org/learn/thermodynamics-intro:Thermodynamics and Heat transfer
5. https://www.coursera.org/learn/uva-darden-project-management : Project Planning
6. https://www.coursera.org/specializations/project-management : Project Planning
7. https://www.coursera.org/learn/material-behavior : Materials
8. https://www.coursera.org/learn/six-sigma-principles
9. https://www.coursera.org/specializations/supply-chain-management

Course Outcomes:

1. Develop conceptual understanding of engineering design for any component and also to select the appropriate manufacturing methods.
2. Select the suitable material based on its mechanical, chemical and other properties for given engineering applications.
3. Understand basics of thermodynamics, heat transfer and sources of energy.
4. Understand nature of manufacturing and service operations; apply principles of operations strategy for process choice, plan and organize projects
5. Understand and apply principles of quality management, quality tools and six sigma methodology
6. Identify the key elements and processes in supply chain and their interaction

CO PO Map:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	1	1	0	0	3	2	2	1	1	1
2	2	2	2	2	1	1	0	0	3	2	2	1	1	1
3	2	2	2	2	1	1	0	0	3	2	2	1	1	1
4	2	2	2	2	1	1	0	0	3	2	2	1	1	1
5	2	2	2	2	1	1	0	0	3	2	2	1	1	1
6	2	2	2	2	1	1	0	0	3	2	2	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Future Courses Mapping:

Machining Processes, Manufacturing Engineering, Machine Design, Operations management, Project Management

Job Mapping:

With the successful completion of this course Students can acquire skills required for following job profile in manufacturing and service industry

1. Manufacturing Engineer
2. Design Engineer
3. Project Manager
4. Quality Control Engineer

FF No.: 654

CS2218: OBJECT ORIENTED PROGRAMMING

Course Prerequisites:
Basic course on programming

Course Objectives:

1. Understand Object Oriented programming concepts
2. Demonstrate Object Oriented programming concepts by writing suitable Java programs
3. Model a given computational problem in Object Oriented fashion
4. To develop problem solving ability using Object Oriented programming constructs like multithreading
5. Develop effective solutions using for real world problems using the concepts such as file handling and GUI
6. Implement applications using Java I/O and event-based GUI handling principles

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:
This is an important course for engineering students. It develops computational problem solving and logic building capability of students. Acquiring programming skills has a high relevance in all branches of Engineering. Once the student gains expertise in coding, this course proves to be beneficial to them to excel in industry demanding coding in specific software.

SECTION-1
Introduction: What is Object Oriented Programming? Why do we need Object Oriented Programming? Characteristics of object-oriented languages, C vs C++. Object Oriented Programming in C++ : Basics, Data Types, Structures, Class, Object, class and data abstraction, class scope and accessing class members, separating interface from implementation, controlling access to members. Functions: Function prototype, Constructors, Destructors, Copy Constructor, Objects and Memory requirements, Static Class members, Data abstraction and information hiding, Inline function, Friend Functions.

Operator Overloading: Concept, Operator overloading, Overloading Unary Operators, Binary Operators.

Inheritance: Base Class and derived Class, protected members, relationship between base Class and derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Types of Inheritance, Public and Private Inheritance, Ambiguity in Multiple Inheritance, constructors in derived classes, Aggregation.

Polymorphism: Concept, Types of polymorphism, relationship among objects in inheritance hierarchy, Function overloading, Virtual Functions: Pointers- indirection Operators, Heap Memory Management: new and delete, this pointer, Pointers to Objects, Pointer to derived classes, Function pointers, Pure virtual function, Abstract classes, Templates, Standard template libraries, Best Practices of Class Design.

SECTION-2

Object Oriented Programming in Java:

Java characteristics, Classes and Objects, Methods and Constructors. Information hiding access modifiers, Static keyword: class variables and instance variables, Class methods and instance methods. Arrays, Strings. Basic array processing strategies including passing arrays to functions, Applications illustrating use of arrays to store ordered and unordered sequences, sets

Inheritance: Types of inheritance, Constructors in Derived Classes, Overriding, Hiding Fields & Methods, Interfaces.

Polymorphism: Static and Dynamic. Abstract classes & methods, Final classes & methods. Exceptions: Checked & unchecked exceptions, User-defined exceptions.

Multithreading: Thread life Cycle, Thread Priority, Thread Methods, Inter-thread Communication, Producer-Consumer using Java.

Introduction to Streams: Types of streams, iostreams, Readers and Writers, Print writer, Stream Benefits.

File management: File Processing, Primitive Data Processing, Object Data Processing.

Java GUI: Applet, Applet Vs Application. AWT, Swing, Components. Layout Manager: Flow, Border, Grid and Card. Label, Button, Choice, List, Event Handling (mouse, key), Menus, Tables

List of Course Seminar Topics:

1. Introduction of Arrays and 1D Array programming examples
2. Multidimensional arrays
3. Variants of main() and command line arguments
4. Input and Output stream classes
5. String concepts and various methods of compairing strings
6. Methods in Java
7. Java String Methods
8. Passing array to a function and Jagged array examples
9. Reading input using Scanner and BufferReader Class

10. String, String buffer and String builder
11. Types of Inheritance in Java
12. Implementation of Types using Constructor in Inheritance
13. Using final with Inheritance
14. Base vs derived class reference in Inheritance
15. Using final with Inheritance, Accessing superclass member
16. Parent and Child classes having same data member
17. Overriding, Hiding Fields & Methods
18. Static vs Dynamic Binding & Hiding Methods
19. Private and final methods
20. Passing and Returning Objects in Java
21. Java Memory Management
22. File handling in Java vs C++
23. Data types used in Java vs C++
24. Java Object Serialization and Deserialization
25. Operator precedence
26. Use of Object Class Methods
27. Garbage collection in JAVA
28. Use of Static Blocks in various applications
29. Keywords used in JAVA
30. Types of Variables In JAVA

List of Group Discussion Topics:

1. Checked and unchecked exception, user defined and standard exception
2. Abstraction in Java and different ways to achieve Abstraction
3. Packages in Java – Types, Advantages & Techniques to Access Packages
4. Inner classes, nested interfaces in Java
5. Difference between Interfaces and abstract classes in Java
6. Exception Handling in Java Vs CPP
7. Difference between 1) throw and throws. 2) Final, finally and finalize in Java
8. Discuss Exception propagation and Discuss Exception handling with method overriding in Java
9. Discuss Packages, Access specifiers and Encapsulation in java.
10. Difference between abstraction and encapsulation in Java.
11. Daemon Threads Vs user threads
12. Preemptive scheduling Vs slicing
13. Is it possible to call the run()method directly to start a new thread? pls comment
14. Arraylist Vs Vector
15. Arrays Vs Collections
16. is Iterator a class or an Interface? what is its use?
17. List Vs Set

18. BufferedWriter and BufferedReader classes in java
19. BufferedReader Vs Scanner class in java
20. Buffered Reader Vs FileReader in java
21. Instanceofjava
22. Difference between CPP and JAVA
23. Difference between JDBC and ODBC connectivity
24. file processing in java
25. Difference between premitive data processing and object data processing
26. Creating GUI using swing
27. comparision between Swing, SWT, AWT, SwingX, JGoodies, JavaFX, Apache Pivot
28. Introduction To JFC And GUI Programming In Java
29. Introduction to wrapper classes
30. Why java uses Unicode System?

List of Practicals:

1. Implement Student class using following Concepts
   All types of Constructors
   Static variables and instance variables
   Static blocks and instance blocks
   Static methods and instance methods
2. There is a class Adder which has two data members of type 1D int array and int variable. It has two functions: getdata and numsum. Function getdata accepts non-empty array of distinct integers from user in 1D int array data member and a targetsum in another data member. The function numsum adds any two elements from an input array which is equal to targetsum and return an array of resulting two elements, in any order. If no two numbers sum up to the target sum, the function should return an empty array. Note that the target sum is to be obtained by summing two different integers in the array; you can't add a single integer to itself in order to obtain the target sum. You can assume that there will be at most one pair of numbers summing up to the target sum. Use constructor. Use extra variables if needed

   Input:
   Array=[3,5,-4,8,11,1,-1,7] targetsum=15
   Output: [8,7]
   Input:
   Array=[3,5,-4,8,11,1,-1,6] targetsum=15
   Output: []

3. Write Java program to calculate area of triangle, square & circle using function overloading. Function parameter accept from user (Use function Overloading concepts and Inheritance).
4. Write a program for following exception, develop a suitable scenario in which the following exceptions occur:
   a. divide by zero

b. Array index out of bounds exception
c. Null pointer Exception

5. Write a java program to solve producer-consumer problem where there are two producer threads and one consumer thread.
6. Implement various operations using JDBC Connectivity.
7. Display bank account information (Use interface and inheritance using java)
8. Develop a GUI in java which reads, update the file.

List of Home Assignments:

Blog:

1. Single and Multidimensional arrays in Java
2. Comparison Inheritance & Polymorphism
3. Need of abstract classes and interfaces in Java
4. Multithreading concept in Java
5. Signed & Unsigned arithmetic operations usin JAVA
6. Role of start() and run() methods in multithreading

Survey:

1. Strategies for Migration from C++ to Java
2. Product development using Inheritance and Polymorphism in Industry
3. on Java/OOP features popular amongst developers
4. Which other (non-JVM) languages does your application use?
5. How Java Impacted the Internet
6. How can a ArrayList be synchronised without using vector?

Design:

1. Implementation of Singleton design pattern in Java
2. Notes Repository System for Academic
3. Design for employee management system
4. Design for student management system
5. Inventory Management System
6. Write a program to delete duplicate numbers from the file

Case Study:

1. Java development milestones from 1.0 to 16.0
2. Implementation of Different Methods in Polymorphism
3. Real world systems which use java for its implementation
4. Drawing a flag using java
5. Use of different methods of Class object
6. Drawing a flag using java

Assessment Scheme:
Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Textbooks:

Herbert Schildt, "JAVA- The Complete Reference", , 11th Edition, McGraw Hill Education

Reference Books:

1. Bruce Eckel, "Thinking In Java – The Definitive Introduction to Object-Oriented Programming in the Language of the World-Wide Web", Fourth Edition, Pearson Education, Inc.
2. R. Morelli and R. Walde, "Java, java, Java – Object-Oriented Problem Solving", 3rd edition, Pearson Education, Inc.

Moocs Links and additional reading material:

Programming using Java| Java Tutorial | By Infosys Technology
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01304972186110361645_shared/overview

An Introduction to Programming through C++ – Prof A.G. Ranade- NPTEL- computer science and engineering – NOC https://nptel.ac.in/courses/106/101/106101208/#

Course Outcomes:

The student will be able to –
1. Understand object-oriented programming features
2. Develop real world applications using class, inheritance and polymorphism
3. Adapt Best Practices of Class Design by using Standard Templates Library
4. Solve computing problems by applying the knowledge of Exception handling and Multithreading
5. Design solutions by choosing suitable data structures such as Array, Vector, Map etc
6. Implement applications using Java I/O and event-based GUI handling principles

CO PO Map:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	3	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	2	0	0	0	0	0	0	0	0	0
4	0	0	0	1	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	2	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	2	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Future Courses Mapping:

1. Advanced Data Structures, Advanced Java, Spring Frame Work, Grails Frame Work

Job Mapping:

2. Java Programmer, Application Developer, Design Engineer, Senior Software Developer

FF No.: 654

ET2231: ENGINEERING DESIGN- I

Course Prerequisites: Basic Electronics, Physics, Engineering Mathematics, Statistics, Programming Languages

Course Objectives:

1. To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.
4. To engage students in rich and authentic learning experiences.
5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Credits: 1 **Teaching Scheme Lab:** 2 Hours/Week

Course Relevance:

Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. Students can be evaluated for higher order skills of Blooms taxanomy like 'analyze, design and apply'. This course is capable of imparting handson experience and self learning to the students which will help them throughout their career. This is a step ahead in line with national policy of Atmanirbhar Bharat.

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. This course is designed to encourage and ensure application of technology for solving real world problems using an interdisciplinary approach. Students need to plan their work in following steps

1) Formation of project group comprising of 4-5 students. Multidisciplinary groups are allowed
2) A supervisor/mentor teacher assigned to individual groups.
3) Carrying out literature survey

4) Finalization of problem statement
5) Planning the project execution
6) Execution of project and testing
7) Writing a report
8) Publication in the form of research paper / patent/ copyright as found suitable by supervisor/mentor

Teacher's Role in PCL :

- Teacher is not the source of solutions rather he will they act as the facilitator and mentor.
- To utilize the principles of problems solving, critical thinking and metacognitive skills of the students.
- To aware the group about time management.
- Commitment to devote the time to solve student's technical problems and interested in helping students to empower them better.

Student's Role in PCL:

- Students must have ability to initiate the task/idea .they should not be mere imitators.
- They must learn to think.
- Students working in PCL must be responsible for their own learning.
- Students must quickly learn how to manage their own learning, Instead of passively receiving instruction.
- Students in PCL are actively constructing their knowledge and understanding of the situation in groups.
- Students in PCL are expected to work in groups.
- They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Core Technology domains identified for E&TC Engg are as below. However this list can be extended as per the need of project and multidisciplinary approach

1) VLSI Design
2) Embedded Systems
3) Signal Processing
4) Communication
5) Machine learning

Moocs Links and additional reading material: www.nptelvideos.in

https://worldwide.espacenet.com/

Course Outcomes:

On completion of the course, learner will be able to–

1. Review the literature to formulate problem statement to solve real world problems
2. Apply knowledge of technology and modern tools to design solution considering sustainability and environmental issues.
3. Manage project ethically as team member/ lead.
4. Demonstrate effectively technical report/ research paper/ prototype/ patent

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	2	1	2	0	2	2	2
2	3	3	3	3	3	3	3	1	1	1	0	2	3	3
3	0	1	1	1	0	2	0	3	3	1	3	2	0	0
4	3	1	1	1	0	0	0	2	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 - 3
CO2 - 4
CO3 - 3
CO4 - 4

FF No.: 654

ET2232: SOFTWARE DESIGN – I

Course Prerequisites: Programming concepts, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are student centric.
4. To engage students in rich and authentic learning experiences.
5. To enhance programming skills of students

Credits: 1 **Teaching Scheme**
Lab: 2 Hours/Week

Course Relevance: Software project development comes under the category of project centric learning (PCL). Students can solve socially relevant problems in different domains using various software technologies. It is designed to give students the opportunity to develop knowledge and skills through engaging software projects set around challenges and problems they may face in the real world.

The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. For all courses of SD, laboratory course contents of "Software Design" are designed as a ladder to extend connectivity of software technology to solve real world problems using an interdisciplinary approach. Students need to plan their work in following steps

1) Software based project to be done by each student
2) A supervisor/mentor teacher assigned who will guide in design and execution of project
3) Carrying out literature survey
4) Finalization of problem statement

5) Planning the project execution
6) Execution of project and testing
7) Writing a report

Course Outcomes:

On completion of the course, learner will be able to–

1 Review the literature to formulate problem statement to solve real world problems
2. Apply knowledge of technology and modern tools to design solution considering sustainability issues
3. Manage project ethically and collaborate for acquiring skills
4. Demonstrate effectively project and technical report

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	2	1	2	0	2	2	2
2	3	3	3	3	3	3	3	1	1	1	0	2	3	3
3	0	1	1	1	0	2	0	3	3	1	3	2	0	0
4	3	1	1	1	0	0	0	2	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 -3
CO2 –4
CO3-3
CO4-4

Job Mapping:

Software Engineer, Software Developer, IT Engineer

FF No.: 654

ET2233: SOFTWARE DEVELOPMENT PROJECT-I

Course Prerequisites:

Programming concepts, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are student centric.
4. To engage students in rich and authentic learning experiences.
5. To enhance programming skills of students

Credits: 3 **Teaching Scheme Lab:** 3 Hours/Week

Course Relevance:

Software project development comes under the category of project centric learning (PCL). Students can solve socially relevant problems in different domains using various software technologies. It is designed to give students the opportunity to develop knowledge and skills through engaging software projects set around challenges and problems they may face in the real world.

The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.

SECTION-1

Preamble: The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. The course contents are designed as a ladder to extend connectivity of software technology to solve real world problems using an interdisciplinary approach. Students need to plan their work in following steps

1) Software based project to be done by each student
2) A supervisor/mentor teacher assigned who will guide in design and execution of project
3) Carrying out literature survey
4) Finalization of problem statement
5) Planning the project execution
6) Execution of project and testing
7) Writing a report

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

Course Outcomes:

1. Review the literature to formulate problem statement to solve real world problems.
2. Apply knowledge of technology and modern tools to design solution considering sustainability issues.
3. Manage project ethically and collaborate for acquiring skills.
4. Demonstrate effectively project and technical report.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1: - Level 3
CO2: - Level 4
CO3: - Level 3
CO4: - Level 4

Job Mapping:

Software Engineer, Software Developer, IT Engineer

FF No. : 654

ET2234: ENGINEERING DESIGN AND INNOVATIONS-III

Course Prerequisites:

Basic Electronics, Physics, Engineering Mathematics, Statistics, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are long-term, inter-disciplinary and student centric.
4. To engage students in rich and authentic learning experiences.
5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Credits: 4 **Teaching Scheme:** Lab 2 Hours/Week

Course Relevance:

Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. Students can be evaluated for higher order skills of Blooms taxonomy like ‘analyze, design and apply’. This course is capable of imparting hands on experience and self-learning to the students which will help them throughout their career. This is a step ahead in line with national policy of Atmanirbhar Bharat.

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3. Carrying out literature survey
4. Finalization of problem statement
5. Planning the project execution
6. Execution of project and testing
7. Writing a report
8. Publication in the form of research paper/patent/copyright as found suitable by supervisor/mentor

Teacher's Role in PCL:

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4. Commitment to devote the time to solve student's technical problems and interested in helping students to empower them better.

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6. Students in PCL are expected to work in groups.
7. They must develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

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1. VLSI Design
2. Embedded Systems
3. Signal Processing
4. Communication
5. Machine learning

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

MOOCs Links and additional reading material:

www.nptelvideos.in
https://worldwide.espacenet.com/

Course Outcomes:

1. Review the literature to formulate problem statement to solve real world problems.
2. Apply knowledge of technology and modern tools to design solution considering sustainability and environmental issues.
3. Manage project ethically as team member/ lead.
4. Demonstrate effectively technical report/ research paper/ prototype/patent.

CO PO Map

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1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels:

CO1: - Level 3
CO2: - Level 4
CO3: - Level 3
CO4: - Level 4

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus of

Second Year B.Tech.

Electronics & Telecommunication Engineering

"Pattern – B20"

Module - IV

FF No.: 654

ET2202: DATA STRUCTURES

Course Prerequisites:

C and C++ programming.

Course Objectives:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques.
3. To construct and implement various data structures and abstract data types including lists, stacks, queues, trees, and graphs.
4. To make understand about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.
5. To emphasize the importance of data structures in developing and implementing efficient algorithms.

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:

This is a basic Course for Computer Engineering and allied branches. This course has a high relevance in all domains of computer engineering such as in Industries, research etc. as a basic prerequisite course.

SECTION-1
Arrays, Stacks, Queues and Linked Lists. Arrays: Representation and application of Single and Multidimensional arrays, Time & Space Complexity Analysis. Sorting Techniques: Quick Sort, Heap sort with Analysis. Searching techniques: Linear Search, Binary search with Analysis. Linked Lists: Dynamic memory allocation, Singly Linked Lists, doubly linked Lists, Circular linked lists and generalized linked lists, Applications of Linked list. Stack: Stack representation and Implementation using arrays and Linked lists. Applications of stack in Recursion, Expression conversions and evaluations. Queues: Representation and implementation using array and Linked lists, Types of queue. Applications of Queues: Job Scheduling, Josephus problem etc.

SECTION-2

Trees, Graphs and Hashing.

Trees: - Basic terminology, representation using array and linked lists. Tree Traversals: Recursive and Non recursive, Operations on binary tree. Binary Search trees (BST).

Advanced Trees: Introduction, AVL tree, R-B tree, B tree and B+ tree.

Graphs: Terminology and representation using Adjacency Matrix and Adjacency Lists, Graph Traversals and Application: BFS and DFS, connected graph, Bipartite Graph, Detecting Cycle in graph. Minimum Spanning tree: Prims and Kruskal's Algorithm, Shortest Path Algorithms, Union Find.

Hashing: Hashing techniques, Hash table, Hash functions. Collision handling and Collision resolution techniques.

List of Tutorials:

1. Sorting Techniques: Insertion, Merge sort, Bubble, Shell Sort, Radix Sort.
2. Searching Techniques: Ternary Search, Fibonacci Search.
3. Problem solving using stack (Maze problem, Tower of Hanoi).
4. Expression conversion like infix to prefix and postfix and vice versa.
5. Priority Queues and Job Scheduling Algorithm.
6. Generalized Linked Lists.
7. Threaded Binary tree and Stack less Traversals using TBT.
8. B and B+ Tree.
9. Applications of Graph in Network problems.
10. Design of Hashing Functions and Collision Resolution techniques.
11. Cuckoo Hashing

List of Practical:

1. Assignment based on Sorting and Searching.
2. Assignment based on Stack Application (Expression conversion etc.)
3. Assignment based on Queue Application (Job scheduling, resources allocation etc.)
4. Assignment based on linked list.
5. Assignment based on BST operations (Create, Insert, Delete and Traversals)
6. Assignment based on various operations on Binary Tree (Mirror image, Height, Leaf node display, Level wise display etc.)
7. Assignment based on AVL and R-B tree.
8. Assignment based on DFS and BFS
9. Assignment based on MST using Prim's and Kruskals Algorithm.
10. Assignment based on Finding shortest path in given Graph.
11. Assignment based on Hashing.

List of Projects:

1. Finding Nearest Neighbors.
2. Calendar Application using File handling.
3. Path finder in Maze
4. Word Completion Using Tire.
5. Bloom Filters.
6. Different Management Systems.
7. Scheduling Applications and Simulation.
8. Shortest Path Applications. (Kirchhoff's Circuit, TSP with Scenario.)
9. Efficient Storage and Data Retrieval Systems.
10. Different Gaming Application.

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Textbooks:

1. E. Horwitz, S. Sahani, Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press.
2. Y. Langsam, M.J. Augenstein, A.M.Tenenbaum, "Data structures using C and C++", Pearson Education, Second Edition.
3. Narasimha karumanchi, "Data Structures and Algorithm Made Easy", Fifth Edition, CareerMonk publication.

Reference Books:

1. J. Tremblay, P. soresan, "An Introduction to data Structures with applications", TMHPublication, 2nd Edition.

MOOCs Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1. To interpret and diagnose the properties of data structures with their memory representations and time complexity Analysis.
2. To use linear data structures like stacks, queues with their applications.
3. To implement operations like searching, insertion, deletion, traversing mechanism etc. on various data structures with the help of dynamic storage representation.
4. To demonstrate the use of binary tree traversals and to perform various operations on Non-linear data structures.
5. To analyze the Graph data structure and to solve the applications of Graph data structures.
6. To design the appropriate data structure by applying various hashing Techniques.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	2	2	1	0	1	2	2	1	2	2	2
2	1	2	3	2	2	1	0	1	2	2	1	2	2	3
3	1	2	3	2	2	1	0	1	2	2	1	2	2	3
4	2	2	3	2	2	1	0	1	2	2	1	2	2	3
5	2	3	3	2	2	1	0	1	2	2	1	2	2	3
6	2	2	3	2	2	1	0	1	2	2	1	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1: - Level 1
CO2: - Level 2
CO3: - Level 3
CO4: - Level 5
CO5: - Level 4
CO6: - Level 3

Future Courses Mapping:

Following courses can be learned after successful completion of this course: Advanced Data Structures, Design and Analysis of Algorithms, Operating Systems, Compiler Design, Embedded system, Systems Programming, Data Science, Artificial Intelligence and similar courses.

Job Mapping:

Data Structures and Algorithm is must necessary part of any programming job. Without Data structures it is not possible to be good in Competitive coding. All Industries always looks for a strong knowledge in Data structures. Without learning this course, one can't imagine a job in computer/IT related industries and research.

FF No.: 654

ET2230: COMPUTER ARCHITECTURE AND OPERATING SYSTEMS

Course Prerequisites:

Basics of computer system, data structures and programming languages

Course Objectives:

1. To illustrate the structure, function, characteristics, and performance parameters of a computer system.
2. To explore several computer architectures.
3. To discuss memory organization in computer system
4. To understand the basic concepts and functions of the operating system.
5. To gain knowledge of process synchronization, its mechanism and CPU scheduling
6. To get familiar with deadlock and memory management techniques as a function of the operating system.

Credits:5. **Teaching Scheme** Theory: 3 Hours/Week

Tut: 01 Hours/Week

Lab: 02 Hours/Week

Course Relevance:

This course focuses on CISC and RISC computer architecture. The Operating System acts as a platform for information exchange between your computer's hardware and the applications running on it. A computer software/hardware architect is deeply involved in the development and design of new software or hardware.

SECTION-1

Introduction: Evolution of Computer Systems, Basic Operation of a Computer, Memory Addressing and Languages, Software and Architecture Types
CISC: Architecture of 8086, Instruction types, instruction format, instruction cycle, Addressing Modes, Assembly Language Programming of 8086.
RISC: Architecture, Instruction set, Pipelining, Programming and Application
Measuring CPU performance: Choice of benchmarks, summarizing performance results, Amdahl's law.
Control Unit: Single Bus CPU organization, register transfers, performing an arithmetic/ logic operation, fetching a word from memory, storing a word in memory, Execution of a complete instruction. Micro-operations, Hardwired Control, Micro-programmed Control: Microinstructions
Memory System: Need of memory system, Hierarchical memory system, Characteristics, Size, Access time, read cycle time and address space, Processor memory interaction, Static and Dynamic ram, Memory interfacing and addressing, Memory hierarchy design, Cache memory: Cache size vs block size, Mapping functions

SECTION-2

Overview of Operating System: What is OS?, Interaction of OS and hardware, Goals of OS, Basic functions of OS, OS Services, System Calls, Types of system calls, Types of OS: Batch, Multiprogramming, Time sharing, Parallel, Distributed & Real-time OS

Process management: Process Concept, Process States: 2, 5, 7 state models, Process Description, Process Control, Multithreading models, Thread implementations – user level and kernel level threads, Concurrency: Issues with concurrency, Principles of Concurrency, Mutual Exclusion: OS/Programming Language Support: Semaphores, Mutex , Classical Process Synchronization problems, Uniprocessor Scheduling, Scheduling Algorithms: FCFS, SJF, RR, Priority.

Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Deadlock Recovery, Memory Management: Requirements, Memory Partitioning, Fragmentation, Placement Strategies: First Fit, Best Fit, Next Fit and Worst Fit, Paging, Segmentation, Address Translation, Virtual Memory, VM with Paging, Page Table Structure, Translation Lookaside Buffer, Page Size, VM with Segmentation, Page Replacement Policies: FIFO, LRU, Optimal.

List of Tutorials:

1. Instructions encoding.
2. Performance parameter (Amdahl's law)
3. Performance through pipelining.
4. Control Unit: Micro-operation and Micro-instruction.
5. Cache mapping functions.
6. Draw the Gantt charts and compute the finish time, turnaround time and waiting time for the following algorithms: a) First come First serve b) Shortest Job First (Preemptive and Non preemptive), c) Priority (Preemptive and Non preemptive) d) Round robin
7. Check whether the given system is in a safe state or not using Banker's Deadlock Avoidance algorithm.
8. Check whether the given system is in a deadlock state or not using the Deadlock Detection algorithm.
9. Using the following placement algorithm, check whether memory can be allocated to a given process or not. a) First fit b) Best fit c) Worst fit d) Next fit
10. Calculate the number of page faults for a reference string for the following page replacement algorithms: a) FIFO b) LRU c) Optimal

List of Practicals:

1. Write an ALP to perform arithmetic operations.
2. Write an ALP using an array.
3. Write an ALP using stack memory.
4. RISC Programming
5. Execution of Basic and Advanced Linux commands
6. Write a shell script program.
7. Write a program demonstrating the use of different system calls.
8. Implementation of Classical problems using Threads and Mutex/Semaphore.
9. Write a program to compute the finish time, turnaround time, and waiting time for the following algorithms: a) First come First serve b) Shortest Job First (Preemptive and Non-preemptive) c) Priority (Preemptive and Non-preemptivee) d) Round robin
10. Write a program to check whether given system is in a safe state or not using Banker's Deadlock Avoidance algorithm
11. Write a program for following placement algorithm check whether memory can be allocated to given process or not by using following methods: a) First fit b) Best fit c) Worst fit d) Next fit
12. Write a program to calculate the number of page faults for a reference string for the following page replacement algorithms: a) FIFO b) LRU c) Optimal

List of Projects:

1. Linux based application using Shell Scripting
2. Design and implementation of a Multiprogramming Operating System: Stage I
   i. CPU/ Machine Simulation, ii. Supervisor Call through interrupt.
3. Design and implementation of a Multiprogramming Operating System: Stage II
   i. Paging, ii. Error Handling, iii. Interrupt Generation and Servicing,
   iv. Process Data Structure.
4. Design and implementation of a Multiprogramming Operating System: Stage III
   i. Multiprogramming, ii. Virtual Memory, iii. Process Scheduling and Synchronization
   iv. Inter-Process Communication, v. I/O Handling, Spooling and Buffering.
5. Design and implementation of a Multiprogramming Operating System for arithmetic and logical operations: Stage III
   i. CPU/ Machine Simulation, ii. Supervisor Call through interrupt.
6. Porting of Linux on Embedded Platform and basic I/O programming.
7. Comparison of various processors using simulators.
8. RTOS Programming.
9. Designing of CPU.
10. Linux kernel programming.
11. Parallel Computing using CUDA.

List of Seminar Topics:

1. Pentium Processor - a complete architecture
2. Microprogram sequencing
3. Improvement of Performance Measurement of Processor: Memory Banking
4. GPU Architecture
5. Micro-Programmed Control Unit used in Recent Computer.
6. Parallel Computers
7. I/O processors
8. Effect of clock on CPU performance
9. Edge computing
10. In-Memory Computing
11. Computer Architectures for vision system
12. RISC -V architecture
13. Cyber Physical Systems
14. Cyber System Debugging
15. Neuromorphic computing
16. Quantum Computing
17. The Challenges of Building Inferencing Chips
18. Hardware accelerator in computer architecture

List of Discussion Topics:

1. OS Structures
2. System call Vs API
3. Classical process synchronization problems
4. Process Vs Threads
5. Inter-process Communication (IPC)
6. Real Time Scheduling
7. Disk Scheduling
8. Best OS for smartphones-Android, iOS, windows, blackberry
9. Shared and Distributed Memory microprocessor
10. Flynn's Taxonomy
11. Booting Process of different Operating Systems.

List of Home Assignments:

Design:

1. Report Generation using Shell Script and AWK system
2. Library Management System using Shell
3. Inter Process Communication in Linux
4. Design any real time application using job scheduling
5. Design any application using Android
6. DRAM design
7. Embedded System design
8. Real Time System design.

Case Study:

1. Intel I3
2. Intel I7
3. Microsoft Windows 10
4. Linux
5. Android
6. Raspberry PI
7. NVIDIA core
8. Supercomputer architecture

Blog Topics:

1. ARM Vs Intel
2. Protection and Security of OS
3. Comparative study of different mobile OS
4. Operating Systems for IoT Devices
5. Performance Measurement of CPU: Pipelining

6.ARM Microcontroller versions
7.Operating System Forensics
8. IOT Architecture

Surveys Topics:

1. Computer System Memory Management and Optimization Techniques
2. Multiprocessor organization
3. A Survey of Mobile OS
4. Analysis and Comparison of CPU Scheduling Algorithms
5. Malware Analysis, Tools and Techniques
6. Laptop Operating Systems
7. Desktop Operating Systems
8. Pipelining hazards
9. Elements of modern computers

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Text Books:

1. William Stallings; "Computer Organization and Architecture: Designing for Performance", 7th Edition, Pearson Prentice Hall Publication; ISBN 81-7758-9 93-8.
2. C. Hamacher, V. Zvonko, S. Zaky, "Computer Organization", 5th Edition, Tata McGraw Hill Publication, ISBN 007-120411-3.
3. Douglas Hall, "Microprocessors and Interfacing", 2nd Edition, Tata McGraw Hill Publications, ISBN 0-07-025742-6.
4. Stalling William, "Operating Systems", 6th Edition, Pearson Education, ISBN: 0-13-031999-6.
5. Silberschatz A., Galvin P., Gagne G., "Operating System Concepts", 9th Edition, John Wiley and Sons.
6. John L. Hennessy, David A. Patterson, "Computer Architecture-A Quantitative Approach", 5th edition, Elsevier Publication
7. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's guide Designing and optimizing system software", Elsevier Publication.

Reference Books:

1. Hwang and Briggs; "Computer Architecture and Parallel Processing"; Tata McGraw Hill Publication; ISBN 13: 9780070315563.
2. A. Tanenbaum; "Structured Computer Organization"; Prentice Hall Publication; ISBN 81 - 1553-7.
3. Silberschatz A., Galvin P., Gagne G; "Operating System Principles"; 7th Edition, John Wiley andSons.
4. Yashavant Kanetkar; "Unix Shell Programming"; 2nd Edition, BPB Publications
5. Sumitabha Das; "Unix Concepts and Applications"; 4th Edition, TMH.
6. Forouzan B. A., Gilberg R. F.; "Unix and Shell Programming"; 1st Edition, Australia Thomson Brooks Cole.

MOOCs Links and additional reading material:

1. https://nptel.ac.in/courses/106/102/106102062/
2. http s://nptel.ac.in/courses/106/108/106108101/
3. https://www.udemy.com/
4. https://www.coursera.org/
5. https://swayam.gov.in/

Course Outcomes:

1. Illustrate the structure, function, characteristics and performance parameters of a computer system such as benchmarks, Amdahl's law, price and power.
2. Explore the knowledge of Computer Architectures such CISC and RISC.
3. Discuss static, dynamic and cache memory in computer system.
4. Understand the functions of a contemporary Operating system with respect to convenience, efficiency, and the ability to evolve.
5. Apply various CPU scheduling algorithms and process synchronization mechanisms.
6. Identify the mechanisms to deal with Deadlock and primary memory management.

CO PO Map:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	0	2	0	1	0	1	2	0	2	0	3
2	3	2	3	0	2	3	1	0	1	2	0	2	2	0
3	2	3	0	3	2	3	0	3	1	2	0	2	3	3
4	2	0	0	0	3	2	2	2	2	2	2	2	2	0
5	3	3	3	3	3	1	2	2	2	1	2	2	0	3
6	3	3	3	3	3	1	2	3	2	1	2	2	3	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels:

CO1: - Level 2
CO2: - Level 3
CO3: - Level 2
CO4: - Level 2
CO5: - Level 3
CO6: - Level 4

Future Courses Mapping:

Advance Computer Architecture, Advance Operating System, Unix Operating System, Linux programming, Distributed System/Computing, High Performance Computing, Embedded Systems, System Programming, Compiler Design.

Job Mapping:

Linux Administration, Kernel Developers, Application Developers, System programmer, Computer Architects, Cyber Security analyst, System administrator.

FF No. : 654

ET2204: COMMUNICATION ENGINEERING

Course Prerequisites:

Basic knowledge of Engineering Mathematics (Fourier Series, Fourier Transform, Probability distributions) and Basic Electronics.

Course Objectives:

1. Understand communication channels and noise types.
2. Perform spectral analysis of AM and FM signals.
3. Brief about Radio transmitters and receivers.
4. Apply sampling concepts to solve easy as well as difficult problems.
5. Deduce the performance parameters of digital modulation techniques.
6. Understand analog and digital communication systems.

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:

Communication engineering concerned with the sending and receiving of signals especially by means of electrical or electroacoustic devices and electromagnetic waves. Today, communications are the largest sector of the electronics field with the most employees and the largest equipment sales annually. In addition, wireless, networking, or other communication technologies are now contained in almost every electronic product. This makes a knowledge and understanding of communication a must rather an option for every student. Rapid development in electronic communication systems is changing the face of human civilization, especially due to the convergence of wireless voice/data communications and Internet technologies. Analog and digital communication is a core subject of Electronics and Communication Engineering.

SECTION - 1

Introduction To Communication System: Analog & Digital Communication System Overview, Types of Electronic Communication, Communication Channels, The Electromagnetic & Optical Spectrum and its usage, Classification of noise, Noise in Cascaded Stages.

Analog Modulation Techniques: Need of modulation, Mathematical treatment for an AM and FM signal, Spectral Analysis, Modulation Index, Efficiency, Power calculations, DSB-SC and SSB-SC, FM generators, pre-emphasis and de-emphasis in FM signal.

Analog Receivers: TRF Receiver, Super Heterodyne Receiver (AM & FM), Intermediate Frequency and Image Frequency, Diode detector, DSB-SC and SSB-SC, FM Detectors, Performance characteristics of radio receiver.

SECTION - 2

Sampling and Waveform Coding: Sampling, ideal sampling, Flat top & Natural Sampling, Aliasing, Pulse amplitude modulation, Quantization, Pulse code modulation & reconstruction, Compounded PCM, Delta modulation, Time division multiplexing, Line Coding, ISI and eye diagram.

Digital Modulation Techniques: Digital modulation techniques - Amplitude Shift Keying, Binary Phase Shift Keying, Quadrature Phase Shift Keying, M-ary PSK, Binary Frequency Shift Keying, Quadrature amplitude modulation, Minimum shift keying.

Detection and Performance analysis of digital signal: Baseband signal receiver, Derivation for Error prob of integrate & dump Filter, Optimum Filter, white noise matched filter, probability error of matched filter, correlation.

List of Tutorials:

1. Noise
2. Amplitude Modulation
3. Frequency Modulation
4. Superheterodyne AM Receiver
5. Super heterodyne FM Receiver
6. Sampling
7. Pulse Code Modulation, Delta Modulation
8. ASK and FSK
9. PSK and QPSK
10. Integrate & dump filter, Matched Filter
11. Review of Fourier Series
12. Review of Fourier Transform
13. Review of Probability Distributions (Normal and Uniform)
14. Review of Amplifiers, Filters and Oscillators

List of Practicals:

1.Spectral analysis of time-domain signal using Digital Storage Oscilloscope (DSO).
2. Double side band full carrier (DSBFC) modulation and demodulation
3. Double sideband suppressed carrier (DSBSC) modulation and demodulation
4. Single sideband suppressed carrier (SSBSC) modulation and demodulation
5. Frequency modulator (FM).
6. Pulse Amplitude modulation (PAM).
7. Pulse Code modulation (PCM).
8. Delta modulation (DM).
9. Binary phase shift keying (BPSK).
10. Frequency shift keying (FSK).

List of Projects:

1. 1.Simple AM Transmitter
2. Double Side Band –Suppressed Carrier modulator and demodulator
3. Pre-emphasis and De-emphasis for FM
4. Anti-Aliasing filter
5. Transistor/IC based Amplitude modulator
6. PLL IC 565 based FM demodulation
7. Discrete PAM signal
8. Analog to Digital Conversion
9. BPSK modulator
10. Digital to Analog Conversion
11. FM generator using IC 8038
12. AM generator using IC 2206

List of Seminar Topics:

1. Wave propagation
2. Electromagnetic spectrum and its usage
3. Types of communication channel
4. Superheterodyne AM Receiver
5. Superheterodyne FM Receiver
6. Pulse Code Modulation
7. Line Encoding
8. SI and Eye diagram
9. Digital modulation techniques
10. Detection of Digital signal.

List of Group Discussion Topics:

1. Impact of new media on Radio broadcast
2. Time domain analysis versus Frequency domain analysis
3. Sideband techniques
4. Amplitude modulation versus Frequency modulation
5. AM Receiver versus FM Receiver
6. Digital communication versus analog communication
7. Natural Sampling versus Flat top sampling
8. Pulse modulation techniques (PAM, PWM, PPM)
9. SI and Eye diagram
10. M-ary PSK and M-ary FSK

List of Home Assignments:

Design:

1. Amplitude modulator using transistor
2. Frequency modulator using PLL
3. Band pass filter for FM
4. Design of Audio amplifier
5. Design of Oscillator

Case Study:

1. HAM Radio ("The Utilization of Amateur Radios In Disaster Management")
2. Space Communication
3. Software Defined Radio
4. Tuned circuits and resonance
5. Filters (RC and LC)

Blog Topics:

1. Radio Receiver performance characteristics
2. Antennas for AM/FM Radio
3. Electromagnetic spectrum and its usage
4. Sampling
5. Digital modulation techniques

Surveys:

1. Multiplexing Technique (Telephone Exchange)
2. Pune Akashwani Studio
3. AM Radio Transmitter
4. FM Radio Transmitter
5. Digital Satellite Radio.

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Text Books:

1. Louis E Frenzel, "Principles of Electronic Communication Systems", Tata McGraw Hill Publications, Third Edition.
2. Kennedy & Davis, "Electronic Communication", Tata McGraw Hill Publications.
3. Taub Schilling, "Principles of Communication Systems", Tata McGraw Hill Fourth Edition.

Reference Books:

1. Dennis Roddy & Coolen, "Electronic Communication", Tata McGraw Hill Publications.
2. Wayne Tomasi, "Electronic Communication Systems", Fourth Edition.
3. Simon Haykin, "Digital Communications", Wiley Publications, Fourth Edition.
4. Carlson, "Communication Systems", McGrawHill, Fourth Edition.
5. Simon Haykin, "Analog & Digital Communications", Wiley Publications.
6. B. Sklar, "Digital Communication", Pearson, Second Edition.

MOOCs Links and additional reading material:

http://wwww.mhhe.com/signal/adc
www.mhhe.com/frenzel/ees3e
https://nptel.ac.in/courses/117/105/117105143/

Course Outcomes:

1. Differentiate communication channels and noise sources.
2. Analyze amplitude and frequency modulated signal and their spectrum.
3. Illustrate working of analog receivers.
4. Discuss sampling and waveform coding techniques.
5. Evaluate modulation techniques with respect to bandwidth, Euclidean distance.
6. Evaluate performance of optimum filter.

CO PO Map:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	0	1	1	1	1	1	1	1	1	2	2
2	3	1	1	0	1	2	1	1	1	1	1	1	2	2
3	2	1	1	0	1	2	1	1	1	1	1	1	2	2
4	2	2	1	1	1	2	1	1	1	1	1	1	2	2
5	3	2	1	0	1	2	1	1	1	1	1	1	2	2
6	3	2	1	0	1	2	1	1	1	1	1	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels:

CO1: - Level 2
CO2: - Level 3
CO3: - Level 3
CO4: - Level 4
CO5: - Level 4
CO6: - Level 5

Future Courses Mapping:

Courses that can be taken after completion of this course: Advances in Digital Communication, Wireless Communication, Mobile Communication, Antenna and Microwave Techniques, Audio and video processing, Data communication and networking.

Job Mapping:

The two major types of technical positions available in the communication field are Engineer and Technicians. Engineers design communication equipment and system engineers work from specifications and create new equipment or systems which are then manufactured. Some engineers specialize in design, other work in manufacturing, testing, quality control and management. Engineers may serve as field service personnel, installing and maintaining complex equipment and systems. There are many outstanding jobs in technical sales, technical writer and as a trainer. Four major segments of industry are manufacturing, resellers, service organization and end users. The major categories in the communication field are Telephone companies, Radio users (Mobile, Marine, Aircraft etc), Radio and TV broadcast stations and Cable TV companies, Business and industries of satellite, networks etc, Transportation companies (Airline, Shipping, Railroads), Government and Military.

FF No. : 654

ET2237: SOFTWARE DEVELOPMENT PROJECT-II

Course Prerequisites:

Programming concepts, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are student centric.
4. To engage students in rich and authentic learning experiences.
5. To enhance programming skills of students

Credits: 3 **Teaching Scheme Lab:** 6 Hours/Week

Course Relevance:

Software project development comes under the category of project centric learning (PCL). Students can solve socially relevant problems in different domains using various software technologies. It is designed to give students the opportunity to develop knowledge and skills through engaging software projects set around challenges and problems they may face in the real world.

The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.

SECTION-1

Preamble: The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. The course contents are designed as a ladder to extend connectivity of software technology to solve real world problems using an interdisciplinary approach. Students need to plan their work in following steps

1) Software based project to be done by each student
2) A supervisor/mentor teacher assigned who will guide in design and execution of project
3) Carrying out literature survey
4) Finalization of problem statement
5) Planning the project execution
6) Execution of project and testing
7) Writing a report

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

Course Outcomes:

5. Review the literature to formulate problem statement to solve real world problems.
6. Apply knowledge of technology and modern tools to design solution considering sustainability issues.
7. Manage project ethically and collaborate for acquiring skills.
8. Demonstrate effectively project and technical report.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1: - Level 3
CO2: - Level 4
CO3: - Level 3
CO4: - Level 4

Job Mapping:

Software Engineer, Software Developer, IT Engineer

FF No. : 654

ET2236: ENGINEERING DESIGN AND INNOVATIONS-IV

Course Prerequisites:

Basic Electronics, Physics, Engineering Mathematics, Statistics, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are long-term, inter-disciplinary and student centric.
4. To engage students in rich and authentic learning experiences.
5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Credits: 4 **Teaching Scheme:** Lab 8 Hours/Week

Course Relevance:

Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. Students can be evaluated for higher order skills of Blooms taxonomy like ‘analyze, design and apply’. This course is capable of imparting hands on experience and self-learning to the students which will help them throughout their career. This is a step ahead in line with national policy of Atmanirbhar Bharat.

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. This course is designed to encourage and ensure application of technology for solving real world problems using an interdisciplinary approach.

Students need to plan their work in following steps:

1. Formation of project group comprising of 4-5 students. Multidisciplinary groups are allowed
2. A supervisor/mentor teacher assigned to individual groups.
3. Carrying out literature survey
4. Finalization of problem statement
5. Planning the project execution
6. Execution of project and testing
7. Writing a report
8. Publication in the form of research paper/patent/copyright as found suitable by supervisor/mentor

Teacher's Role in PCL:

1. Teacher is not the source of solutions rather he will they act as the facilitator and mentor.
2. To utilize the principles of problems solving, critical thinking and metacognitive skills of the students.
3. To aware the group about time management.
4. Commitment to devote the time to solve student's technical problems and interested in helping students to empower them better.

Student's Role in PCL:

1. Students must have ability to initiate the task/idea they should not be mere imitators.
2. They must learn to think.
3. Students working in PCL must be responsible for their own learning.
4. Students must quickly learn how to manage their own learning, Instead of passively receiving instruction.
5. Students in PCL are actively constructing their knowledge and understanding of the situation in groups.
6. Students in PCL are expected to work in groups.
7. They must develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Core Technology domains identified for E&TC Engg are as below. However, this list can be extended as per the need of project and multidisciplinary approach

1. VLSI Design
2. Embedded Systems
3. Signal Processing
4. Communication
5. Machine learning

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

MOOCs Links and additional reading material:

www.nptelvideos.in
https://worldwide.espacenet.com/

Course Outcomes:

1. Review the literature to formulate problem statement to solve real world problems.
2. Apply knowledge of technology and modern tools to design solution considering sustainability and environmental issues.
3. Manage project ethically as team member/ lead.
4. Demonstrate effectively technical report/ research paper/ prototype/patent.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels:

CO1: - Level 3
CO2: - Level 4
CO3: - Level 3
CO4: - Level 4

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus of

Third Year B.Tech.

Electronics & Telecommunication Engineering

"Pattern – C20"

Module – V & VI

FF No. : 654

ET3202: DIGITAL SIGNAL PROCESSING

Course Prerequisites:

Previous exposure to algebra and complex numbers, concepts from linear system theory for continuous-time signals, including Laplace and Fourier transforms is required.

Course Objectives:

1. To develop a thorough understanding of the digital signal processing systems and its advantages compared to analog signal processing systems
2. Use z-transform and discrete Fourier transform to analyze digital systems
3. Apply DFT-FFT algorithm to perform spectral analysis of discrete time signals
4. Provide an understanding of different methods to design digital filters
5. To develop an ability to apply the DSP concepts to a wide range of real-world signal processing applications

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:

DSP is the heart of the digital revolution that brought us CDs, DVDs, MP3 players, mobile phones and countless other devices which has enabled unprecedented levels of interpersonal communication and of on-demand entertainment. The inherent flexibility of digital elements permits the utilization of a variety of sophisticated signal processing techniques which had previously been impractical to implement. A thorough understanding of digital signal processing fundamentals and techniques is essential for anyone whose work is concerned with signal processing applications. Digital Signal Processing begins with a discussion of the sampling process, analysis and representation of discrete-time signals and systems, discrete-time convolution and different transforms like Z-transform, DFT, FFT, to analyse DT signals and systems. Digital Signal Processing concludes with digital filter design techniques and their efficient realizations. An integral part of the course is MATLAB based computer assignments and course projects, which are designed to reinforce theoretical concepts.

SECTION-1

Elements of DSP, Z-Transform, Relation between Laplace Transform and Z-Transform, Properties of Z-transform, relation between pole location and time domain behaviour, causality and stability considerations for LTI systems, Unilateral Z-transform, Inverse Z-transform, Discrete Fourier Transform (DFT), DFT properties, Circular convolution, relation between circular convolution and linear convolution, linear filtering using Overlap algorithms, FFT Algorithm, DIT and DIF algorithms, Goertzel Algorithm.

SECTION-2

Design of IIR filters from analog filters, Impulse invariance method, Bilinear transformation method, comparison between Impulse invariance and bilinear transformation methods, Realization of IIR filters using Direct Form -I, Direct Form-II, cascade, parallel structures, Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different windowing functions, FIR filter realization using direct form and using symmetry property, FIR Lattice structure.

List of Tutorials:

1. Verification of sampling theorem, conversion of continuous time (CT) signals into discrete time (DT) signals and recovery of CT signals.
2. Compute Z transform and inverse Z transform of DT signals
3. Analysis of LTI systems using pole-zero plot
4. Compute DFT and IDFT using direct computation and matrix method
5. Compute DFT and IDFT using FFT algorithm
6. Find, visualize, and analyze spectrum of a DT signal
7. Design IIR filters using Impulse invariance method
8. Design IIR filters using BLT method
9. Design of FIR filters using windowing method
10. Realization of digital filters.

List of Practical's:

1. Analysis of Discrete time LTI system using Z-Transform
2. Implement an algorithm to perform linear convolution of two sequences using DFT
3. Perform circular convolution between two sequences
4. To perform spectral analysis of the signal using Discrete Fourier Transform (DFT

5. To filter the long data sequence using overlap add/save algorithm
6. Design Butterworth filter (IIR) using bilinear transformation method and plot its frequency response
7. Implement different window functions and observe the effect of different windows on FIR filter response
8. To design and apply the IIR digital filter to recover the clean speech signal from the noisy signal
9. Design and apply moving average and difference filters on the audio signals
10. Design and apply a suitable digital filter to clean noisy ECG signal.

List of Projects:

1. ECG Signal Analysis.
2. Speech Enhancement using Spectral Subtraction Method
3. Musical Instrument Identification
4. Audio Equalizer
5. Speech Recognition
6. DTMF Encoder and Decoder
7. Correcting the geometrical orientation of text in an image using discrete Fourier transform
8. Real time filtering using overlap-save or overlap-add method
9. Audio Effects Generation
10. Voice Activity Detector
11. Vibration signal analysis using signal processing techniques
12. Design of 2D filters suitable for the given vision application

List of Course Seminar Topics:

1. Use of DSP in Telephony applications
2. DSP in motor control
3. DSP in Biomedical applications – ECG, EEG MRI etc.
4. DSP in Seismology
5. DSP in speech processing
6. DSP in video signal processing
7. DSP in audio signal processing
8. DSP in communication systems
9. Issues in using DSP in Real Time applications
10. Audio Codec.

List of Course Group Discussion Topics:

1. Analog filters Vs Digital filters --- Design (typical cases) and analysis
2. Analog filters Vs Digital filters --- Implementation issues
3. IIR filters Vs. FIR filters -- Design (typical cases) and analysis
4. IIR filters Vs. FIR filters -- Implementation
5. Hardware Vs. Software implementation of Digital filters
6. Implementation of Digital filters on Microcontrollers, dedicated DSP Processors and FPGAs
7. Comparison of different windows in design of FIR filter
8. LTI System analysis using DFT and Z transform
9. Spectral analysis of stationary and non-stationary signals
10. Real time and non-real time processing of DT signals
11. Fixed-point and floating-point digital signal processors

List of Home Assignments:

Design:

1. Design and develop a high-quality surround sound system and implement in MATLAB Simulink
2. Real Time Filtering of audio signals in MATLAB
3. Design of Adaptive noise cancellation system
4. Design of digital Dolby system
5. Design and implement LPC vocoder

Case Study:

1. FFT spectrum analyzer
2. ECG/EEG monitoring system
3. Audio compression (mp3)
4. Adaptive echo cancellation systems
5. Speech coding and decoding

Blog:

1. Audio codec
2. Comb Filter implementation
3. Power spectral density estimation
4. Text-to speech synthesizer
5. Radar signal processing

Surveys:

1. Selection of digital signal processor based on the application
2. Signal processing in military applications

3. Underwater signal processing
4. Hearing aids and background noise
5. Voice assistant systems (e.g. Alexa, Siri)

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Textbooks:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing-Principles algorithms and applications," PHI, 1997
2. E.C. Ifeachor and B.W. jervice, "Digital signal processing – A practical approach," Pearson, Edu, 2nd edition, 2002
3. S.K.Mitra, "Digital Signal Processing- A Computer Based approach," Tata McGraw Hill, 1998

Reference Books:

1. Ramesh babu, "Digital Signal processing," Scitech publications, 2001
2. Shalivahan, Vallavraj, Gnyanapriya C. , "Digital Signal processing," TMH, 2001
3. Li Tan, Jean Jiang, "Digital Signal Processing: Fundamentals and applications," Academic press

MOOC's Links and additional reading material:

1. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
2. https://swayam.gov.in/nd1_noc19_ee50/preview
3. http://www.ws.binghamton.edu/fowler/fowler%20personal%20page/EE521.htm
4. http://vlabs.iitkgp.ernet.in/dsp/
5. https://ocw.tudelft.nl/courses/digital-signal-processing/subjects/3-ofdm/

Course Outcomes:

The student will be able to –

1. Analyze LTI systems using Z-transform
2. Apply DFT to find frequency response of a system.
3. Analyze spectrum of discrete time signals
4. Design IIR filter of given specification from Analog filter
5. Design linear phase FIR filter of given specification
6. Develop IIR, FIR and Lattice filter structures

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	0	0	2	0	0	0	0	0	0	0	0	0
2	3	3	0	0	0	0	0	0	2	0	0	0	3	0
3	3	3	0	0	2	0	0	0	0	0	1	2	0	0
4	3	3	3	0	3	3	0	0	2	1	1	0	3	3
5	3	3	3	0	3	3	0	0	2	1	1	0	3	3
6	3	0	3	0	3	3	0	0	2	1	1	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 - Level 2
CO2 - Level 2
CO3 - Level 3
CO4 - Level 4
CO5 - Level 4
CO6 - Level 5

Future Courses Mapping:

1. Advanced Digital Signal Processing
2. Adaptive Signal Processing
3. Speech Processing
4. Digital Image Processing
5. Audio and video data compression
6. Pattern recognition
7. Digital communication systems

Job Mapping:

Unlike in most fields of study, in digital signal processing, future jobs are not defined by or restricted to a single professional area. Signal processing – the enabling technology for the generation, transformation, extraction and interpretation of information via electronic signals – is essential for our smartphones and wearable devices, as well as the latest health care technologies, digital cameras and our digital assistants like Amazon Echo and Google Home etc.

Some of the core digital signal processing industries are:

Cadence Design Systems India Pvt, Ltd.
Qualcomm India Pvt. Ltd.
Mathworks India Pvt. Ltd.
Nvidia Corporation
TataElxsi

FF No.: 654

ET3201: EMBEDDED SYSTEM DESIGN

Course Prerequisites:

Microprocessor & Microcontroller concepts and applications, Assembly language concepts, C programming, Computer architecture and operating system

Course Objectives:

1. Learn designing and programming Embedded Systems for real time applications.
2. Set up and operate Raspberry Pi with different interfaces
3. Develop embedded software using RTOS and implement small programs to solve well-defined problems on an embedded platform.

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:

SECTION-1
ARM Processor : Architecture of ARM7 , operating modes, Exception Handling,ARM and thumb instruction set. **LPC2148 Microcontroller** : Features , Block diagram , GPIO, Interrupts, Timers, PLL, ADC/DAC,PWM, RTC interfacing and programming , Protocols such as UART, CAN, I2C & SPI Implementation. C
SECTION-2
Raspberry PI : Introduction to Raspberry Pi, setting up Raspberry Pi, Interfacing & Programming Raspberry Pi using Python **RTOS** :Introduction to Real Time Operating systems, Characteristics, Critical section of code, race condition , Shared resource, multitasking, Task scheduling, Context switching , Intertask Communication, Mutual Exclusion, Semaphores , preemptive and non-preemptive kernel, Priority Inversion, Deadlock, memory management, ISR, Timer. µCOS II OS: Kernel structure, services Design & Development of RTOS applications using LPC 2148.

List of Tutorials:

1. ARM nomenclature and Comparative study of different versions of ARM
2. LPC2148 GPIO
3. LPC2148 Timers and ADC
4. LPC 2148 Interrupts
5. LPC 2148 DAC
6. LPC2148 UART
7. LPC 2148 I2C /SPI protocols
8. Study of various embedded hardware development platforms
9. STudy of different Embedded OS
10. uCOS III RTOS task scheduling /multitasking.

List of Practicals:

1. LPC2148 interface with LED and & 7 segment Display
2. LPC2148 interface with 16 X 2 LCD
3. LPC2148 interface with Matrix Keyboard.
4. LPC2148 interface with temperature sensor and relay.
5. LPC2148 interface with DC Motor
6. Setting up Raspberry Pi
7. GPIO programming with Raspberry pi
8. Task Scheduling for Input and Output Devices using µCOS- II Semaphore
9. Implementation of Message Queue for 3 Tasks on µCOS- II.
10. Implementation of Message Mailbox for 3 Tasks on µCOS- II.

List of Projects:

1. Rolling Display
2. Automatic sanitizer dispenser and water tap
3. Automatic door opener and closure along with display of total count of people gone into the shop/bank.
4. Queue regulation in shop/bank at safe social distance.
5. Image operated bill generating machines at Govt. Ration shops.
6. Mobile app for grocery/vegetable shopkeeper and customer.
7. Home automation.
8. Non touching Electric switches for home/offices/shops
9. Greenhouse farming
10. AC /stepper motor speed control.

List of Course Seminar Topics:

1. Speeding up power estimation of embedded software
2. Battery model for embedded system
3. Integrating security policies with embedded real time systems

4. Real time dynamic voltage scaling for embedded systems
5. Scratchpad memory: A design alternative for cache on chip memory in embedded systems
6. AUTOSAR architecture in Automobiles
7. Performance issues of embedded systems
8. Lin protocol in automobile
9. GPU
10. Reconfigurable processor.

List of Course Group Discussion Topics:

1. Serial interface vs parallel interface
2. Various types of semiconductor memories used in microcontrollers.
3. Wired Vs. wireless interface
4. .Industrial communication protocols
5. Microcontroller Vs. FPGA/ASIC
6. OS scheduling algorithms
7. RTLinux Vs uCOS III RTOS
8. uCOS III Vs FreeRTOS
9. CAN Vs MODBUS Protocol
10. Microcontroller based system's Real time testing vs Simulation based testing.

List of Home Assignments:

Design:

1. Incremetal Phase shifter design
2. Prevention system from Locust attack
3. Battery management system in electric vehicle
4. Implementation of CAN protocol
5. Health monitoring system

Case Study:

1. Software development life cycle models
2. ECU in automobiles
3. Aerospace / Aircraft monitor and control
4. Electric vehicles and microcontroller application
5. Assessment of Malware for embedded Architectures

Blog:

1. Protection and Security of RTOS
2. Modern embedded system programming: Beyond RTOS

3. Role of RTOS in autonomous cars
4. Embedded system: A carrier option

Surveys:

1. Securing wireless data: design challenges
2. Multicore processors architecture
3. RTOS and GPOS
4. Flexray protocol

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Text Books:

1. Sloss Andrew , "ARM system Developer's Guide", Elsevier Publication
2. Dr. K.V.K.K. PrasSad , " Embedded / Real Time Systems Programming" Black Book, Dreamtech Press,
3. Jean J. Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books.

Reference Books:

1. Embedded System Design, CMP Books, Arnold S. Berger
2. Software introduction" 3rd edition, Wiley, Frank Vahid and Tony Givargis.
3. LPC 2148 Datasheet
4. LPC 2148 reference manual

MOOC's Links and additional reading material:

https://swayam.gov.in/nd1_noc20_cs15
https://nptel.ac.in/courses/106/105/106105193/
https://nptel.ac.in/courses/106/105/106105166/

Course Outcomes:

The student will be able to

1. Elaborate Classic ARM processor architecture
2. Design and analyse various peripheral device interfaces with LPC2148 Microcontroller.
3. Compare various communication protocols used in embedded systems
4. Describe Raspberry Pi system.
5. Design and analyse various peripheral device interface with Raspberry Pi
6. Apply uCOS II RTOS in real time application.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	0	0	1	0	0	1	1	2	2	3	2	0	0
2	2	3	3	1	3	3	2	2	3	3	3	3	0	3
3	1	0	3	1	3	0	1	2	3	3	3	3	3	0
4	1	0	3	1	3	3	1	2	3	2	3	2	3	0
5	2	3	0	1	3	3	2	2	3	3	3	3	0	3
6	2	3	0	1	3	3	2	2	3	3	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1: Level 1
CO2: Level 3
CO3: Level 2
CO4: Level 2
CO5: Level 4
CO6: Level 4

Future Courses Mapping:

Automotive Electronics, Embedded networking

Job Mapping:

System software engineer, Embedded software engineer, System expert, Chip design engineer. Application software engineer in various sectors like automotive, consumer electronics, medical, aviation etc.

FF No.: 654

ET3209: INTERNET OF THINGS

Course Prerequisites:

Students should have a basic knowledge of Communication and Basic Electronics.

Course Objectives:

The student will be able to

1. Understand IoT Architecture and framework.
2. Analyze multiple types of sensors and their principle of operation.
3. Learn about fundamental concepts of networking and protocols.
4. Understand IoT Physical and Data link layer Protocols.
5. Explore Higher layer IoT Protocols.
6. Apply theoretical knowledge for Cloud computing.

Credits: 5

Teaching Scheme Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:

Internet of Things is a system of interrelated computing and sensing devices and has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT is highly relevant in this growing ecosystem of internet-enabled devices. IoT offers increasing opportunities to collect, exchange, analyze and interpret data in real-time. This robust access to data will result in opportunities to further enhance and improve operations.

SECTION-1
Introduction to Internet of Things: Definitions and Frameworks, IoT Architecture: topologies, client-server architecture, P2P, M2M, IoT functional blocks, Characteristics of IoT, Physical and Logical design of IoT, Different hardware platforms for IoT, Challenges in IoT. Sensors: Working Principle, Selection of sensors for Practical Applications, Introduction to different types of Sensors such as Displacement, Force, Pressure, Position, Proximity,

Motion, Force, Pressure, Temperature, Light sensors etc., Signal Conditioning, Interfacing, Smart Sensors.

Introduction to Networking: Network Architecture, layered architecture, functions of each layer, Communication Protocols, TCP/IP protocol, IoT Communication model

SECTION-2

IoT Data Link Layer and Network Layer protocols: IoT Data Link Layer Protocols-IEEE 802.11, IEEE 802.15, Wireless HART, ZWave, Bluetooth Low Energy, Zigbee & IoT Network Layer Protocols-IPv4, IPv6, 6LoWPAN

IoT Transport & Session Layer Protocols: Transport Layer protocols-TCP, UDP, SCTP,TLS, DTLS, IoT Session Layer protocols- HTTP, CoAP, MQTT

IoT Cloud Platforms, Cloud Computing, Web Services, Sensor-Cloud, Fog Computing, Mist Computing.

List of Tutorials:

1. Sensor selection for IoT Applications
2. Smart sensors
3. Intelligent Sensors
4. Signal Conditioning
5. Network Models
6. IPv4/IPv6
7. Smart Water Irrigation System
8. Traffic Management
9. Garbage Monitoring
10. Street Light Monitoring
11. Bluetooth
12. Cloud Computing

List of Practicals:

1. Setting up the Raspberry Pi
2. LED Interfacing
3. Temperature measurement using DHT11
4. Temperature measurement using LM35
5. Distance measurement using Ultrasonic sensor

6. Traffic Signal Control

7. Intrusion Detection using IR transmitter-receiver
8. Raspberry Pi as a web server
9. Transferring sensor data to web pages
10. Email alert using SMTP protocol
11. Twitter alert using HTTP protocol
12. Text transfer using MQTT protocol

List of Projects:

1. Smart Home
2. Mobility and Transport
3. Energy Usage Monitoring
4. Smart Grid
5. Air Quality Monitoring
6. Anti-Lost Device
7. Smart Clock
8. Smart Parking System
9. Weather Station
10. Motion Capture Security System
11. Home Automation System
12. Health Monitoring System

List of Course Seminar Topics:

1. IoT Architecture
2. Sensor Characteristics
3. IoT for supply chain management and inventory systems
4. IoT Ethics
5. Security in IoT
6. Cloud Computing Platform
7. IoT Best Practices
8. 5G in IoT
9. Middleware Technology
10. M2M energy efficiency routing protocol
11. IoT based Biometric Implementation
12. Complete IoT solution using AWS

List of Course Group Discussion Topics:

1. Smart Sensors
2. Intelligent Sensors
3. Signal Conditioning
4. Characteristics of IoT
5. LowPAN
6. Z-Wave
7. Bluetooth
8. Wireless HART
9. Constrained Application Protocol
10. Cloud Platforms
11. Fog Computing
12. Web Services.

List of Home Assignments:

Design:

1. Smart City
2. Smart Transportation
3. Smart Healthcare
4. Smart Industry using IoT
5. Design of IoT framework

Case Study:

1. Open Source in IoT
2. IoT solutions for automobile
3. Cloud Computing
4. AWS
5. Microsoft Azure

Blog:

1. Network Selection for IoT
2. Need of secure protocols
3. Future of IoT
4. IIoT
5. IoT and Industry 4.0

Surveys:

1. Autonomous Vehicles

2. List of Indian companies which offer IoT solutions for agriculture and farming. Describe the problem they are addressing and their solution.
3. Make a list of Indian companies which offer IoT solutions for healthcare. Describe the problem they are addressing and their solution.
4. Make an exhaustive list of everything inside, just outside (immediate surroundings) and on the auto body which must be "observed" for safe and comfortable driving using autonomous vehicles.
5. Compare different Cloud Service providers in the market.

An assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Textbooks:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", (CRC Press)
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", (Universities Press)

Reference Books:

1. Ovidiu Vermesan & Peter Friess "Internet of Things Applications - From Research and Innovation to Market Deployment", ISBN:987-87-93102-94-1, River PublishersJo
2. Biron and Jonathan Follett, "Foundational Elements of an IoT Solution," by Joe Biron.

MOOC's Links and additional reading material:

1. www.nptelvideos.in
2. https://nptel.ac.in/courses/108/108/108108123/
3. https://nptel.ac.in/courses/106/105/106105167/

Course Outcomes: The student will be able to

1. Demonstrate fundamental concepts of Internet of Things
2. Select sensors for different IoT applications
3. Analyze fundamentals of networking

4. Apply basic protocols in IoT
5. Understand higher layer Protocols in IoT
6. Interface sensor data to cloud platforms

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	0	0	0	1	1	1	1	1	1	1	2	2
2	3	1	0	0	0	1	1	1	1	1	1	1	2	2
3	2	2	0	0	0	2	1	1	1	1	1	1	2	2
4	2	2	0	0	0	2	1	1	1	1	1	1	2	2
5	3	2	0	0	0	2	1	1	1	1	1	1	2	2
6	3	2	0	0	0	2	1	1	1	1	1	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO 1: level 2
CO 2: level 3
CO 3: level 3
CO 4: level 4
CO 5: level 4
CO 6: level 5

Future Courses Mapping:

Other courses that can be taken after completion of this course

Ad-Hoc Networks

Job Mapping:

The Internet of Things (IoT) is the most emerging field in today's world. It is revolutionizing every industry, from home appliances to agriculture to space exploration. Since the advent of cloud computing, there has been an exponential growth in the number of sensor-enabled devices connected to the internet and expecting further growth accelerating in the coming years. There are diversified career opportunities in this field. The various career positions available as IoT Research Developer, IoT Design Engineer, IoT Product Manager, IoT Software Developer, IoT Solution Architect, IoT Service Manager and many more.

FF No.: 654

ET3242: ENGINEERING DESIGN- I

Course Prerequisites: Basic Electronics, Physics, Engineering Mathematics, Statistics, Programming Languages

Course Objectives:

1. To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.
4. To engage students in rich and authentic learning experiences.
5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Credits: 1 **Teaching Scheme Lab:** 2 Hours/Week

Course Relevance:

Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. Students can be evaluated for higher order skills of Blooms taxanomy like 'analyze, design and apply'. This course is capable of imparting handson experience and self learning to the students which will help them throughout their career. This is a step ahead in line with national policy of Atmanirbhar Bharat.

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. This course is designed to encourage and ensure application of technology for solving real world problems using an interdisciplinary approach. Students need to plan their work in following steps

1) Formation of project group comprising of 4-5 students. Multidisciplinary groups are allowed
2) A supervisor/mentor teacher assigned to individual groups.
3) Carrying out literature survey

4) Finalization of problem statement
5) Planning the project execution
6) Execution of project and testing
7) Writing a report
8) Publication in the form of research paper / patent/ copyright as found suitable by supervisor/mentor

Teacher's Role in PCL :

- Teacher is not the source of solutions rather he will they act as the facilitator and mentor.
- To utilize the principles of problems solving, critical thinking and metacognitive skills of the students.
- To aware the group about time management.
- Commitment to devote the time to solve student's technical problems and interested in helping students to empower them better.

Student's Role in PCL:

- Students must have ability to initiate the task/idea .they should not be mere imitators.
- They must learn to think.
- Students working in PCL must be responsible for their own learning.
- Students must quickly learn how to manage their own learning, Instead of passively receiving instruction.
- Students in PCL are actively constructing their knowledge and understanding of the situation in groups.
- Students in PCL are expected to work in groups.
- They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Core Technology domains identified for E&TC Engg are as below. However this list can be extended as per the need of project and multidisciplinary approach

1) VLSI Design
2) Embedded Systems
3) Signal Processing
4) Communication
5) Machine learning

Moocs Links and additional reading material: www.nptelvideos.in

https://worldwide.espacenet.com/

Course Outcomes:

On completion of the course, learner will be able to–

1. Review the literature to formulate problem statement to solve real world problems
2. Apply knowledge of technology and modern tools to design solution considering sustainability and environmental issues.
3. Manage project ethically as team member/ lead.
4. Demonstrate effectively technical report/ research paper/ prototype/ patent

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO:1	3	3	2	3	1	0	0	2	1	2	0	2	2	2
CO:2	3	3	3	3	3	3	3	1	1	1	0	2	3	3
CO:3	0	1	1	1	0	2	0	3	3	1	3	2	0	0
CO:4	3	1	1	1	0	0	0	2	1	3	3	2	1	0

CO attainment levels

CO1 -3
CO2 4
CO3-3
CO4-4

FF No. : 654

ET3221: SOFTWARE DESIGN – I

Course Prerequisites: Programming concepts, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are student centric.
4. To engage students in rich and authentic learning experiences.
5. To enhance programming skills of students

Credits: 1

Teaching Scheme
Lab: 2 Hours/Week

Course Relevance: Software project development comes under the category of project centric learning (PCL). Students can solve socially relevant problems in different domains using various software technologies. It is designed to give students the opportunity to develop knowledge and skills through engaging software projects set around challenges and problems they may face in the real world.

The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. For all courses of SD, laboratory course contents of "Software Design" are designed as a ladder to extend connectivity of software technology to solve real world problems using an interdisciplinary approach. Students need to plan their work in following steps

1) Software based project to be done by each student
2) A supervisor/mentor teacher assigned who will guide in design and execution of project
3) Carrying out literature survey
4) Finalization of problem statement

5) Planning the project execution
6) Execution of project and testing
7) Writing a report

Course Outcomes:

On completion of the course, learner will be able to–

1 Review the literature to formulate problem statement to solve real world problems
2. Apply knowledge of technology and modern tools to design solution considering sustainability issues
3. Manage project ethically and collaborate for acquiring skills
4. Demonstrate effectively project and technical report

CO PO Map

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO:1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
CO:2	3	0	3	0	3	3	3	0	0	0	0	3	0	0
CO:3	0	0	0	0	0	0	0	3	3		3	3	0	0
CO:4	0	0	0	0	0	0	0		0	3	00	3	0	0

CO attainment levels

CO1 -3
CO2 –4
CO3-3
CO4-4

Job Mapping:

Software Engineer, Software Developer, IT Engineer

FF No. : 654

ET3237: SOFTWARE DEVELOPMENT PROJECT-I

Course Prerequisites:

Programming concepts, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are student centric.
4. To engage students in rich and authentic learning experiences.
5. To enhance programming skills of students

Credits: 3 **Teaching Scheme Lab: 6** Hours/Week

Course Relevance:

Software project development comes under the category of project centric learning (PCL). Students can solve socially relevant problems in different domains using various software technologies. It is designed to give students the opportunity to develop knowledge and skills through engaging software projects set around challenges and problems they may face in the real world.

The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.

SECTION-1

Preamble: The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. The course contents are designed as a ladder to extend connectivity of software technology to solve real world problems using an interdisciplinary approach. Students need to plan their work in following steps

1) Software based project to be done by each student
2) A supervisor/mentor teacher assigned who will guide in design and execution of project
3) Carrying out literature survey
4) Finalization of problem statement
5) Planning the project execution
6) Execution of project and testing
7) Writing a report

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

Course Outcomes:

1. Review the literature to formulate problem statement to solve real world problems.
2. Apply knowledge of technology and modern tools to design solution considering sustainability issues.
3. Manage project ethically and collaborate for acquiring skills.
4. Demonstrate effectively project and technical report.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1: - Level 3
CO2: - Level 4
CO3: - Level 3
CO4: - Level 4

Job Mapping:

Software Engineer, Software Developer, IT Engineer

FF No.: 654

ET3238: ENGINEERING DESIGN AND INNOVATIONS-III

Course Prerequisites:

Basic Electronics, Physics, Engineering Mathematics, Statistics, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are long-term, inter-disciplinary and student centric.
4. To engage students in rich and authentic learning experiences.
5. To provide every student the opportunity to get involved either individually or as a group to develop team skills and learn professionalism.

Credits: 4 **Teaching Scheme:** Lab 2 Hours/Week

Course Relevance:

Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. Students can be evaluated for higher order skills of Blooms taxonomy like ‘analyze, design and apply’. This course is capable of imparting hands on experience and self-learning to the students which will help them throughout their career. This is a step ahead in line with national policy of Atmanirbhar Bharat.

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. This course is designed to encourage and ensure application of technology for solving real world problems using an interdisciplinary approach.

Students need to plan their work in following steps:

1. Formation of project group comprising of 4-5 students. Multidisciplinary groups are allowed
2. A supervisor/mentor teacher assigned to individual groups.
3. Carrying out literature survey
4. Finalization of problem statement
5. Planning the project execution
6. Execution of project and testing
7. Writing a report
8. Publication in the form of research paper/patent/copyright as found suitable by supervisor/mentor

Teacher's Role in PCL:

1. Teacher is not the source of solutions rather he will they act as the facilitator and mentor.
2. To utilize the principles of problems solving, critical thinking and metacognitive skills of the students.
3. To aware the group about time management.
4. Commitment to devote the time to solve student's technical problems and interested in helping students to empower them better.

Student's Role in PCL:

1. Students must have ability to initiate the task/idea they should not be mere imitators.
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5. Students in PCL are actively constructing their knowledge and understanding of the situation in groups.
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Core Technology domains identified for E&TC Engg are as below. However, this list can be extended as per the need of project and multidisciplinary approach

1) VLSI Design
2) Embedded Systems
3) Signal Processing
4) Communication
5) Machine learning

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

MOOCs Links and additional reading material:

www.nptelvideos.in
https://worldwide.espacenet.com/

Course Outcomes:

1. Review the literature to formulate problem statement to solve real world problems.
2. Apply knowledge of technology and modern tools to design solution considering sustainability and environmental issues.
3. Manage project ethically as team member/ lead.
4. Demonstrate effectively technical report/ research paper/ prototype/patent.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels:

CO1: - Level 3
CO2: - Level 4
CO3: - Level 3
CO4: - Level 4

FF No.: 654

ET3221: COMPUTER VISION

Course Prerequisites:

1. Linear Algebra
2. Python / C Programming
3. Basics of Digital Electronics

Course Objectives:

1. Learn Fundamentals of Digital Image Processing
2. Understand Features, their Selection and Extraction
3. Implement Object Detection
4. Implement Object Recognition
5. Implement Object Classification

Credits:5 **Teaching Scheme** Theory: 3. Hours/Week
Tut: 1 Hour/Week
Lab: 2 Hours/Week

Course Relevance:
Computer vision is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to understand and automate tasks that the human visual system can do.

SECTION-1
Fundamentals of Image Formation, Human Vision System, Computer Vision System, Geometric Transformation, Fourier Transform, Discrete Fourier Transform, Convolution and Filtering, Image Enhancement, Histogram Processing, Image Registration, Image Restoration. Image Segmentation: Edge Based approaches to segmentation, Gradient using Masks, Laplacian of

Gaussian, Canny, Edge Linking, Line detectors (Hough Transform), Corners – Harris, Region Growing, Region Splitting.

SECTION-2

Feature Detectors and Descriptors: Features from Accelerated Segment Test, Oriented Fast and Rotated Brief, Scale Invariant Feature Transform, Haar-Cascade, Local Binary Pattern, Local Directional Pattern, Feature Matching and Feature Tracking. Supervised and Unsupervised Machine Learning for Image Classification: Support Vector Machine, K-Nearest Neighbours, Principal Component Analysis, K-Means. Camera Geometry Fundamentals, Camera Calibration, Epipolar Geometry, Stereo Vision: Distortion, Rectification, Point-Correspondence, Triangulation.

List of Tutorials:

1. Introduction to OpenCV and Setting up Python Programming Environment for Computer Vision
2. Essentials of Linear Algebra Part-I (Matrix Theory) for Computer Vision
3. Essentials of Linear Algebra Part-II (Vector Spaces) for Computer Vision
4. Configuration of Raspberry Pi-4B for Computer Vision
5. Essentials of Raspbian Operating System
6. Configuration of Jetson Nano for Computer Vision
7. Essentials of Ubuntu Operating System
8. Camera Calibration
9. Mathematics of Support Vector Machine
10. Mathematics of K-Means Classification.

List of Practicals:

1. Image Manipulations and Geometrical Transformations
2. Image Filtering and Enhancement
3. Detection of Lines, Edges and Corners
4. Camera Calibration
5. Image Registration
6. Feature Detection and Description by using FAST, ORB
7. Feature Detection and Description by using SIFT, SURF
8. Feature Detection and Description by using LBP, LDP
9. Implementation of Object Tracking
10. Object Classification by using SVM and K-Means

List of Projects:

1. Counting of Objects
2. Object Locator.
3. Barcode Detection
4. Traffic Sign Recognition
5. Motion Detection and Tracking
6. Detection of Potholes
7. Face Recognition
8. Detection of Dents on a Car
9. Detection of Type of Roads (Tar, Cement, and Mud)
10. Detection of Roadside Vegetation, Trees, etc.
11. Detection of Littering / Garbage on the Road
12. Detection of Stray Animals on the Road
13. Detection of Road Intersection (Crossings)
14. Vehicle License Plate Recognition at Security Checkpoints

List of Course Seminar Topics:

1. Bioinspired Stereo Vision Calibration for Dynamic Vision Sensors
2. Low-Power Computer Vision: Status, Challenges, and Opportunities
3. Subpixel Computer Vision Detection based on Wavelet Transform
4. Automatic Counting and Individual Size and Mass Estimation of Olive-Fruits Through Computer Vision Techniques
5. Person Recognition in Personal Photo Collection
6. Measuring Gait Variables Using Computer Vision to Access Mobility and Fall Risk in Older Adults with Dementia
7. Wearable Vision Assistance System based on Binocular Sensors for Visually Impaired Users

8. Edge Detection Algorithm for Musca-Domestica Inspired Vision System
9. Automated Vision Based High Intraocular Pressure Detection using Frontal Eye Images
10. Detection of Possible Illicit Messages using Natural Language Processing and Computer
11. Vision on Twitter and LinkedIn Websites

List of Course Group Discussion Topics:

1. Human Visual System and Computer Vision System
2. Spatial Domain Filtering and Frequency Domain Filtering
3. Features from Accelerated Segment Test Features from Accelerated Segment Test and
4. Oriented Fast and Rotated Brief
5. Local Binary Pattern and Local Directional Pattern
6. K-Nearest Neighbors and K-Means
7. Monocular Vision and Stereo Vision
8. Image Enhancement and Image Restoration
9. Raspberry Pi-4B and Jetson Nano
10. Essential Matrix and Fundamental Matrix
11. Camera Calibration.

List of Home Assignments:

Design:

1. Depth Calculation based on Monocular Vision
2. Depth Calculation based on Stereo Vision
3. Automatic Attendance monitoring system
4. Detection of Traffic Signals
5. Pose Estimation

Case Study:

1 Detection of Roadside Infrastructure (Lampposts, Pavement Blocks, Seating Arrangements, Roadside Line Markers, Manholes, Barricades, etc.
2. Vehicle License Plate Recognition at Security Checkpoints
3. Detection of Dents on a Car
4. Detection of Type of Roads (Tar, Cement, and Mud)
5. Hand-Gesture Recognition

Blog

Computer Vision for:

1. Mobility of Visually Impaired People
2. Avoiding Accidents
3. Obstacle Detection and Avoidance

4. Patient Monitoring
5. Fall detection

Survey:

Computer Vision for

1. Differently Abled People
2. Computer Vision for Kids Care
3. Computer Vision Electric Vehicles
4. Computer Vision for Women Safety
5. Computer Vision for Teaching-Learning Process at Academic Institutes

Assessment Scheme:

1. Seminar (PPT) – 15 marks
2. Group Discussion – 15 marks
3. Home Assignment – 10 marks
4. Course Viva – 20 marks
5. Lab – 10 marks
6. Course Project- 10 marks
7. MSE – 10 marks
8. ESE – 10 marks

Text Books:

1. Gonzalez, Woods, “Digital Image Processing”, Prentice Hall India, 2nd edition.
2. Pratt W.K., “Image Processing”, John Wiley, 2001
3. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Publication.
4. Forsyth and Ponce, “Computer Vision-A Modern Approach”, 2nd Edition, Pearson Education.
5. R. O. Duda, P.E.Hart, and D.G.Stork,”, Pattern Classification”, 2nd edition, Springer, 2007.
6. Theodoridis and Koutrombas,” Pattern Recognition”, 4th edition, Academic Press, 2009

Reference Books:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, Thomson Learning.
2. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison-Wesley, 1993.
3. Ludmila I.Kuncheva,”Combining pattern classifiers”, John Wiley and sons Publication.
4. Ethem Alpaydin,” Introduction to Machine Learning”, The MIT press.

MOOC’s Links and additional reading material:

https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs58/

Course Outcomes:

1. Perform Image Enhancement Operations
2. Apply Segmentation Techniques to Divide Image into Parts
3. Develop Feature Vectors for Object Detection Purpose
4. Select Algorithm for Object Recognition
5. Classify Image / Signal / Data/ by using Supervised / Unsupervised Classifier
6. Discuss Epipolar Geometry and Stereo Vision for Depth Calculation.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	1	3	1	0	3	3	3	2	2	1	1
2	3	3	3	1	3	1	0	3	3	3	2	2	1	1
3	3	3	3	3	3	2	0	3	3	3	2	2	3	3
4	3	1	3	1	3	3	0	3	3	3	2	2	3	3
5	3	3	3	3	3	2	1	3	3	3	2	2	3	3
6	3	2	1	3	2	1	1	3	3	3	2	2	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 : Level 3
CO2 : Level 4
CO3 : Level 4
CO4 : Level 5
CO5 : Level 5
CO6 : Level 4

Future Courses Mapping:

1. Pattern Recognition
2. Deep Learning

Job Mapping:

1. Embedded Engineer
2. Computer Vision Specialist
3. Data Engineer
4. Machine Learning Engineer
5. Data Scientist
6. Engineer-Autonomous Vehicle
7. Research Engineer

FF No.: 654

ET3206: DIGITAL DESIGN

Course Prerequisites:

Semiconductor devices: FET, MOS operation, biasing techniques. MOS as inverter.
Digital Electronics: Logic Gates, Boolean Algebra, Truth table, K-maps, Combinational Circuits, Sequential Circuits, State Diagrams.

Course Objectives:

Student will be able to

1. Understand the effect of power and frequency of operation of MOS on overall performance.
2. Compare performance of digital logic families
3. Optimizing pipelines for speed, area, power and resources
4. Understanding parallelism of hardware and advantage over sequential processors
5. Design optimized digital circuits in HDL Verilog
6. Generate self-checking test bench for given functionality

Credits: 5 **Teaching Scheme** Theory: 3 Hours/Week
Tut: 1 Hours/Week
Lab: 2 Hours/Week

Course Relevance:

This course emphasizes on the deep understanding of the operation of a transistor. The understanding of the transistor is necessary to model and innovate future process technologies. The basic circuit understanding is essential for achieving the best PPA (Power, performance and area) metrics. A transistor level understanding of the circuits is regularly used for circuit analysis, design and debug in standard cell, methodology development, process technology, memory design, analog design, digital design, physical design teams in the industry. Often, high performance designs need hand instantiation of logic gates to meet the timing at the high clock speeds. For example: CPU, Memory controller cores, PHY designs are high performance cores being clocked at greater than 2-4GHz. The second section of the course emphasizes on the language constructs and a method of implementation of complex logic and functionalities in the SoCs. The language is a powerful tool for keeping the designs technology independent and hence increasing reusability across technology nodes and across designs.

SECTION-1

MOS Inverter: Digital vs Analog vs Discrete vs Continuous, MOS as Switch, Concept of Gate Threshold voltage, MOS structure and working, Types of MOS : Enhancement , Depletion, NMOS , PMOS, Capacitors in MOS, IV Characteristics, Equations, Channel length modulation, its effect on current.

Importance of scaling, dimensions for scaling, types of scaling. Effect on threshold, current, power, delay due to - Constant voltage scaling. Effect on threshold, current, power, delay due to - Constant Field scaling. Comparison of constant voltage and constant field scaling. Short channel and narrow channel effects, DIBL, supporting Equations. Drain punch through, Hot carrier effect, Surface states and interface trapped charge.

CMOS Combinational Circuits: Ratioed logic, Need of of PUN and PDN for digital circuits, Design issues of RL in ratioed logic, TPLH vs Power dissipation, CMOS Logic, PUN PDN for CMOS. Inverter and basic logic gates using CMOS, Weak 1 and Strong 0 using NMOS, Weak 0 and Strong 1 using PMOS in CMOS inverter, DCVSL Working, Pass Transistor logic, Level restorer, Transmission Gate logic, Dynamic Logic Design , Speed and power dissipation in dynamic logic, Signal Integrity issues in Dynamic Design, Domino Logic & Optimization of Domino

CMOS Sequential Circuits - Overview of working, Multiplexer based latch, Mux based FF, NMOS only pass transistor logic - FF circuit, Clock overlap issues. C2MOS Logic Working and immunity to clock overlap. TSPC Working. Pipelining - Approach to optimize sequential circuits, Latch vs Register pipeline, NORA CMOS.

SECTION-2

Configurable Hardware: Design options for digital systems, Standard Chips, PLDs, FPGAs and ASICs. VLSI design flow. Role of hardware description languages, motivation. Concurrency in hardware.

Introduction to Verilog HDL: Levels of Design Description, Concurrency, Simulation and Synthesis, Function Verification, Module, System Tasks, Simulation and Synthesis. Verilog Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators. Gate level modelling and Data flow modelling.

Behavioral modeling : Procedural constructs- initial & always block, procedural assignments – blocking and nonblocking statements, difference in blocking and nonblocking statements, active region, inactive region, event scheduling under stratified event queue, event scheduling

in Verilog, delay timing control, selection statements- if-else, case, iterative statements- while, for, repeat, forever loop. Task, function, system tasks and functions, file I/O system task

List of Tutorials:

1. Moores Law, Technology nodes in VLSI Fabrication
2. VLSI Fabrication process
3. FINFET technology
4. Power Delay optimization
5. Simulation of combinational and sequential circuits in SPICE
6. Simulation Verification & Synthesis
7. Protocol implementation using Verilog
8. High Level Synthesis
9. Filter implementation in HDL
10. Self checking test bench.

List of Practicals:

1. Operation point analysis, DC Analysis and AC analysis of RC network using SPICE.
2. DC analysis of nMOS, pMOS and CMOS Inverter for varying threshold voltage and W/L ratio using SPICE.
3. Transient analysis and Voltage Transfer Characteristics of CMOS inverter using SPICE.
4. CMOS Inverter Layout, Pulse and dc sweep characteristics using Layout editor.
5. CMOS Logic Gate, Pulse and dc sweep characteristics using SPICE
6. CMOS ratioed logic analysis for varying loads using SPICE.
7. Transient analysis of CMOS based 2:4 Decoder
8. Transient analysis of CMOS based 3:2 priority encoder
9. Simulation of Combinational Circuit using Verilog
10. Simulation of Sequential Circuits using Verilog.

List of Projects:

1. To simulate I2C protocol in Verilog HDL
2. To simulate SPI protocol in Verilog HDL
3. To simulate RAM in Verilog HDL
4. To simulate FIFO in Verilog HDL
5. To simulate encryption standard in Verilog HDL
6. To simulate UART in Verilog HDL
7. To simulate CPU in Verilog HDL
8. To simulate electronic voting machine in Verilog HDL
9. To simulate traffic light controller in Verilog HDL
10. To implement filter in Verilog HDL

List of Course Seminar Topics:

1. Moores Law, Technology nodes in VLSI Fabrication
2. VLSI Fabrication process
3. FINFET technology
4. Power Delay optimization
5. Simulation of combinational and sequential circuits in SPICE
6. Simulation Verification & Synthesis
7. Protocol implementation using Verilog
8. High Level Synthesis
9. Filter implementation in HDL
10. Self checking test bench.

List of Course Group Discussion Topics:

1. Emerging Technology for CMOS replacement
2. Comparison of VLSI Fabrication techniques & representation schemes
3. High Level Synthesis vs Verilog which one describes hardware better
4. Bicmos Technology, Combining BJT & MOS, comparison with CMOS, Fabrication flow, Companies using that technology.
5. Different Types of Fabrication Techniques, SOI/ CMOS/ FINFET technologies, Stick diagram representation, Lambda rules, area calculation
6. Semiconductor memories - RAMBUS, SDRAM, DDR RAM etc., DDR Standards, DDR IC manufacturers,
7. Synchronizer techniques for multiblock domain SOCs, Clock domain crossing, MUX synchronizer, FIFO, Handshake
8. Timing issues in datapath design, Clock Skew positive vs negative skew, Metastability
9. Instruction Pipelining, MIPS pipelined data path, Basic 5 stage pipeline, Multicycle pipeline, performance improvement and hazards etc.
10. Fermi energy band diagrams, Band diagram representing NMOS and PMOS accumulation, depletion, inversion stages.

List of Home Assignments:

Design:

1. Design & Verify packet processor
2. Design AMBA Bus protocol
3. Design of AXB Bus
4. CPU Design
5. Microprocessor design

Case Study:

1. Design & Verify packet processor
2. Design AMBA Bus protocol

Blog : Blog based on course project based reading

1. Memory Technologies
2. Owning a Fab vs Staying Fabless
3. Security Risks in SoCs and Systems
4. Open Source in Semiconductor Industry
5. Moore's Law; Thermal Challenges

Surveys

1. VLSI supply chain security risks and mitigation techniques
2. VLSI Architectures for Image Interpolation
3. Optimal solution for VLSI circuit partitioning in physical design
4. Verilog HDL simulator technology
5. Parallel Multi-core Verilog HDL Simulation
6. Historical Survey of Functional Hardware Languages
7. Survey of High-Level Synthesis Systems
8. Defect tolerance in VLSI circuits: techniques and yield analysis
9. Synchronizer techniques for multi-clock domain SoCs
10. Impact of FSM Design for High-Performance Architecture Evaluation.

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Textbooks:

1. Kang, Sung-Mo, and Yusuf Leblebici. CMOS digital integrated circuits. Tata McGraw -Hill Education, 2003.
2. Rabaey, Jan M., Anantha P. Chandrakasan, and Borivoje Nikolić. Digital integrated circuits: a design perspective. Vol. 7. Upper Saddle River, NJ: Pearson Education, 2003.
3. Palnitkar, Samir. Verilog HDL: a guide to digital design and synthesis. Vol. 1. Prentice Hall Professional, 2003.

4. Link to e-books http://www.stem-edu.com/wp-content/uploads/2017/02/Rabaey-Digital-Integrated-Circuits-Asign-Perspective-2Nd-Edition.pdf

Reference Books:

1. Weste, Neil HE, and David Harris. CMOS VLSI design: a circuits and systems perspective. Pearson Education India, 2015.
2. Ciletti, Michael D. Advanced digital design with the Verilog HDL. Vol. 1. Upper Saddle River: Prentice Hall, 2003.

Moocs Links and additional reading material:

www.nptelvideos.in
https://nptel.ac.in/courses/108/106/108106158/ IIT Madras
https://nptel.ac.in/courses/106/105/106105165/ Dr. Indranil Sengupta

Course Outcomes:

Student will be able to

1. Determine MOSFET behavior under dimension scaling
2. Compare performance of CMOS based logic circuit
3. Analyze combinational and sequential circuit for pipelining
4. Describe VLSI design flow and basic Verilog constructs
5. Describe functionality of digital Circuits using Verilog HDL
6. Select Verilog HDL statement for coding and synthesis optimization

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	3	2	3	3	3	3	3	3	3	3
2	2	3	3	2	3	2	3	3	3	2	2	3	2	3
3	2	3	3	3	2	2	3	3	2	2	1	3	2	3
4	3	3	3	2	3	2	3	3	3	3	3	3	3	3
5	3	2	3	3	3	2	3	3	3	3	3	3	3	2
6	2	2	3	3	3	2	3	3	2	3	1	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 : Level 3
CO2 : Level 4
CO3 : Level 4
CO4 : Level 5
CO5 : Level 5
CO6 : Level 5

Future Courses Mapping:

CMOS Analog Design, System Verilog.

FF No. : 654

ET3204: ROBOTICS

Course Prerequisites:

Matrices, Calculus, Geometry, MATLAB programming.

Course Objectives:

1. Understand the configurations, components of industrial manipulators
2. Evaluate forward and inverse kinematics
3. Describe End Effectors
4. Compute trajectory in joint and cartesian space
5. Perform vision based analysis for application development

Credits: 5

Teaching Scheme Theory: 5 Hours/Week
Tut:1 Hours/Week
Lab:2 Hours/Week

SECTION-1
Introduction to robotics, Safety and economics of robots, Specifications, Robot Anatomy, Degrees of freedom, Robot Coordinate systems, Joints, workspace, Singularity, Representation of position and orientation by Homogeneous Transformation, Actuator, Forward and inverse kinematics of robot, D-H convention, End effectors-Grippers and tools.
SECTION-2
Fundamentals of dynamics. Path planning, Trajectory Planning, Joint space and Cartesian space trajectories. Linear function with parabolic blends, Robotic sensors, actuators, Robot vision system. Hardware and software architecture of robot controllers, Robot programming, Basics of Robot operating system, Case studies.

List of Tutorials:

1. Homogeneous Transformation matrix
2. Inverse of HTM
3. DH parameters
4. Forward Kinematics
5. Inverse Kinematics
6. P and H Actuator selection
7. Electrical actuator selection
8. Dynamics
9. Trajectory planning
10. Robot sensors and system
11. Robot Vision system
12. Case study design

List of Practicals:

1. Study of robot configuration using Roboanalyzer
2. Simulation of homogeneous transformation
3. Simulation of forward and inverse kinematic
4. Interfacing of proximity sensor with microcontroller
5. Motion control of Virtual robot control using teach pendant.
6. Interfacing of actuator with microcontroller
7. Simulation of point-to-point motion
8. Simulation of continuous path motion
9. Simulation of joint space trajectory
10. Simulation of basic machine vision algorithms.

List of Projects:

1. Harvest bot
2. Pick and place bot
3. Wall follower Bot
4. Maze solver bot
5. Obstacle avoidance bot
6. Line follower bot
7. Designing of gripper for cylindrical objects.
8. Designing of wheelbase for mobile robots.
9. Design of pick and place robot for a given pay load capacity
10. Industrial vision system

List of Course Seminar Topics:

1. DH parameters
2. Task Planning
3. Structured Illumination
4. Joint Dynamic
5. Jacobian in Manipulator
6. Future of robot end effectors
7. Control of robot manipulators
8. Humanoid robot
9. Intelligence in robot sensing
10. Robot actuation systems

List of Course Group Discussion Topics:

1. Articulated robot-SCARA robot: a right choice?
2. Robot eye spy for 1, 2 and 3 dimensional object detection
3. Gripper design for delicate glass objects
4. Path planning algorithms
5. Mechanical design of manipulator
6. Transmission system
7. Intelligence in robotic system
8. Image enhancement techniques
9. Motion planning
10. Data communication in robotic systems

List of Home Assignments:

Design:

1. Robot work cell design egg packing system
2. Robot work cell design PCB assembly
3. Design cylindrical robot for part handling
4. Feature extraction algorithms for industrial job inspection
5. Maze Solver Robot

Case Study:

1. Robot in surveillance system
2. Robot in paint shop
3. Robot work cell for spot and arc welding shop
4. Robot synchronisation in automobile industry
5. Humanoid Robots

Blog

Robot/cobot in 2020

Surveys

1. End effectors
2. Commercial robots
3. Robot sensory systems
4. Electric Actuators
5. Connectors and cables

Assessment Scheme:

Mid Semester Examination - 10 Marks
Presentation - 15 Marks
Laboratory - 10 Marks
Course Project - 10 Marks
Home Assignment - 10 Marks
Group Discussion - 15 Marks
End Semester Examination - 10 Marks
Comprehensive Viva Voce - 20 Marks

Textbooks:

1. Saeed Niku, "Introduction to Robotics analysis, Systems, Applications", Prentice-Hall
2. Mikell P. Groover, "Industrial Robotics Technology Programming and Applications", McGraw Hill.
3. M. W. Sponge, M. Vidyasagar, "Robot Dynamics and Control", Wiley and Sons.

Reference Books:

1. Klafter R.D., Chmielewski T.A. and Noggins, "Robot Engineering: An Integrated Approach", Prentice Hall.
2. Fu K.S., Gonzalez R.C., & Lee, C.S.G., "Robotics control, sensing, vision and intelligence", McGraw Hill
3. Craig J. J., "Introduction to Robotics mechanics and control", Addison-Wesley, London.
4. S. K. Saha, "Introduction to Robotics" Tata Mcgraw Hill.

MOOC's Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1. Acquire knowledge of robot configurations and components.
2. Understand the mechanics and kinematics of robots.
3. Select end effectors for a given application.
4. Demonstrate use of engineering methods and problem solving to compute trajectory of the robot.
5. Familiar with robotic sensing and vision systems for application development.
6. Apply pre-requisite knowledge of programming, microcontroller, sensor and actuator interfacing for development of robots.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	0	2	0	0	3	3	1	2	0	1	1	1	1
2	3	2	2	2	0	0	1	1	2	0	1	2	1	1
3	2	0	2	1	1	0	0	1	2	1	1	2	1	2
4	2	3	2	2	2	1	1	1	2	0	1	1	2	3
5	3	3	2	1	3	1	2	1	2	0	1	2	2	3
6	2	3	2	2	2	0	2	1	2	0	1	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO 1 : Level 2
CO 2 : Level4
CO 3 : Level 3
CO 4 : Level 4
CO 5 : Level 3
CO 6 : Level 4

Future Courses Mapping:

Autonomous Mobile Robots

Job Mapping:

Students have job opportunities in the following areas: Job opportunities in leading industries in the following sector:
Defense, Automotive Industry, Manufacturing, Automated Product Design, Health Care Equipment Manufacturing, Electronic Equipment Manufacturing,

FF No. : 654

ET3203: POWER ELECTRONICS AND DRIVES

Course Prerequisites:

Semiconductor Devices, Electronics Circuits, Fourier Series Representation, Basics of Electrical Circuits and Machines

Course Objectives: The student will be able to

1. Understand uses of power devices in power converters.
2. Examine the performance of controlled converter fed DC Drives.
3. Observe the performance of AC voltage controllers.
4. Examine the performance of inverter fed AC Drives.
5. Use DC to DC converters for relevant applications .
6. Apply the knowledge of power converters for real life applications.

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Course Relevance:

There is an encouraging growth in power electronics technology creating an impact over electrical energy sectors. To meet the growing demand of power uses, converters are used as suitable to the applications. The research on power devices is improving the performance of these power converters. Also, as most of the real world applications use machines with it's optimum performance, schemes can be implemented through an integration of power electronics and electrical machines which will serve as electrical drives.
In view of this technologically advancing area, course on power electronics introduces the learner (student), power devices and different power converter topologies with the judgement of it's performance when used for control of power utilization and drives.

SECTION-1
Power Devices**:** - Power Diode and BJT, SCR, Triac, MOSFET, IGBT- Structure, Characteristics, LDMOS-Structure and I-V, Selection criterion, Driver Circuits, Protection of power Devices: Snubber circuit. DC Drives: Controlled bridge rectifiers and its analysis, DC Motors starting, characteristic and speed control, DC drive requirements. AC Voltage Controllers: Configurations and operation.

SECTION-2

Switched mode DC/DC Converters: Linear power supplies, switching power supplies, step down converters, step up converter, buck boost converter - continuous and discontinuous conduction, fly back converters, forward converters, push pull converters.

AC Drives: Single phase inverters – Working of push pull inverters, full bridge inverter with R and L load, Importance of PWM technique for voltage control.
Induction motor- Starting, Characteristic and speed control, AC drive requirements.
Applications: HF induction heating, , ON- line and OFF line UPS, Power Management Unit (PMU), Solar Photovoltaic (SPV) system.

List of Practicals:

1. DC I-V of Power MOSFET.
2. Performance of IGBT.
3. Single phase Half Controlled (Semi) converter
4. Single phase Fully Controlled (Full) converter
5. AC to AC Converter.
6. Single phase Bridge-inverter
7. MOSFET based PWM step down Chopper
8. Step up Chopper
9. Power electronic conversion system (AC-DC/ DC-DC), with suitable load.
10. Power electronic conversion system (DC-AC/AC-AC), with suitable load.
11. Study of SMPS
12. Study of UPS

List of Projects:

1. Single phase Power Control (e.g. Fan speed regulator)
2. Switching/triggering circuit for a power device (SCR / power BJT / power MOSFET / IGBT)
3. PWM generation for device switching
4. Power Supply/Battery charger
5. Intensity control of lighting
6. Inverter
7. SMPS
8. DC motor speed control
9. Induction motor speed control
10. Emergency lighting system
11. Power Management Unit (PMU)

List of Course Seminar Topics:

1. GaN Power Devices

2. Gate Drivers for Power Devices
3. Heat Sink Design
4. SiC Power Devices
5. IGBT based Rectifiers
6. Power Factor of Converter Systems
7. Converter Suitability for Applications
8. Sensing of Power Parameters
9. Simulation Softwares in power system design
10. Harmonic Control in Inverters

List of Course Group Discussion Topics:

1. GaN versus SiC Power Devices
2. SCR Rectifiers versus IGBT Rectifiers
3. Protection for AC/DC Drives
4. Power Electronics Systems and Control in Electric vehicle
5. Power Quality
6. Power Management Unit
7. Solar PV System
8. Renewable Energy
9. Power Electronics in eMobilty
10. Modern Control Tehniques for Converters

List of Home Assignments:

Design:

1. Design of Controlled Converter System
2. Design of Inverter System
3. Design of UPS
4. Design of Converter driven DC Drive
5. Design of Inverter driven AC Drive

Case Study:

1. Simulation Software Tool for Power System Design
2. Motor Control in Robotics
3. BLDC Motors
4. Battery Management Systems
5. Buck-Boost Converters

Blog:

1. Growth in Power demand
2. Latest Control technology of Power Systems
3. Power Regeneration Electric Tractions
4. Power Systems in Self-driving Vehicles
5. Power Applications in Domestic Uses

Survey:

1. Power electronics in Space Applications
2. Power Electronics in Telecommunication
3. Generations of Power Devices
4. Filters in Power Circuits
5. Magnetics in Power Systems

Assessment Scheme:

1. Seminar (PPT) – 15 marks
2. Group Discussion – 15 marks
3. Home Assignment – 10 marks
4. Course Viva – 20 marks
5. Lab – 10 marks
6. Course Project- 10 marks
7. MSE – 10 marks
8. ESE – 10 marks

Text Books:

1. M. D Singh & K B Khanchandani, “Power Electronics”, 2nd Edition, Tata McGraw Hill.
2. M. H. Rashid, “Power Electronics: Circuits, Devices, and Application”, 2nd Edition, Prentice Hall
3. B L Theraja & A K Theraja, “A Text Book of Electrical Technology - AC & DC Machines”, Volume II, S. Chand.

Reference Books:

1. Ned Mohan, Tore Undeland, Williams Robbins, “Power Electronics: Converters, Applications, and Design”, 2nd Edition, John Wiley & Sons.
2. P. C. Sen,.”MODERN POWER ELECTRONICS”, S Chand & Co., New Delhi.

MOOC’s Links and additional reading material:

www.nptelvideos.in
https://nptel.ac.in/courses
https://www.coursera.org/specializations/power-electronics

Course Outcomes: The student will be able to –

1. Identify power device from the structure.
2. List the differences between uncontrolled and controlled DC converters.
3. Draw output voltage waveform of AC converters.
4. Differentiate between linear and switched mode power supplies.
5. Calculate duty cycle of PWM waveform.
6. Select power converters for real life applications.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	0	0	0	0	1	0	1	0	2	2	2
2	3	3	2	0	2	0	0	1	1	1	0	2	1	3
3	3	3	2	0	0	0	0	1	1	1	0	2	1	3
4	3	3	2	0	2	0	0	1	1	1	0	2	1	3
5	3	3	2	0	0	0	0	1	1	1	0	2	1	3
6	3	2	2	0	0	0	0	1	0	1	0	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1: Level 3
CO2: Level 2
CO3: Level 5
CO4: Level 4
CO5: Level 3
CO6: Level 2

Future Courses Mapping:

Upon completion of this course, student can take following courses –

1. Advanced Power Electronics
2. Power Systems
3. Renewable Energy
4. High Power Devices
5. Electric Vehicles/ Hybrid Vehicles
6. Electrical Machines and Drives
7. Power Control Systems

Job Mapping:

Upon completion of this course, student will be able to –

1. Join an industry which is into Automation, Robotics, Control Panel Designs, eMobility, EV Sector, Embedded Control of Power with state-of-art technology, Energy Management Services, Design of Power Converters in Space Applications etc.
2. Join Govt sectors/ Services in the areas of Power Generation, Utilization, Renewable Energy Development, Space applications
3. Become an antrepreneur in the area of Solar Systems, Energy Management Services, Power Control Units, Drives and Drives Control etc.

FF No. : 654

ET3240: SOFTWARE DEVELOPMENT PROJECT-II

Course Prerequisites:

Programming concepts, Programming Languages

Course Objectives:

6. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
7. To Evaluate alternative approaches, and justify the use of selected tools and methods,
8. To emphasize learning activities those are student centric.
9. To engage students in rich and authentic learning experiences.
10. To enhance programming skills of students

Credits: 3 **Teaching Scheme Lab: 6** Hours/Week

Course Relevance:

Software project development comes under the category of project centric learning (PCL). Students can solve socially relevant problems in different domains using various software technologies. It is designed to give students the opportunity to develop knowledge and skills through engaging software projects set around challenges and problems they may face in the real world.

The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.

SECTION-1

Preamble: The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. The course contents are designed as a ladder to extend connectivity of software technology to solve real world problems using an interdisciplinary approach. Students need to plan their work in following steps

1) Software based project to be done by each student
2) A supervisor/mentor teacher assigned who will guide in design and execution of project
3) Carrying out literature survey
4) Finalization of problem statement
5) Planning the project execution
6) Execution of project and testing
7) Writing a report

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

Course Outcomes:

5. Review the literature to formulate problem statement to solve real world problems.
6. Apply knowledge of technology and modern tools to design solution considering sustainability issues.
7. Manage project ethically and collaborate for acquiring skills.
8. Demonstrate effectively project and technical report.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1: - Level 3
CO2: - Level 4
CO3: - Level 3
CO4: - Level 4

Job Mapping:

Software Engineer, Software Developer, IT Engineer

FF No.: 654

ET3244: ENGINEERING DESIGN AND INNOVATIONS-IV

Course Prerequisites:

Basic Electronics, Physics, Engineering Mathematics, Statistics, Programming Languages

Course Objectives:

6. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
7. To Evaluate alternative approaches, and justify the use of selected tools and methods,
8. To emphasize learning activities those are long-term, inter-disciplinary and student centric.
9. To engage students in rich and authentic learning experiences.
10. To provide every student the opportunity to get involved either individually or as a group to develop team skills and learn professionalism.

Credits: 4 **Teaching Scheme:** Lab 2 Hours/Week

Course Relevance:

Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. Students can be evaluated for higher order skills of Blooms taxonomy like ‘analyze, design and apply’. This course is capable of imparting hands on experience and self-learning to the students which will help them throughout their career. This is a step ahead in line with national policy of Atmanirbhar Bharat.

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. This course is designed to encourage and ensure application of technology for solving real world problems using an interdisciplinary approach.

Students need to plan their work in following steps:

9. Formation of project group comprising of 4-5 students. Multidisciplinary groups are allowed
10. A supervisor/mentor teacher assigned to individual groups.
11. Carrying out literature survey
12. Finalization of problem statement
13. Planning the project execution
14. Execution of project and testing
15. Writing a report
16. Publication in the form of research paper/patent/copyright as found suitable by supervisor/mentor

Teacher's Role in PCL:

5. Teacher is not the source of solutions rather he will they act as the facilitator and mentor.
6. To utilize the principles of problems solving, critical thinking and metacognitive skills of the students.
7. To aware the group about time management.
8. Commitment to devote the time to solve student's technical problems and interested in helping students to empower them better.

Student's Role in PCL:

8. Students must have ability to initiate the task/idea they should not be mere imitators.
9. They must learn to think.
10. Students working in PCL must be responsible for their own learning.
11. Students must quickly learn how to manage their own learning, Instead of passively receiving instruction.
12. Students in PCL are actively constructing their knowledge and understanding of the situation in groups.
13. Students in PCL are expected to work in groups.
14. They must develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Core Technology domains identified for E&TC Engg are as below. However, this list can be extended as per the need of project and multidisciplinary approach

6) VLSI Design
7) Embedded Systems
8) Signal Processing
9) Communication
10) Machine learning

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

MOOCs Links and additional reading material:

www.nptelvideos.in
https://worldwide.espacenet.com/

Course Outcomes:

5. Review the literature to formulate problem statement to solve real world problems.
6. Apply knowledge of technology and modern tools to design solution considering sustainability and environmental issues.
7. Manage project ethically as team member/ lead.
8. Demonstrate effectively technical report/ research paper/ prototype/patent.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels:

CO1: - Level 3
CO2: - Level 4
CO3: - Level 3
CO4: - Level 4

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus of

Final Year B.Tech.

Electronics & Telecommunication Engineering

"Pattern – D20"

Module - VII

FF No.: 654

MD4203: BUSINESS PROPOSAL WRITING

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

SECTION-1

Introduction

The world of B2B Businesses, Pre-Scale Roles and Responsibilities, End to end bid management Process including costing.

Focus on Customer

Compliance, Responsiveness, Client Analysis and Competitive Intelligence, Strategies and win themes, Features, Benefits and Discriminators, Teaming/sub-contracting

SECTION-2

Manage Processes

Proposal development cycle, Business approvals, and reviews, lessons learned

Elements of persuasive writing

Assertive writing, Headings, graphics and action captions, Page and document design, and style guides.

Textbooks:

1. Tom Sant, Persuasive Business Proposal, AMACOM; 3rd edition
2. John Care and Aron Bohlig, Mastering Technical Sale- The Sales Engineer's Handbook, Artech House; 3rd ed. Edition.
3. Neil Cobb and Charlie Divine, Writing Business Bids and Proposal for Dummies, For Dummies; 1st edition, 2016.
4. Larry Newman, The Shipley Proposal Guide 4.0, Shipley Associates; 4th Edition, 2011.

Course Outcomes

1. To understand basic bid and proposal management terminologies.
2. They will be able to conceptualize the entire process of bid and proposal management.
3. Know the techniques and tools for customer analysis and competitive intelligence.
4. Create business proposals with basic building blocks.
5. Can create customer-centric theme statements.

6. Present a business proposal and defend it.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	0	0	0	0	0	0	0	0	0	0	2	0	0	0
2	0	0	0	0	0	0	0	0	0	0	2	0	0	0
3	0	0	2	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	2	0	0	0	0	3	0	0	0	0	0
5	0	0	0	0	0	0	0	0	3	0	0	0	0	0
6	0	0	0	0	0	0	0	0	3	0	0	0	0	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO Attainment Level:

CO1: Level 3
CO2: Level 3
CO3: Level 3
CO4: Level 3
CO5: Level 3
CO6: Level 3

FF No. : 654

MB4204: UI/UX Design

Course Objectives:

1. Ability to design and rationalize user interfaces in digital medium or for software products using the principles of user experience design, laws of design.
2. Applying principles of 6D Discover, Define, Design, Develop, Deploy and Drive in their assignments and projects with respect to industry live projects.

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

SECTION-1
Laws of UX , Gestalt's principles of design, 10 Heuristics by NN Group, Usability Guidelines by Usability.gov, 6Ds of user centered design process
SECTION-2
User Groups & Personas, Data Gathering techniques (when to use which one), Contextual Enquiry & user Interviews, Brainstorming techniques and product roadmap based on user experience
Textbooks: 1. Don Norman, The Design of Everyday Things. 2. Jenfier Tidwell, Charles Brewer, Aynne Valencia, Designing Interfaces: patterns for effective interaction design. 3. Creative Tim, Fundamentals of Creating a Great UI/UX.
Course Outcomes 1. Understand the definition and principles of UI/UX Design in order to design with intention. 2. Achieve a deep understanding of the entire life-cycle of design—the process, purpose, and tools. 3. Execute UX & UI design through journey maps, wireframes and visual design. 4. Discover the industry-standard tools and specific project deliverables in UI/UX

5. Increase impact by being able to explain why you made the choices you made and learning how to be an effective and persuasive communicator.
6. Improve presentation skills, including presentations of homework, portfolio building, process pages, and a poster at the end of the term, help you demonstrate skills, aesthetic viewpoint, UI/UX process.

CO PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	0	0	1	1	0	0	0	0	0	0	1	1
2	1	1	3	0	2	2	0	0	0	0	0	0	2	2
3	3	2	1	3	0	2	0	0	0	0	0	0	0	3
4	1	1	3	0	1	1	2	0	0	0	0	0	1	1
5	0	0	1	0	0	1	0	0	0	0	0	1	1	0
6	0	0	1	0	0	0	0	0	0	0	0	0	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO Attainment Level:

CO1: Level 3
CO2: Level 3
CO3: Level 3
CO4: Level 3
CO5: Level 3
CO6: Level 3

FF No.: 654

ET4205: INDUSTRIAL AUTOMATION

Course Prerequisites: Digital Electronics, Concepts of physics

Course Objectives: To impart knowledge about

1. Architecture of Industrial Automation Systems
2. Sensors and actuators required for automation
3. Programmable logic controllers
4. PID controllers
5. Functionality of SCADA, HMI, and networking in automation.
6. Fuzzy logic control system

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

Advantages commonly attributed to automation include higher production rates increased productivity, more efficient use of materials, better product quality, improved safety and reduced timelines. Industries are embracing technology to streamline production, IT, business, development and service processes and hence automation has become an inseparable part of today's industries. Thus, this course is highly relevant in the current scenario.

SECTION-1
Architecture of Industrial Automation Systems, types, pyramid of automation, Sensors and measurement systems, Actuators -Hydraulic, Pneumatic and Electrical, Programmable logic controllers: Architecture, Standalone and Distributed PLCs, Relay logic, I/O module, Scan cycle, Ladder programming, Programming languages, Instruction set, Case studies.
SECTION-2
Introduction to Process Control, P-I-D Control, Comparison of P,PI,PD,PID Control systems and applications, SCADA, HMI: Concepts and functionality, Communication and Networking protocols, Fuzzy Controllers - concepts, membership functions, fuzzy inference, Fuzzy controller in automation, Case studies of Industrial automation systems.

List of Seminar Topics:

1. Spinning Mill automation
2. Industrial Networking: Impact on SCADA performance
3. Industry 4.0
4. State of the art of HMI
5. Automation in oil and gas industry
6. PID controllers in Process control application: A case study
7. Control of chemical processes using Fuzzy logic
8. Cybersecurity in IA
9. Electrical, Pneumatic, Hydraulic controllers: Pros and cons
10. Top five disruptive trends in automation.

List of Group Discussion Topics:

1. Interfacing signals to PLC: Analog or Discrete?
2. Automation for ICU in a hospital – challenges and solutions
3. Should use of HMI be made compulsory in industrial automation?
4. IA boon or bane?
5. Functioning of Timer instructions in PLCs: AB, Siemens, Mitsubishi
6. Language choice for PLCs
7. What is effective networking protocol in automation: Proprietary or open source
8. Rack PLC-Modular PLC: a right choice?
9. PID or PLC controllers: a right choice?
10. DCS or SCADA: Better choice?

List of Home Assignments:

Design:

1. Designing SCADA for Multiplex Theatre
2. SCADA system for VIT
3. Design of Intelligent Multilayer car parking system
4. Design of PLC based elevator system
5. Interfacing of analog sensors to PLC: design approach

Case Study:

1. 2-wire transmitter using HART protocol
2. Intelligent Building Automation
3. Comparing instruction set of AB and Siemens PLC
4. Programming languages of PLC
5. Fuzzy control in an industrial application

Blog

1. Industry 4.0-thinking Industry further

2. RPA Software: UIPATH
3. RPA Software: Blue prism
4. Top 5 disruptive trends in automation
5. Human machine interface in plant Automation

Surveys

1. Survey of Industrial Networking protocols
2. A survey of automation practices in food industry
3. Intelligent PID control algorithms
4. PLC:safety, Troubleshooting, Installation and Maintenance
5. Effects of automation in manufacturing.

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Text Books:

1. Frank D Petruzella, "Programmable logic controller ", McGraw-Hill Education.
2. SCADA by Stuart A Boyer: ISA 1999
3. Peng Zhang," Handbook on Industrial Control Technology", William Andrew Inc.,USA.

Reference Books:

1. S. Mukhopadhyay, S. Sen and A. K. Deb, "Industrial instrumentation, control and automation", Jaico Publishing House
2. L. A. Bryan and E. A. Bryan, "Programmable controllers, Theory and Implementation".An Industrial Text Company Publication, USA
3. C. D. Johnson, "Process Control Instrumentation Technology", John Wiley and Sons Ltd. Eighth ed.

MOOCS Links and additional reading material:

https://nptel.ac.in/courses/108/105/108105088/
https://nptel.ac.in/courses/108/105/108105063/

Course Outcomes:

1) Describe Architecture of Industrial Automation
2) Demonstrate understanding of sensors / actuators
3) Demonstrate PLC programming skills
4) Compare P, PI, PD, PID controllers
5) Understand the functionality of SCDA, HMI, DCS and networking in automation.
6) Design fuzzy controller.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	0	2	0	3	0	1	1	2	0	1	1	1	1
2	1	0	2	1	3	1	1	1	2	0	1	2	1	1
3	2	0	2	1	3	2	3	1	2	1	1	2	1	2
4	2	3	2	0	3	0	1	1	2	0	1	1	2	3
5	2	3	2	1	3	1	2	1	2	0	1	2	2	3
6	2	3	2	0	3	0	2	1	2	0	1	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 : Level 2
CO2 : Level 3
CO3 : Level 4
CO4 : Level 4
CO5 : Level 3
CO6 : Level 4

Future Courses Mapping:

IoT based industrial automation, Robotic process automation.

Job Mapping:

Entrepreneur, Automation Engineer, PLC programmer, Design Engineer-Automation, IT automation Engineer, Automation test Engineer, RPA developer.

FF No. : 654

ET4230: NATURAL LANGUAGE PROCESSING

Course Prerequisites:

1. Probability and statistics.
2. Linear Algebra
3. Python programming language

Course Objectives:

1. Learn fundamentals of Text processing
2. Understand the different Language Models
3. Implement POS tagging
4. Implement Text classification
5. Implement sentiment analysis
6. Implement Machine translation

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

Natural Language Processing is a branch of artificial intelligence that deals with the interaction between computers and humans using the natural language. The common applications of NLP involves, Google translator, Word Processors such as Microsoft, Interactive Voice Response, Personal assistant applications.

SECTION-1
Text Processing: Basics, Empirical Laws, Spelling Correction: Edit Distance, N-Gram Language Models, Basic Smoothing, POS Tagging, Hidden Markov Models for POS Tagging, Viterbi Decoding for HMM and Parameter Learning, Maximum Entropy Models.
SECTION-2
Maximum Entropy Models, Name entity recognition, Syntax, Dependency Grammars and Parsing, Semantic, text classification, sentiment analysis, Machine Translation, Question Answering.

List of Course Seminar Topics:

1. SemEval-2016 task 4: Sentiment analysis in Twitter
2. Modelling user attitudes using hierarchical sentiment-topic model
3. Multilingual dynamic topic model
4. Document-Level Text -classification Using Single-Layer Multisize Filters Convolutional Neural Network
5. Twitter Storytelling Generator Using Latent Dirichlet Allocation and Hidden Markov Model POS-TAG (Part-of-Speech Tagging)
7. Part-of-speech Tagging and Named Entity Recognition Using Improved Hidden Markov Model and Bloom Filter
8. Part of speech tagging for Twitter conversations using Conditional Random Fields model
9. A system for named entity recognition based on local grammars
10. A Maximum-Entropy Segmentation Model for Statistical Machine Translation
11. Mobile embodied conversational agent for task specific applications.

List of Course Group Discussion Topics:

1. Smoothing Technique
2. N-gram models
3. POS tagging
4. Ambiguities in NLP
5. Challenges in NLP
6. Challenges in designing Language Translators
7. Challenges in designing text classification
8. Challenges in designing sentiment analysis
9. Challenges in designing Question and Answering system
10. Challenges in designing text summarization

List of Home Assignments:

Design:

1. POS tagging using HMM
2. Build Chatbot
3. Summarization of customers reviews
4. Social media Information extraction
5. SMS spam classification

Case Study:

1. Hiring and recruitment
2. Advertising
3. Healthcare

4. Market intelligence
5. Sentiment analysis

Blog:

1. Social media Information extraction
2. Name Prediction in Multiple Languages using Recurrent Neural Networks
3. Text Classification using Sentiment Analysis
4. Image Caption Generator
5. gender identification in Marathi names

Surveys

1. POS tagging techniques
2. SMS and email spam classification
3. Categorization of sport articles
4. Machine translation Techniques
5. Name entity recognition methods

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Jurafsky & Martin "Speech and Language Processing" Prentice Hall, 2000
2. Akshar Bharati, Rajeev Sangal and Vineet Chaitanya: "Natural Language Processing: Paninian Perspective", Prentice-Hall of India, New Delhi, 1995.

Reference Books:

1. Steven Bird, Ewan Klein, and Edward Loper “Natural Language Processing”

MOOCS Links and additional reading material:

1. https://nptel.ac.in/courses/106/105/106105158/
2. https://nptel.ac.in/courses/106/106/106106211/

Course Outcomes: The student will be able to –

1. Have broad understanding of the field of natural language processing.
2. Get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3. Apply mathematical models and algorithms in applications of NLP.
4. Design and implementation issues in various NLP applications such as information retrieval and information extraction.

5. Demonstrate crucial ideas in linguistics (e.g., syntax, semantics, pragmatics), artificial intelligence (e.g., knowledge representation), and machine learning (e.g., deep learning) to natural language processing.
6. Identify one of the contemporary (sub) problems of natural language processing and implement, in the form of a complete computer program as a possible solution to it.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2	1	0	2	2	2	0	2	2	2
2	3	2	2	2	2	1	0	2	2	2	0	2	2	2
3	3	3	3	3	2	1	0	2	2	3	1	2	3	2
4	3	3	3	3	3	2	0	2	3	3	2	2	3	2
5	3	3	3	3	3	2	0	2	3	2	2	2	3	2
6	3	3	3	3	3	2	0	2	3	3	2	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

1. CO1- Level 3
2. C02- Level 3
3. CO3- Level 4
4. CO4- Level 4
5. CO5- Level 4
6. CO6- Level 5

Job Mapping:

Natural Language engineers, Data Scientist and Algorithm Architect with industries in domains Media & Entertainment, Healthcare and Finance.

FF No. : 654

ET4240: POWER ELECTRONICS

Course Prerequisites: Semiconductor Devices, Electronics Circuits, Fourier series Representation, Basics of Electrical Circuits and Machines

Course Objectives: The student will be able to –

1. Understand uses of power devices in power converters.
2. Examine the performance of controlled converter fed DC Drives.
3. Observe the performance of AC voltage controllers.
4. Examine the performance of inverter fed AC Drives.
5. Use DC to DC converters for relevant applications.
6. Apply the knowledge of power converters for real life applications.

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

There is an encouraging growth in power electronics technology creating an impact over electrical energy sectors. To meet the growing demand of power uses, converters are used as suitable to the applications. The research on power devices is improving the performance of these power converters. Also, as most of the real-world applications use machines with it's optimum performance, schemes can be implemented through an integration of power electronics and electrical machines which will serve as electrical drives.

In view of this technologically advancing area, course on power electronics introduces the learner (student), power devices and different power converter topologies with the judgement of it's performance when used for control of power utilization and drives.

SECTION-1

Power Devices- power diode, SCR, IGBT- Structure, Characteristics, Selection, Driver Circuits-Analysis of Single phase controlled converters, Power factor analysis.
DC motor drives – Performance and Speed Control.
AC Voltage Controllers: Configurations and Applications.

SECTION-2

Switched mode DC/DC Converters: Linear power supplies, switching power supplies, step down converters, step up converter, buck boost converter - continuous and discontinuous conduction, fly back converters, forward converters, push pull converters.
AC Drives: Single phase inverters – Working of push pull inverters, full bridge inverter with R and L load, Importance of PWM technique for voltage control.
Induction motor- Starting, Characteristic and speed control, AC drive requirements.
Applications: HF induction heating, , ON- line and OFF line UPS, Power Management Unit (PMU), Solar Photovoltaic (SPV) system.

List of Course Seminar Topics:

1. GaN Power Devices
2. Gate Drivers for Power Devices
3. Heat Sink Design
4. SiC Power Devices
5. IGBT based Rectifiers
6. Power Factor of Converter Systems
7. Converter Suitability for Applications
8. Sensing of Power Parameters
9. Simulation Softwares in power system design
10. Harmonic Control in Inverter

List of Course Group Discussion Topics:

1. GaN versus Sic Power Devices
2. SCR Rectifiers versus IGBT Rectifiers
3. Protection for AC/DC Drives
4. Power Electronics Systems and Control in Electric vehicle
5. Power Quality
6. Power Management Unit
7. Solar PV System

8. Renewable Energy
9. Power Electronics in eMobilty
10. Modern Control Tehniques for Converters

List of Home Assignments:

Design:

1. Design of Controlled Converter System
2. Design of Inverter System
3. Design of UPS
4. Design of Converter driven DC Drive
5. Design of Inverter driven AC Drive

Case Study:

1. Simulation Software Tool for Power System Design
2. Motor Control in Robotics
3. BLDC Motors
4. Battery Management Systems
5. Buck-Boost Converters

Blog

1. Growth in Power demand
2. Latest Control technology of Power Systems
3. Power Regeneration Electric Tractions
4. Power Systems in Self-driving Vehicles
5. Power Applications in Domestic Uses

Surveys

1. Power electronics in Space Applications
2. Power Electronics in Telecommunication
3. Generations of Power Devices
4. Filters in Power Circuits
5. Magnetics in Power Systems.

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. M D Singh & K B Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill.
2. M. H. Rashid, "Power Electronics: Circuits, Devices, and Application", 2nd Edition, Prentice Hall (I).
3. B L Theraja & A K Theraja, "A Text Book of Electrical Technology - AC & DC Machines", Volume II, S. Chand.

Reference Books:

1. Ned Mohan, Tore Undeland, Williams Robbins, "Power Electronics: Converters, Applications, and Design", 2nd Edition, John Wiley & Sons.
2. P. C. Sen, "Modern Power Electronics", S Chand & Co., New Delhi.

MOOCS Links and additional reading material:

https://nptel.ac.in/courses
https://www.coursera.org/specializations/power-electronics

Course Outcomes:

Upon completion of the course, the student will be able to –

1. Select power device for given voltage- current specifications.
2. Analyze DC Drives with controlled converter.
3. Analyze AC to AC converters.
4. Analyze AC Drives with inverter.
5. Analyze DC to DC converters.
6. Select power converters for real life applications.

CO PO Map

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	0	0	0	0	1	0	1	0	2	2	2
CO2	3	3	2	0	2	0	0	1	1	1	0	2	1	3
CO3	3	3	2	0	0	0	0	1	1	1	0	2	1	3
CO4	3	3	2	0	2	0	0	1	1	1	0	2	1	3
CO5	3	3	2	0	0	0	0	1	1	1	0	2	1	3
CO6	3	2	2	0	0	0	0	1	0	1	0	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1:- Level 2
CO2:- Level 5
CO3:- Level 4
CO4:- Level 5
CO5:- Level 4
CO6:- Level 3

Job Mapping:

Upon completion of this course, student will be able to –

1. Join an industry which is into Automation, Robotics, Control Panel Designs, eMobility, EV Sector, Embedded Control of Power with state-of-art technology, Energy Management Services, Design of Power Converters in Space Applications etc.
2. Join Govt sectors/ Services in the areas of Power Generation, Utilization, Renewable Energy Development, Space applications.
3. Become an entrepreneur in Solar Systems, Energy Management Services, Power Control Units, Drives and Drives Control etc.

FF No.: 654

ET4241: ADVANCED COMMUNICATION ENGINEERING

Course Prerequisites: Communication Engineering, Digital Signal Processing, Wireless Communication

Course Objectives:

1. Analyze the path loss and shadowing effects in wireless communication.
2. Understand diversity techniques of communication.
3. Understand wireless channel modelling.
4. Analyze Orthogonal Frequency Division Multiplexing system.
5. Evaluate the performance of Multiple Input Multiple Output systems.
6. Simulate MIMO receivers

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

Future generations of cellular communication require higher data rates and a more reliable transmission link. The transmission data rates can be increase by increasing transmission bandwidth and using higher transmitter power. Wireless communication channels suffer from various factors. Fading problem is the major impairment problem. To improve the performance of those fading channels, diversity techniques are used. Advanced Communication Engineering begins with wireless channel modelling. Also it covers Bit Error Rate performance in fading wireless channel. It covers deep fading issues in wireless communication. Also, it covers how to solve fading problems. It also covers advanced technologies like OFDM (Orthogonal Frequency Division Multiplexing) and MIMO (Multiple Input Multiple Output. An integral part of the course is MATLAB based computer assignments, which are designed to reinforce theoretical concepts.

SECTION-1

Wireless Communication and Diversity

Path Loss and Shadowing, Wireless Channel Modelling, Bit Error Rate (BER) performance in Additive White Gaussian Noise (AWGN) communication channel-Analysis, Bit Error Rate (BER) performance in fading wireless channel, Deep fade phenomenon in wireless channels.

Diversity in Wireless System

Multiple antenna Wireless Systems, optimal receiver combining, Bit Error Rate (BER) performance with diversity, Types of diversity, Deep Fade Analysis with Diversity.

SECTION-2

Orthogonal Frequency Division Multiplexing

Multicarrier modulation, Introduction to Orthogonal Frequency Division Multiplexing (OFDM), OFDM system model, IFFT/ FFT Transceiver Model, OFDM -BER and SNR performance, multiuser OFDM.

Multiple Input Multiple Output (MIMO) Technology

MIMO System model, MIMO- Zero-Forcing (ZF) and Minimum Mean Square Error (MMSE) Receivers, Singular Value Decomposition (SVD), MIMO channel capacity, Optimal water filling power allocation.

List of Course Seminar Topics:

1. Performance analysis of multiple-input multiple-output singular value decomposition transceivers.
2. Modeling the Indoor MIMO Wireless Channel
3. Channel Modelling for 5G mobile Communication
4. Comparison of Indoor Geolocation methods in DSSS and OFDM Wireless Lan Systems
5. Analysis of MIMO system through Zero Forcing and MMSE detection scheme
6. SVD for Engine design of High Throughput MIMO OFDM system
7. Measured capacity gain using water filling in frequency selective MIMO Channels
8. MIMO channel capacity in Co-channel interference.
9. OFDM Channel estimation using Singular value decomposition
10. Increase in capacity of Multiuser OFDM system

List of Course Group Discussion Topics:

1. Fading Environment
2. Deep Fade Phenomenon in Wireless Communication
3. OFDM versus CDMA
4. Filtered -OFDM & OFDM modulation

5. OFDM vs MIMO-OFDM
6. OFDM for Optical Communication
7. MIMO -opportunities and challenges
8. MIMO Radar
9. Massive MIMO for next generation wireless systems
10. 5G - Spectrum, Deployment & Customer Trends

List of Home Assignments:

Design:

1. Design of OFDM for UWB environment
2. Design of 4G MIMO OFDM wireless system
3. OFDM for underwater Acoustic communication
4. Design LMSE algorithm for equalization
5. Design Zero forcing Algorithm

Case Study:

1. Role of digital communication in digital transformation
2. Digital Communication over fading channels
3. Network coding for wireless Mesh Networks
4. Capacity of wireless communication systems employing antenna arrays
5. MIMO OFDM

Blog

1. 5G and Industrial IoT
2. Equalization Techniques for MIMO
3. Diversity Techniques for 4G wireless Communication
4. Massive MIMO
5. Will 5G change the world?

Surveys

1. Diversity techniques in Wireless Communication
2. Space time coding scheme for MIMO
3. Survey on resource allocation techniques in OFDM (A) networks
4. Survey on Mobile WiMax
5. Performance Analysis in MIMO OFDM system.

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Principles of Modern wireless communication systems. Theory and practice , Aditya K. Jagannatham ,McGraw –Hill publication.
2. Wireless Communications-Andrea Goldsmith –Cambridge university press.
3. Wireless Communications- Principle and practice- Theodore S, Rappaport, Pearson.
4. Digital communications -Fundamentals and applications –Bernard Sklar, Prentice Hall

Reference Books:

1. Baseband Receiver Design for wireless MIMO-OFDM communications, Tzi-Dar Chiueh, Pei-Yun Tsai, I-Wei Lai, Wiley-IEEE Press, 2012.
2. Theory and applications of OFDM and CDMA : Wideband Wireless COmmunications , Henrik Schulze, Christian Lueders, Wiley, 2005.
3. Radio Propagation and Adaptive Antennas for Wireless Communication Networks, Nathan Blaunstein, Christos G. Christodoulou, Wiley , 2014.
4. Fundamentals of Wireless Communication , David Tse, Pramod Vishwanath, Cambridge University Press, 2005

MOOCS Links and additional reading material:

www.nptelvideos.in
Advanced 3G, 4G Wireless Mobile Communications
https://nptel.ac.in/courses/117/104/117104099/#

Course Outcomes:

1. Calculate received power by system and keep required margin
2. Differentiate between diversity techniques
3. Understand channel modelling
4. Illustrate OFDM System
5. Discuss performance behavior of MIMO systems
6. Differentiate between ZF & MMSE receivers

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	0	0	0	0	0	0	0	0	0	0	0	0
2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
4	3	3	0	0	0	0	0	0	0	0	0	0	0	0
5	3	3	0	0	0	0	0	0	0	0	0	0	0	0
6	3	3	0	0	0	0	0	0	0	0	0	0	0	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Future Courses Mapping:

1. Mobile Communication

Job Mapping:

Students will have good opportunities in the communication industry as service engineers for operations and maintenance, network planning, software product developer, analytics engineer and so many.

FF No. : 654

CS4217: HUMAN-COMPUTER INTERACTION

Course Prerequisites: Mathematics

Course Objectives:

1. To differentiate IT applications into categories based on measurable human factors
2. To study ethnographic observations in user community
3. To generate the awareness about usability standards and accessibility guidelines
4. To design user-friendly user interface with due consideration of interface theory and principles
5. To apply usability evaluation methods to identify the usability issues with IT applications
6. To integrate web, CSCW and mobile app design approaches as per user requirement

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:
Human-Computer Interaction (HCI) is a socio-technical course, with a goal of bringing the power of computers and communication systems to users, customers or people. It aims to make all computing and communications systems more accessible, maintainable and useful in working, learning and recreational lives of users or people. It helps every computing, web or mobile application to become really user-centric, increasing its users as well as related sales.

SECTION-1
Fundamentals of Human Computer Interaction (HCI): Definition of HCI, Interdisciplinary Nature, Related Disciplines, Goals of System Engineering, Usability, Types of Usability, User Interface (UI), Measurable Human Factors, Accessibility, Differently abled Users, Accessibility Guidelines. **Interaction Concepts and Models:** User Persona, User Categorization, Golden Rules of Interface Design, Miller's Principle, Norman's Action Model, Task Analysis - GOMS, Contextual Inquiry, Work Models, Interaction Styles, Empathy Maps. **Design Process:** Design Concept, Three Pillars of Design, Process of Design, Ethnographic Observations, Participatory Design, Internationalization, Interaction Design Patterns.

SECTION-2

Usability Evaluation: Expert-based Evaluation, User-based Evaluation, Formative Evaluation, Summative Evaluation, Heuristic Evaluation, Cognitive Walkthrough, Semiotic Analysis, Icon Categorization, User Surveys, Interviews, Usability Testing, Data Analysis, Statistical Methods.
Documentation and Groupware: Classification of Documents, Reading from Displays, Online Help, Tutorials, Error / Warning Messages, Groupware, Computer Supported Cooperative Work (CSCW), Dimensions of Cooperation, Asynchronous Interactions, Synchronous Interactions, Online Communities, Challenges with Online Communications.
Website and Mobile App Design: Content Design, Interaction and Navigation Design, Presentation Design, Differences in design approaches, Design and Evaluation Tools.

List of Course Seminar Topics:

1. Accessibility guidelines
2. Empathy maps
3. Internationalization
4. SIGCHI
5. Ethnography with IT applications
6. Design thinking
7. Participatory design
8. Color schemes in user interfaces
9. Design of home screens
10. Human errors

List of Course Group Discussion Topics:

1. Which is better - human skills or computer abilities?
2. What adds more value - aesthetics or gamification?
3. Are accessibility guidelines affordable?
4. Is multilingual support essential in mobile apps?
5. Should users be involved in the UI design process?
6. Is user-based evaluation better than expert-based evaluation?
7. Is heuristic evaluation more valuable than cognitive walkthrough?
8. Is internationalization essential in IT applications?
9. Are websites easier to design than mobile apps?
10. Are documents designed?

List of Home Assignments:

Design:

1. Social Network for Spiritual Users
2. App for Alzheimer's disease
3. Health Tracking App
4. Ration Card Management App
5. Innovative e-Commerce Platform

Case Study:

1. Chatbot in healthcare domain
2. Best food ordering app in India
3. Online teaching-learning process
4. Use of Twitter with Indian Users
5. User experience with car booking in India

Blog:

1. Noise of Notifications
2. Challenges in Food Delivery Service
3. Need for Accessibility Guidelines
4. Usability of Autonomous Vehicles
5. Failure of Usability Testing

Surveys:

1. User experience with video-conferencing apps
2. User errors on Social Networking Sites (SNS)
3. Challenges for hearing impaired users with IT applications
4. Most popular Indian mobile apps (Made in/by India)
5. Impact of ban on Chinese apps in India

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Ben Shneiderman, "Designing the User Interface", Third Edition, Pearson Education, ISBN 81-7808-262-4.
2. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "Human-Computer Interaction",Third Edition, Pearson Education, ISBN 81- 297-0409-9.

Reference Books:

1. Donald Norman, "The Design of Everyday Things", 2002 Edition, Basic Books, ISBN 100-465-06710-7.
2. Wilbert Galitz, "The Essential Guide to User Interface Design", Second Edition, Wiley-Dreamtech India (P) Ltd., ISBN 81-265-0280-0.
3. John Carroll, "Human-Computer Interaction in the New Millennium", Pearson Education, ISBN 81-7808-549-6.

MOOCS Links and additional reading material:

https://nptel.ac.in/courses/106/103/106103115/
https://www.coursera.org/learn/human-computer-interaction
https://classroom.udacity.com/courses/ud400

Course Outcomes:

1. Students will be able to appreciate the differences among IT applications and their categories based on measurable human factors.
2. Students will be able to capture the ethnographic observations in user community
3. Students will be able to follow usability standards and accessibility guidelines
4. Students will be able to design user interfaces as per interface theory and user requirements
5. Students will be able to apply a suitable usability evaluation method to identify the usability issues
6. Students will be able to enhance UI designs as per desired web, CSCW or mobile app design approach.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	0	0	0	3	0	0	0	0	2	0	0	0	0	0
2	0	0	0	0	0	0	0	0	2	0	0	0	0	3
3	0	0	3	0	0	0	0	0	2	1	0	0	0	0
4	0	0	0	0	0	0	0	0	2	0	0	0	0	0
5	0	0	0	0	0	0	0	0	2	2	0	0	0	0
6	0	0	0	0	0	0	0	0	2	0	1	0	0	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1-Level 3
CO2-Level 3
CO3- Level 2
CO4- Level 2
CO5- Level 1
CO6- Level 3

Future Courses Mapping:

User Interface Design
Usable Security
Intelligent User Interfaces

Job Mapping:

What are the Job opportunities that one can get after learning this course
UI Designer, Product Designer, Software Engineer, Mobile App Developer

FF No. : 654

CS4219: INTERNET OF THINGS

Course Prerequisites: Microprocessor Hardware, Microcontroller

Course Objectives:

1. Learn the terminology, technology, and its applications of IoT
2. Analyze Embedded suite widely used in IoT.
3. Describe the concept of M2M with necessary protocols
4. Understand the cloud storage for IoT applications.
5. Optimize resources for different IoT applications
6. Understand Real world IoT Design constraint.

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:
IoT is regarded as the significant frontier that can improve almost all activities in our lives. Most of the devices, which have not previously been connected to the internet, can be networked and respond the same way as smart devices. Internet of Things and related technologies improve the convenience, comforts and security of our homes and be more efficient and cost effective in the way we consume services such as energy. IOT will help track and monitor a huge range of our own physiological functions.

SECTION-1
Introduction and Application to Internet of Things: Need of IoT, Towards the IoT, Strategic Research and Innovation Directions, Future Internet Technologies, Iot Smart X Application: Smart Cities, Smart Energy & Smart Grid, Smart Mobility & transport,Smart Home, Smart Building & Infrastructure, Smart Factory & Manufacturing, Smart Health, Smart Logistics & Retails. **Embedded Suite for IoT:** Introduction to Arduino and Raspberry Pi, Understanding the Arduino and Raspberry Pi board and its Components, recognizing the Input/output, GPIO connectivity. **Wireless Technologies supporting IoT:** Protocol Standardization for IoT, Machine to machine (M2M) and WSN Protocols, Basics of RFID, RFID Protocols , Issues with IoT Standardization, Protocols- IEEE 802.15.4, ZigBee, IPv6 technologies for IOT.

SECTION-2

IoT Networking: Star, Mesh, Tree, and Overview of networking Protocols: TCP/IP, 6LowPan, IoT Devices Application-Level Protocol Service parameter in MQTT,

IoT: PRIVACY, SECURITY & GOVERNANCE: Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT Platforms for Smart Cities, First Steps towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities

Cloud Analytics for IoT Application:

Introduction to cloud computing, Difference between Cloud Computing and Fog Computing: The Next Evolution of Cloud Computing, Role of Cloud Computing in IoT, Connecting IoT to cloud, Cloud Storage for IoT Challenge in integration of IoT with Cloud.

List of Tutorials:

1. Introduction to the Internet of Things
2. How IoT works
3. Features of Internet of Things.
4. IoT Applications
5. Advantages of Internet of Things
6. Representative applications of IoT
7. Architectures for the IoT
8. Layered Architectures for the IoT
9. Relevant MAS concepts and techniques
10. Limitations of MAS concepts and techniques and directions for further research

List of Practical's:

1. LED Blinky
2. Switch
3. ADC
4. PIR, Ultrasonic sensor, IR Sensor, Flame Sensor interface with Microcontroller
5. MQ6 Sensor, Humidity sensor, Raindrop Sensor interface
6. Communication over Wifi through Node MCU
7. Voice Controlled Iot application
8. Serial Communication
9. PWM
10. Bluetooth Controlled application(Interfacing Bluetooth Module (HC-05)
11. Control through Android APP
12. RFID Interface
13. Use IOT Comm Protocol (MQTT)

List of Projects:

1. IoT Based Humidity and Temperature Monitoring Using Arduino Uno
2. IoT Weather Reporting system using Raspberry pi.
3. IoT Connected Healthcare Applications.
4. IoT Based Intelligent Traffic Management System
5. IoT Based Smart Parking System Using RFID
6. Smart Irrigation System Using IoT.
7. Waste and water management using IoT
8. Smart Healthcare Solution using IoT
9. Automatic Herbicides Sprayers
10. Fish Feeder
11. Green Corridor
12. Trusted high-quality elderly care
13. Gesture controlled Iot Application

List of Course Seminar Topics:

1. Authentication of Edge-Device in AWS IoT
2. How to Build a Complete IoT Solution with AWS- An Use Case Approach.
3. Exploring IoT Through a Use Case
4. Security Technologies behind SSL
5. A Look at the AWS IoT Ecosystem
6. Wireless Protocols for Internet of Things
7. Sensor Characteristics.
8. Manufacturing Intelligence
9. IoT in the Manufacturing industry
10. IoT and Machine Learning
11. IoT Communication Protocol selection based on application
12. Security and Privacy issue in internet of things.

List of Course Group Discussion Topics:

1. Role of Internet of Things in development of India.
2. Manufacturing industries should make efforts to limit contribution to IoT.
3. Should countries put a ban on IoT for children?
4. Should IoT pay more attention to security rather than just expanding its horizon to the extremes?
5. IoT is the next big thing in technology.
6. IoT poses a huge risk to privacy, if they your system is hacked.
7. IoT is the next big thing for hackers trying to have access to your intimate data.
8. Pros and cons of over-usage of IoT at homes and offices.
9. IoT at battlefields will make life of soldiers safer and easier.

10. IoT will make way for robots to rule over humans one day.
11. IoT devices are making people lazier and obese.
12. IoT needs to be regulated before it goes out of limits and poses serious threat.
13. MQTT vs COAP protocol for IoT applications.

List of Home Assignments:

Design:

1. IoT Based Smart Waste Management System for Smart City
2. IoT Based Smart Street Light
3. IoT Based Smart Grid System
4. IoT based Water Quality Management system using Arduino
5. IoT Smart Home automation using Node MC

Case Study:

1. IoT Real Time DashBoard
2. IoT and Block chain
3. IoT Sensor Gateway
4. IoT Operational Analytics
5. Autonomous trucks reduce driver fatigue and improve road safety.
6. Industrial Internet of Things
7. IoT Enabled Next Generation Farming
8. The Tesla IoT Car
9. Role of IoT in Supply chain management
10. Ecosystem for Logistics Industry with IoT

Blog

1. Monitoring environmental conditions to improve safety and prevent environmental accidents
2. Today's hard hats and safety goggles could be tomorrow's sensored vests and work sites. Can an IoT enabled ecosystem prevent accidents from happening in the frst place
3. How can machines tell us when they are about to break down?Using connected technologies to predict maintenance saves clients . time and money
4. Automation benefit from IoT
5. Farmers used to rely on clouds for rain. Today’s digital cloud helps maximize crop yield, optimize seeding, automate harvesting, and more.
6. Security and Privacy issues for Iot application
7. Suitability of MQTT protocols for IoT application
8. Interoperability issues in IoT
9. Toward Industry 4.0 With IoT
10. IoT Applications in Logistics and Supply chain managements
11. Data management for IoT applications.

Surveys:

1. The future of IOT Connectivity
2. IoT applications value creation for industry
3. IoT involvement in Software development, selling software for IoT products
4. IoT Platform
5. The internet of things (IoT) represents the Fourth Industrial Revolution
6. Cloud support for Iot Application
7. Interdependencies of BIG data and IoT
8. IoT enabled Smart manufacturing
9. Role of Internet of Things for Electric Vehicle
10. Secure Vehicular Area Network
11. Security attacks on IoT Devices
12. IoT vs. Industrial IoT: What's the difference?

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Sta matis Karnouskos,David Boyle, "From Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014. to the Internet of Things:
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014. (ISBN-13: 978-0124076846)

Reference Books:

1. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014
2. Daniel Minoli John Wiley & Sons ,,Building the internet of things with ipv6 and mipv6, The Evolving World of M2M Communications, ISBN: 978-1-118-47347-4
3. Cassimally, Hakim, "Designing the Internet of Things", Wiley Publications, ISBN 10: 111843062X
4. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013. (ISBN-13: 978- 1430257400)

MOOCS Links an additional reading material: www.nptelvideos.in

Course Outcomes:

The student will be able to

1. Understand the application areas of IOT
2. Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
3. Understand building blocks of Internet of Things and characteristics of Sensors and Communication Devices
4. Implement state of the art architecture in IoT
5. Demonstrate the application of IoT in Industrial Automation and identify Real World Design Constraints.
6. Compare and Contrast the use of Devices, Gateways and Data Management in IoT
7. Design and program IOT Devices
8. Implement Security protocols to prevent internal and External damage.
9. Design an IoT device to work with a Emerging and Adaptive Computing infrastructure.
10. Define the infrastructure for supporting IoT deployments.
11. Lead a team to achieve design goals and contribute significantly in smooth implementation of design

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	0	0	3	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	2	0	0	0	0	0
3	0	0	0	3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	2	0	0	0	0	0	0
5	0	0	0	0	0	0	3	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	2	0	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1- Level 3
CO2- Level 3
CO3- Level 2
CO4- Level 2
CO5 - Level 1
CO6- Level 3

Future Courses Mapping:

Mention other courses that can be taken after completion of this course

Job Mapping:

1) All sectors of business from agriculture, transportation, health, manufacturing, resources, mining and retail to service sector are set to benefit from or at least be impacted by IoT.
2) IOT will offer Local governments a great opportunity to provide a range of services that will not only improve the quality of life of its citizens but also improve the efficiency and profitability of state services.

FF No. : 654

CS4222: IMAGE PROCESSING

Course Prerequisites: Digital Signal Processing

Course Objectives:

1. Describe different color models and the need for those
2. Analyze image condition and deduce enhancement algorithms
3. Recognize geometric distortions in image and correct those
4. Learn different compression techniques
5. Understand different mathematical transforms and their properties

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

Vision sense is the most powerful human sense organ. In the world where intelligent automation is taking place, image processing is a vital domain for research and development. In Industry 4.0, image processing systems built around industrial cameras are an essential component in automated production. Throughout all steps of production, from the inspection of raw materials and production monitoring (i.e. flaw detection) to final inspections and quality assurance, they are an indispensable part of achieving high efficiency and quality standards. In the Entertainment Industry, latest trends such as 4K video streaming requires high quality compression that can provide limited/no loss image quality with high fps. In social networking, sharing images has been a vital part. Creating innovative effects and overall manipulating the images will be explored.

SECTION-1
Introduction: Elements of image processing system, Scenes and Images, Vector Algebra, Human Visual System, color vision color model: RGB, HVS, YUV, CMYK, YCbCr and some basic relationships between pixels, linear and nonlinear operations. Image types (optical and microwave), Image file formats (BMP, tiff, jpeg,PIN, GIF,png, raster image format). Image sampling and quantization. **Image Enhancements:** Memory-less operations, Convolution, Spatial domain image enhancements: Denoising filters, Smoothing Operation, Sharpening Operation, and Contrast stretching /enhancement, histogram and histogram equalization. **Frequency Domain Processing:** 2 dimensional Fourier transform of an image, filtering in Fourier domain.

Image segmentation: Classification of image segmentation techniques: Edge-based Segmentation, Region based techniques. Binarization: Global Thresholding, Adaptive thresholding. Types of Edge detector: derivative filters, Sobel, Canny. Edge linking. Feature Extraction- Boundary representation (Chain code), Boundary detection based techniques.

SECTION-2

Morphological Operation: Binary Morphology, Erosion Dilation, Opening and Closing.
Object Recognition: Feature points and feature detection (Line, circle and corner). Line detection: RANSAC, Hough Transform. Corner detection: Harris Corner Detector. Feature descriptors, Descriptor matching. SIFT, SURF.
Image compression: Introduction and need, Coding redundancy, classification of compression techniques (Lossy and lossless- JPEG, Run Length Coding, Huffman Coding, Shannon fano coding).

List of Course Seminar Topics:

1. Challenges in Automated Video Surveillance
2. Tumor detection in MRI images
3. Eye gaze tracking for HMI: Pros, cons and implementation
4. Roll of image processing in Industry 4.0
5. Parallelism for performance enhancement in image processing
6. Vision based ADAS
7. Computational photography
8. Computational microscopy
9. Automatic navigation using Visual SLAM
10. Animoji

List of Course Group Discussion Topics:

1. Lines Vs. Corners as features
2. Hough Transform for line detection Vs. RANSAC
3. Fourier domain denoising Vs. Spetial domain denoising
4. Kernel size Vs. Speed of operation
5. Histogram equalization Vs. Gamma correction
6. OTSU Vs Adaptive thresholding
7. Compression techniques
8. Color models
9. SIFT Vs SURF
10. Roll of image processing in security.

List of Home Assignments:

Design:

1. Design an algorithm to identify fault in a "PCB inspection system" as shown below

2. Design an algorithm to perform segmentation of the image below to extract the mango from its background.

3. Design an algorithm to get from image 1 to image 2

4. Design an algorithm to recognize character "0" in the image below

5. Design an algorithm to compress a 300x300 pixel image with horizontal black to white gradient as shown below

Case Study:

1. Cam-scanner: Document scanning app
2. Tesseract OCR library
3. Instagram filters
4. OpenCV
5. Google Street View

Blog

1. Image processing on Embedded platforms
2. Face recognition system security analysis for authentication
3. Image processing in MSME for effective automation
4. H.264 codec for image streaming
5. Role of mathematics in image processing

Surveys

1. Image quality metrics
2. Vision based self driving car safety
3. Compression techniques & codecs
4. State of the art applications such as AR/ XR
5. Human recognition in social networking apps like Facebook

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Rafael Gonzalez & Richard Woods, "Digital Image Processing," 3rd Edition, Pearson publications, ISBN 0132345633.
2. Anil K. Jain, "Fundamental of Digital Image Processing," 5th Edition, PHI publication, ISBN 13: 9780133361650.

Reference Books:

1. Pratt, "Digital Image Processing," Wiley Publication, 3rdEdition , ISBN 0-471-37407-5.
2. K.R. Castleman, "Digital Image Processing," 3rd Edition, Prentice Hall: Upper Saddle River, NJ, 3, ISBN 0-13-211467 -4.
3. K. D. Soman and K. I. Ramchandran, "Insight into wavelets - From theory to practice," 2nd Edition PHI, 2005.

MOOCS Links and additional reading material: www.nptelvideos.in

Course Outcomes:

The student will be able to

1. Apply various corrective geometric transforms on a distorted image.
2. Determine and implement required image enhancement techniques using open source technologies such as OpenCV.
3. Deploy optimized algorithms for lossless and lossy compression techniques which ensures expected performance on a variety of hardware architectures.
4. Contribute to an algorithmic solution for social and personal security.
5. Differentiate between various mathematical transforms and its use for a given use Case.
6. Deduce a solution for a given industrial.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	0	3	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	3	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	2	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	2	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	1	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1- Level 3
CO2- Level 4
CO3- Level 3
CO4- Level 2
CO5- Level 1
CO6- Level 5

Future Courses Mapping:

Augmented Reality
Multimedia Processing

Job Mapping:
Augmented Reality Experience Designer
Automation Engineer
Embedded Software Developer
Image Processing Expert

FF No. : 654

IT4201: DESIGN AND ANALYSIS OF ALGORITHMS

Course Prerequisites: Basic courses on programming, data structures, Discrete structures

Course Objectives:

1. Formulate a given computational problem in an abstract and mathematically precise manner.
2. Choose a suitable paradigm to design an algorithm for given computational problems.
3. Understand asymptotic notations and apply suitable mathematical techniques to find asymptotic time and space complexities of algorithms.
4. Understand notions of NP-hardness and NP-completeness and their relationship with the intractability of decision problems.

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:.

This is an important course for Information Technology Engineering. which helps to develop algorithmic thinking capability of students. It also facilitates in systematic study of any other domain which demands logical thinking. Designing algorithms using suitable paradigms and analysing the algorithms for computational problems has a high relevance in Industry as well as research. This course is also relevant for students who want to pursue research careers in theory of computing, computational complexity theory, advanced algorithmic research.

SECTION-1
Basic introduction and time and space complexity analysis: Asymptotic notations (Big Oh, small oh, Big Omega, Theta notations). Best case, average case, and worst-case time and space complexity of algorithms. Overview of searching, sorting algorithms. Using Recurrence relations and Mathematical Induction to get asymptotic bounds on time complexity. Proving correctness of algorithms. **Divide and Conquer:** General strategy**,** Binary search and applications, Analyzing Quick sort, Merge sort, Finding a majority element, Order statistics (deterministic algorithms), Josephus problem using recurrence, Efficient algorithms for Integer arithmetic (Euclid's algorithm, Karatsuba's algorithm for integer multiplication, fast exponentiation). **Dynamic Programming:** General strategy, simple dynamic programming-based algorithms to compute Fibonacci numbers, Matrix Chain multiplication, Optimal binary search tree (OBST) construction, 0-1 Knapsack, Traveling Salesperson Problem, All pair shortest path algorithm.

SECTION-2

Greedy strategy: General strategy, Analysis and correctness proof of minimum spanning tree and shortest path algorithms, fractional knapsack problem, Huffman coding, conflict free scheduling.
Backtracking strategy: General strategy, n-queen problem, backtracking strategy for some NP-complete problems (e.g. graph coloring, SUDOKU)
Branch and Bound strategy: LIFO Search and FIFO search, Assignment problem
Introduction to complexity classes and NP-completeness:
Complexity classes P, NP, coNP, and their interrelation, Notion of polynomial time many one reductions reduction, Notion of NP-hardness and NP-completeness, Cook-Levin theorem and implication to P versus NP question, NP-hardness of halting problem. NP-Complete problems (some selected examples from - vertex cover problem, independent set problem, clique problem, Hamiltonian-circuit problem), reducing NP problems to Integer Linear Programming.

List of Projects:

1. Applications of A* algorithm in gaming
2. Pac-Man game
3. Creation / Solution of Maze (comparing the backtracking based solution and Dijkstra's algorithm)
4. Knight tour algorithms
5. Network flow optimization and maximum matching
6. AI for minesweeper game
7. AI for shooting games
8. AI for Hex, connect-4, sokoban games
9. SUDOKU solver
10. Algorithms for factoring large integers

List of Course Seminar Topics:

1. Complexity classes
2. Divide and Conquer Vs Dynamic Programming
3. Space complexity
4. Greedy strategy Vs Backtracking strategy
5. Dynamic Programming Vs Greedy
6. Computational Complexity
7. Comparison of P Vs NP problems
8. Compression Techniques
9. NP-hardness
10. Real world applications of Graph theoretic algorithms

List of Course Group Discussion Topics:

1. Greedy Algorithms Vs. Dynamic Programming strategy
2. Dynamic Programming Vs Greedy
3. NP-completeness
4. P Vs NP problems
5. Paradigms for algorithm design
6. Different Searching techniques
7. Relevance of Cook-Levin theorem
8. Backtracking strategy
9. Branch and Bound strategy
10. Application of Recursion

List of Home Assignments:

Design:

1. Divide and Conquer strategy for real world problem solving
2. Dynamic Programming strategy for real world problem solving
3. Greedy strategy for real world problem solving
4. Problems on NP completeness
5. Branch and Bound strategy

Case Study:

1. Encoding techniques
2. Network flow optimization algorithms
3. Huffman Encoding, LZW encoding
4. Sorting techniques
5. AKS primality test

Blog

1. Analysis of P Vs NP Problems and their solutions
2. Study and comparison of Complexity classes
3. Applications of Computational Geometry Algorithms
4. Role of number-theoretic algorithms in cryptography
5. Performance analysis of Graph Theoretic Algorithms

Surveys

1. Primality Testing Algorithms
2. Integer Factoring Algorithms
3. Shortest Path Algorithms
4. Algorithms for finding Minimum Weight Spanning Tree
5. SAT solvers

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Cormen, Leiserson, Rivest and Stein "Introduction to Algorithms" ,PHI 3nd edition, 2009. ISBN 81-203-2141-3
2. Jon Kleinberg, Eva Tardos "Algorithm Design", Pearson, 1st edition, 2005. ISBN 978-81-317-310-6
3. Dasgupta, Papadimitriu, Vazirani "Algorithms" McGraw-Hill Education; 1 edition (September 13, 2006), ISBN-10: 9780073523408, ISBN-13: 978-0073523408

Reference Books:

1. Motwani, Raghavan "Randomized Algorithms", Cambridge University Press; 1 edition (August 25, 1995), ISBN-10: 0521474655, ISBN-13: 978-0521474658
2. Vazirani, "Approximation Algorithms", Springer (December 8, 2010), ISBN-10: 3642084699, ISBN-13: 978-3642084690

MOOCS Links and additional reading material: www.nptelvideos.in

Course Outcomes:

The student will be able –

1) To formulate computational problems in abstract and mathematically precise manner
2) To design efficient algorithms for computational problems using appropriate algorithmic paradigm
3) To analyze asymptotic complexity of the algorithm for a complex computational problem using suitable mathematical techniques.
4) To differentiate among Complexity classes, and understand their interrelation
5) To establish NP-completeness of some decision problems, grasp the significance of the notion of NP-completeness and its relationship with intractability of the decision problems.
6) To incorporate appropriate data structures, algorithmic paradigms to craft innovative scientific solutions for complex computing problems

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	0	2	3	0	0	0	0	0	1	2	2	0
2	2	0	3	0	0	2	3	3	3	3	3	0	3	0
3	3	3	0	0	0	0	0	0	0	0	0	0	0	3
4	2	2	0	3	0	0	0	0	0	0	0	3	0	0
5	2	2	0	3	0	0	0	0	2	0	0	3	3	2
6	1	2	3	0	3	2	0	2	2	2	2	0	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 – Level 2
CO2 - Level 3
CO3 - Level 4
CO4 - Level 3
CO5 - Level 4
CO6 - Level 4

Future Courses Mapping:

Following courses can be learned after successful completion of this course:
Advanced Algorithms, Computational Geometry, Algorithmic Number Theory, Motion planning and Robotics

Job Mapping:

Algorithm design is an essential component of any job based on programming. All Industries in IT Engineering always look for a strong knowledge in Algorithm design and Data structures for positions like Developer, Architect, Principal Engineer, Backend lead engineer, Full stack developers, Solution architect, Solution / Senior engineer, Technical lead etc

FF No. : 654

IC4201: INDUSTRIAL ELECTRONICS

Course Prerequisites: Basic knowledge electrical and electronics engineering

Course Objectives:

1. To understand the operation of various power devices
2. Knowledge of protection techniques for power devices
3. To understand power devices driving techniques and driver circuits
4. Study various power electronics circuits and their analysis
5. To Learn various power electronics circuits for industrial applications
6. To understand power electronics in Electric vehicles and solar photovoltaic systems

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

This course gives knowledge of power electronics and its industrial applications. Almost in all industries power electronic systems are used either for power power supply, control, conversion and other applications. Power electronics is also involved in electric vehicles and renewable energy systems which have a great scope currently and also in future.

SECTION-1

Power electronics devices: Introduction to various power devices such as SCR, TRIAC, DIAC, IGBT, silicon and silicon carbide MOSFETs. Construction, characteristics, specifications and selection of the above devices.

Power dissipation and heat sink design: Static and dynamic switching losses in power devices. Power dissipation calculations, cooling requirement, heat sink design and selection. Over current and overvoltage protection of power devices.

Power device drivers and protection techniques: Various driver ICs such as isolated, non-isolated, low side, high side etc. Interfacing power devices with digital logic circuits and microcontrollers-based systems. Protection devices such as semiconductor fuses, resettable fuses, PTC thermistors, MOV, TVS, snubber and overcurrent protection circuits for protection of power devices. Series and parallel operation of power devices. Driving requirement for power devices.

SECTION-2

AC power control and controlled rectifiers: Single phase-controlled rectifiers, three phase half wave, full wave rectifiers, AC power control techniques. Calculations of RMS and average values. Power factor improvement. Static switches.

DC to DC converters: Non-isolated dc-dc various converters such as buck, boost, buck boost etc. Transformer isolated dc-dc converters such as flyback, forward, push-pull, half bridge and full bridge. Bidirectional converters.

Industrial applications: SMPS, Inverters and UPS systems. Induction and dielectric heating. Temperature and light intensity control. Speed control of AC and DC motors. Variable frequency drives for AC induction motor. LED drivers. Solar photovoltaic power converters. Power converters for electric vehicles. Wireless power transmission.

List of Tutorials:

1. Power device selection for a given application
2. Power dissipation calculation in a power device
3. Selection of a driver IC for a given power device
4. Comparison of power devices
5. Design of a boost converter
6. Design of an LED driver
7. Selection of a solar panel
8. Selection of batteries for UPS system
9. Calculation of efficiency of an UPS system
10. Design of a solar photovoltaic system

List of Practicals:

1. Study of various power devices.
2. Demonstration of operation of various types of protection devices
3. Design and mounting of a heat sink
4. Design of a crowbar circuit.
5. Design of a phase control circuit
6. Study of IGBT and MOSFET driver ICs
7. Interfacing of a power device with a microcontroller
8. Demonstration of an overcurrent protection circuit
9. Power electronics circuit simulation
10. Design of a driver circuit

List of Projects:

1. Speed control of a PMDC motor
2. Design of a boost converter
3. Design of a buck converter
4. Design of an inverter
5. Design of an induction heater
6. Design of an LED driver circuit
7. Battery charging system using a solar panel
8. Microcontroller based furnace temperature controller
9. Wireless battery charging system
10. Solar panel tracking system

List of Course Seminar Topics:

1. Silicon carbide power devices
2. Ferrite cores for power electronic transformers
3. Resettable fuses and applications
4. Electric vehicles
5. Hybrid electric vehicles
6. Overcurrent protection circuits for power devices
7. Super capacitors and applications
8. Smart grids
9. Resonant converters
10. Power electronics in robotics

List of Course Group Discussion Topics:

1. Scope for power electronics in various fields
2. Selection of fuses for overcurrent protection
3. HVDC transmission
4. IOT and power electronics
5. Selection of batteries for electric vehicles
6. Energy storage medium for power electronics
7. TRIAC applications
8. Renewable energy systems
9. Overcurrent sensing techniques
10. Power electronics in industrial process control

List of Home Assignments:

Design:

1. Snubber circuit design for a given application
2. Estimation of power losses and design of a heat sink
3. Design of a boost converter
4. Design of a buck converter
5. Sepic converter

Case Study:

1. Power converters in electric vehicles
2. Power electronic in wind energy system
3. Power electronics in locomotives
4. High power UPS systems
5. Rooftop solar photovoltaic system

Blog

1. GaN power devices and applications
2. Solar photovoltaic plants
3. SiC MOSFETs applications
4. Fuel cell
5. Electric vehicle battery charging

Surveys

1. Ferrite cores types and applications
2. Energy storage systems
3. Solar microinverters
4. Snubber circuits
5. Wind generators types and applications

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Singh, Khanchandani; Power Electronics; Tata McGraw-Hill Education, 2008.
2. Robert W. Erickson, Dragan Maksimovic; Fundamentals of Power Electronics, Springer.

Reference Books:

1. Ned Mohan; Power Electronics: A First Course; Wiley International.
2. Kambiz Ebrahimi, Yimin Gao, Stefano Longo; Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, 3rd Edition; CRC Press

MOOCS Links and additional reading material:

www.nptelvideos.in
http://www.nptelvideos.in/2012/11/power-electronics.html
http://www.nptelvideos.in/2012/11/industrial-drives-power-electronics.html

Course Outcomes: After completing the course the students will be able to

1. Select a suitable power device for the given applications
2. Select suitable protection devices and driver ICs for power devices
3. Design a required heatsink for the cooling requirements of the power devices
4. Analyse power electronic circuits
5. Contribute in the design and development of power electronic systems.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	4	3	3	2	4	1	-	1	1	1	-	2	1	1
2	4	3	3	2	4	2	-	1	1	1	-	2	3	3
3	4	3	3	3	4	2	-	1	1	1	-	2	3	3
4	4	3	3	3	4	2	-	1	1	1	-	2	3	3
5	4	4	3	3	4	2	-	1	1	1	-	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 – Level 2
CO2 - Level 3
CO3 - Level 5
CO4 - Level 4
CO5 - Level 3
CO6 - Level 4

Future Courses Mapping:

Mention other courses that can be taken after completion of this course

Job Mapping:

Job opportunities in UPS and Inverter manufacturing industries. Industries manufacturing AC and DC drives or motor controllers. In instrumentation industries where power electronics components are involved. Industries related to electric vehicles and solar photovoltaic power plants.

FF No.: 654

ET4232: DEEP LEARNING

Course Prerequisites: Linear algebra, probability theory and statistics, Digital signal processing, Computer vision

Course Objectives:

1. To present the mathematical, statistical and computational concepts for stable representations of high-dimensional data, such as images, text
2. To introduce NN and techniques to improve network performance
3. To introduce Convolutional networks
4. To introduce Sequential models of NN
5. To build deep nets with applications to solve real world problem

Credits: 2 **Teaching Scheme Theory: 2** Hours/Week

Course Relevance:

Deep learning is revolutionizing the technology and business world today. It is a subfield of machine learning concerned with algorithms to train computers to perform tasks by exposing neural networks to large amounts of data, its analysis and prediction. It is an incredibly powerful field with capacity to execute feature engineering on its own, uses multiple neural network layers to extract patterns from the data. Top applications of Deep learning involve, self-driving cars, natural language processing, robotics, finance, and healthcare.

SECTION-1
Foundations of neural networks and deep learning, Logistic regression as a neural network, different activation function, logistic regression cost function, logistic regression gradient descent, vectorizing logistic regression, forward and backward propagation, Techniques to improve neural networks: regularization and optimizations, hyperparameter tuning, batch normalization, data augmentation, deep learning frameworks, Implementation of neural network for a case study.

SECTION-2

Convolutional Neural Networks, padding, strided convolution, pooling layers, convolutional implementation of sliding windows, Applications: object classification, object detection, face verification. ResNet, inception networks, bounding boxes, anchor boxes. Sequence modelling: recurrent nets, architecture, vanishing and exploding gradient problem, Applications & use cases.

List of Course Seminar Topics:

1. Deep learning for Stock Market Clustering
2. Application of Deep Networks in health care
3. Credit card fraud detection
4. Classification of skin cancer with deep neural networks
5. ALEXNET
6. VCGNET
7. Accelerating Deep Network Training by Reducing Internal Covariate Shift
8. Deep learning applications for predicting pharmacological properties of drugs
9. GAN (Generalised Adversial network)
10. Auto encoders
11. LSTM

List of Course Group Discussion Topics:

1. Recurrent or Recursive Networks for sequential Modelling?
2. Initializing network weights vs performance
3. Difficulty of training deep feedforward neural networks
4. Hyperparameter tuning: Is there a rule of thumb?
5. Problem of overfitting: How to handle?

6 Which cost function: Least squared error or binary cross entropy?

7. How to tackle with loss of corner information in CNN
8. Need of hundred classifiers to solve real world classification problem
9. Which optimization: Batch gradient descent of stochastic gradient descent
10. Activation functions: Comparison of trends
11. Remedy of problem of vanishing gradient and exploding gradient in RNN

List of Home Assignments:

Design:

1. Deep learning for library shelf books identification
2. Development of control system for fruit classification based on convolutional neural networks
3. Classifying movie review using deep learning
4. Sentiment analysis of the demonetization of economy 2016 India
5. Predicting Students Performance in Final Examination

Case Study:

1. Deep learning for security
2. Bag of tricks for efficient text classification
3. Convolutional Neural Networks for Visual Recognition
4. Deep Learning for Natural Language Processing
5. Scalable object detection using deep neural networks

Blog

1. Brain tumor segmentation with deep neural networks
2. Region-based convolutional networks for accurate object detection and segmentation
3. Human pose estimation via deep neural networks
4. Content Based Image Retrieval
5. Visual Perception with Deep Learning
6. Music genre classification system

Surveys:

1. Machine translation using deep learning - survey
2. Shaping future of radiology using deep learning
3. Training Recurrent Neural Networks
4. Text generation with LSTM
5. Deep learning applications in Biomedicine

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Text Books:

1. Goodfellow, I., Bengio, Y., and Courville, A., Deeep Learning, MIT Press, 2016.
2. C., M., Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books:

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

MOOCS Links and additional reading material:

1. www.nptelvideos.in
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs11
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs50

Course Outcomes: Students will be able to

1. Demonstrate understanding of a logistic regression model, structured as a shallow Neural network.
2. Build and train a deep Neural Network.
3. Apply techniques to improve neural network performance.
4. Demonstrate understanding of functionality of all layers in a convolutional neural network.
5. Implement convolutional networks for image recognition/classification tasks.
6. Demonstrate Understanding of Recurrent nets and their applications.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	4	3	3	2	4	1	-	1	1	1	-	2	1	1
2	4	3	3	2	4	2	-	1	1	1	-	2	3	3
3	4	3	3	3	4	2	-	1	1	1	-	2	3	3
4	4	3	3	3	4	2	-	1	1	1	-	2	3	3
5	4	4	3	3	4	2	-	1	1	1	-	2	3	3
6	4	4	3	3	4	2	-	1	1	1	-	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 - Level 3
CO 2 - Level 3
CO 3 - Level 5
CO 4 - Level 4
CO 5 - Level 5
CO 6 - Level 4

Future Courses Mapping:

Advanced course on Deep learning including Autoencoders and Boltzmann machines, Reinforcement Learning.

Job Mapping:

Deep learning engineer, Data Scientist and Algorithm Architect with industries in domains Healthcare, Industrials & Energy, Automobiles, Finance & Insurance, Human Resources, Agriculture, Cybersecurity, Ad & Marketing, Media and Entertainment, Government, Defense

FF No.: 654

ET4242: PATTERN RECOGNITION

Course Prerequisites:

Knowledge of following courses is desirable:
Linear algebra, probability theory and statistics, Digital signal processing or image processing

Course Objectives:

1. To introduce the students to the basic concepts and methods for the recognition of patterns in data
2. To provide the student with a working knowledge of pattern recognition application development process
3. Understand and apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data
4. Apply different algorithmic approaches for the detection and characterization of patterns in multi-dimensional data
5. To introduce the curse of dimensionality and various methods of dimensions reduction

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

Pattern recognition techniques are used to automatically classify objects like handwritten characters, fruits, vehicles etc. or abstract multidimensional patterns into known or possibly unknown number of categories. Several commercial pattern recognition systems are available for character recognition, signature recognition, document classification, fingerprint classification, speech and speaker recognition etc.
A pattern recognition system can be designed based on a number of different approaches: (i) template matching, (ii) geometric (statistical) methods, (iii) structural (syntactic) methods, and (iv) neural (deep) networks. This course will introduce the fundamentals of statistical pattern recognition with examples from several application areas. The course will cover techniques for visualizing and analyzing multi-dimensional data along with algorithms for projection, dimensionality reduction, clustering and classification

SECTION-1

Pattern recognition systems, design cycle, learning and adaptation. Bayes decision theory, minimum error rate classification, Discriminant Functions, and Decision Surfaces, Normal density, discriminant functions for normal density. Parametric Techniques: maximum likelihood (ML) estimation, Bayesian parameter estimation. Non-parametric techniques: density estimation, Parzen windows, nearest neighbor estimation.

SECTION-2

Linear discriminant functions. Unsupervised learning and clustering: Mixture Densities, Maximum-Likelihood Estimates, unsupervised Bayesian Learning. Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical, Gaussian mixture models. Dimensionality reduction: Fisher discriminant analysis, Principal component analysis.
Applications of pattern recognition to real world problems.

List of Course Seminar Topics:
Pattern recognition applications in

1. Radar signal classification
2. Agriculture
3. Music analysis
4. Speech recognition
5. Image segmentation
6. Aerial photo interpretation
7. Handwriting Recognition
8. Text Classification
9. Diagnostic Systems
10. Military Applications

List of Course Group Discussion Topics:

1. Classification of alphanumeric characters
2. Classification of Devanagari and Roman scripts
3. Selection of classifier for classifying geometric objects
4. Selection of classifier for classifying fruits
5. Different methods to classify types of grains
6. Supervised and unsupervised classifiers
7. Discriminant analysis: Linear Vs Quadratic
8. Parametric and nonparametric techniques: Pros and cons
9. Linear and nonlinear classifiers

10. Machine Learning Vs Deep Learning

List of Home Assignments:

Design:

1. Shadow detection and removal
2. Classification of vehicles for parking purpose
3. Identifying people without mask for COVID-19
4. Design an algorithm to calculate the value of a resistor from it's image
5. Develop an application of pattern recognition for Automated Inspection System

Case Study:

1. Pattern recognition methods for texture analysis
2. Pattern Recognition: Plant Taxonomy
3. Bayes Estimator for multivariate Gaussian density
4. Pattern recognition of sport performance data
5. Identifying patterns in human affect (emotion) recognition

Blog

1. Pattern Recognition applications
2. Performance measure of different Pattern Recognition algorithms
3. Pattern Recognition: Generative methods
4. Pattern Recognition: Discriminative methods
5. Hidden Markov Model

Surveys

1. Component Analysis Techniques
2. Image pattern recognition in big data
3. Pattern recognition methods for image and video retrieval by contents
4. Edge detection techniques for identifying patterns
5. Biometric pattern recognition

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. R.O. Duda, P.E. Hart, G. G. Stork, "Pattern Classification," John Wiley and sons, 2004.
2. Theodoridis, Koutrombas "Introduction to Pattern Recognition," Academic Press, 3rd Edition.
3. C.M.Bishop, "Pattern Recognition & Machine Learning," Springer, 2006

Reference Books:

1. Morton Nadier and Eric Smith P "Pattern Recognition Engineering," John Wiley & Sons, New York, 1993
2. Robert J. Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches," John Wiley & Sons Inc., New York, 2007

MOOCS Links and additional reading material:

1. https://nptel.ac.in/courses/106/106/106106046/
2. https://nptel.ac.in/courses/117/106/117106100/
3. https://nptel.ac.in/courses/117/105/117105101/
4. https://nptel.ac.in/courses/117/108/117108048/
5. https://nptel.ac.in/courses/106/108/106108057/
6. http://www.cse.msu.edu/~cse802/
7. https://lme.tf.fau.de/teaching/free-deep-learning-resources/

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

1. Collect and critically interpret relevant information to design a simple pattern recognition system
2. Identify the strengths and weaknesses of different pattern classification techniques
3. Implement different pattern classifiers
4. Apply pattern recognition techniques to real-world problems
5. Evaluate the result from a simple pattern recognition system
6. Apply various dimensionality reduction methods for feature selection or feature extraction.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	0	0	0	0	0	0	0	0	2	3	0
2	2	3	0	0	0	0	0	0	0	0	0	2	0	0
3	3	2	3	0	2	0	0	0	2	0	0	0	3	0
4	3	3	3	0	2	2	0	0	2	0	2	0	2	3
5	0	2	0	3	2	0	0	0	0	0	0	0	2	0
6	3	2	0	0	2	0	0	0	0	0	0	2	2	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 -Level 4
CO 2 - Level 5
CO 3 - Level 3
CO 4 - Level 3
CO 5 - Level 4
CO 6 - Level 2

Future Courses Mapping:
Artificial intelligence, Machine Learning, Deep Learning

Job Mapping:
Students studying pattern recognition (machine learning) will have a wide array of opportunities before them, as our society is moving to automate significant numbers of processes performed by human beings today. Careers in pattern recognition and machine learning are increasing in demand, as algorithms are needed in more industries.

FF No. : 654

ET4243:DESIGN OF EXPERIMENTS

Course Prerequisites: Basic statistics, Matrix operations, Probability

Course Objectives: To make the students understand

1. Importance of planned experiment and related terms/concepts
2. Statistical concepts required for experimental design
3. How to test hypothesis
4. How to design and analyze experiments efficiently and effectively,
5. Analyze the resulting data to obtain objective conclusions.
6. Model processes using experimental data and confirm model adequacy

Credits: 2 **Teaching Scheme** Theory: 2Hours/Week

Course Relevance:
Design of experiments (DOE) is a systematic, rigorous approach to engineering problem-solving that applies principles and techniques at the data collection stage to ensure the generation of valid, defensible, and supportable engineering conclusions. This also helps in modeling and optimization of processes. Hence important for all Engineering disciplines

SECTION-1
Concepts of Experimental design: Strategy of experimentation, applications of experimental design, characterizing a process, optimizing a process variable, principles of experimental design replication, randomization, blocking, design guidelines, statistical techniques in experimentation, applications. **Statistics for Simple comparative experiments:** Probability distributions, sampling and sampling distributions, properties of sample, mean, variance, degrees of freedom, normal distribution, standard normal distribution, Chi square distribution, t distribution, f distribution, hypothesis testing, confidence intervals. **Experiments with single factor:** Analysis of Variance (ANOVA), fixed effect and random effect model, analysis of fixed effect model, decomposition of total sum of squares, Cochrans theorem, model adequacy checking, Introduction to Minitab

SECTION-2

2^k Factorial design: Basic definitions and principles, advantages of factorials, two factor factorial design, statistical analysis of fixed effect model, analysis of variance table for two factor factorial design fixed effect model, Interaction and main plots, model adequacy checking, normal probability plot, pareto plots, plot of residuals versus fitted values

Regression models: Regression fitting for 2^k factorial design, Linear regression model, simple and multiple regression analysis, estimation of parameters, predicted values, least squares fit, residuals and diagnostics

Advanced techniques: Introduction to fractional factorial Designs, Robust design: Taguchis philosophy, Used cases with the help of Minitab.

List of Course Seminar Topics:

1. Partial Factorial Designs
2. Taguchi Designs
3. DOE in process industry
4. DOE for process optimization
5. Applications of DOE
6. Interpretation of different plots in DOE
7. Minitab: A tool for DOE
8. Use of ANOVA in DOE
9. Importance of sampling design in DOE
10. Randomized complete block design

List of Course Group Discussion Topics:

1. Full factorial Vs Partial Factorial Designs
2. Main effects and interaction effects in factorial designs
3. DOE in banking sector
4. DOE in financial sector
5. Two paired t tests
6. Comparison of Student's t test and ANOVA
7. DOE in marketing sector
8. Model adequacy checking
9. Parametric Vs. Nonparametric tests
10. Response surface methods

List of Home Assignments:

Design:

1. Design of Full factorial experiment, carrying out experimentation, analyze experimental data, conduct model adequacy checking and suggest solution for an industrial problem statement
2. Design of Full factorial experiment, carrying out experimentation, analyze experimental data, conduct model adequacy checking and suggest solution for problem statement in health care
3. Design of Full factorial experiment, carrying out experimentation, analyze experimental data, conduct model adequacy checking and suggest solution for a problem statement related to environmental care
4. Design of Full factorial experiment, carrying out experimentation, analyze experimental data, conduct model adequacy checking and suggest solution for a problem statement related to societal issues
5. Design of Full factorial experiment, carrying out experimentation, analyse experimental data, conduct model adequacy checking and suggest solution for a problem statement related to education sector

Case Study:

1. Process characterization and optimization in a manufacturing industry
2. Quality improvement using DOE in an IT industry
3. Product design using Taguchi method
4. Application of Taguchi method in CMOS technology
5. Design of experiment case study in healthcare

Blog

1. Applications of experimental design in industry
2. Reliability issues in industries: Experimental design to rescue
3. Robust Experimental Design
4. Six sigma
5. Use of Six sigma in various sectors

Surveys

1. Agricultural Yield maximization using DOE
2. Applications of DOE in an IT industry
3. Application of DOE in project management
4. Application of DOE in supply chain and logistics
5. Improvement in Food product quality using DOE

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Douglas Montgomerry, Design and analysis of experiments, (2007), Wiley India
2. C.R.Kothari, Research Methodology: Methods and Techniques, Second revised edition, New age publication, second revised edition.

Reference Books:

1. Douglas Montgomery, Applied statistics and probability for engineers,(2007), Wiley India,
2. Das M.N. and Giri N, Design and Analysis of Experiments, Wiley Eastern, New Delhi.

MOOCS Links and additional reading material:

https://nptel.ac.in/courses/102/106/102106051/

Course Outcomes: The student will be able to –

1. Demonstrate understanding of importance of experimental design
2. Compare different statistical distributions
3. Formulate and test Hypothesis
4. Design/ Analyze factorial experiments
5. Model cause effect relationship using regression
6. Analyse adequacy of process model

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	4	3	3	2	4	1	0	1	1	1	0	2	1	1
2	4	3	3	2	4	2	0	1	1	1	0	2	3	3
3	4	3	3	3	4	2	0	1	1	1	0	2	3	3
4	4	3	3	3	4	2	0	1	1	1	0	2	3	3
5	4	4	3	3	4	2	0	1	1	1	0	2	3	3
6	4	4	3	3	4	2	0	1	1	1	0	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO Attainment Level:

CO1: Level 3
CO2: Level 3
CO3: Level 4
CO4: Level 3
CO5: Level 3
CO6: Level 4

Future Courses Mapping:

Six sigma.

Job Mapping:

DOE techniques are applied in various sectors like aerospace, electronics, telecom, banking and financial services, IT, HR, marketing, and many more industries. These techniques can be applied to streamline business processes, improve employee acceptance, reduce costs, and increase revenue—all of which lead to a better bottom line, no matter the industry. Knowledge of quality improvement throughout the team or organization will enhance leadership skill set, making him even more valuable. It can be useful in professional roles like Business Analyst, ·Data Scientist, Project Engineer, IT Project manager, Manufacturing Engineer, Process Development Engineer, · Reliability Engineer, ·Quality Engineer etc.

FF No. : 654

ET4244: CMOS RF INTEGRATED CIRCUITS

Course Prerequisites

Good Understanding of Semiconductor Devices (more specifically MOSFET), Knowledge of Analog Circuit Design**,** SPICE Simulations, Frequency response of Devices and Circuits.

Course Objectives

The overall objective of this course is to present the concepts of design and analysis of modern RF and wireless communication integrated circuits.

1. Introduce to the students the RF and Wireless Technology (the Big Picture)
2. Understand the MOSFET from RF perspective
3. Learn analysis of circuits at high frequencies using Scattering parameters
4. Understand the issue of Input Matching and then learn various LNA topologies
5. Design of Loop Filters, VCO and PLL

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

The rapid expansion of wireless communications services over the last decade has led to an explosion in the development of integrated circuit approaches in the RF area. Highly integrated RF components, low-noise and power amplifiers, and frequency synthesizers, are now commonplace, replacing hybrid circuits employing discrete semiconductor devices. The successive growth of electronics, Internet-of-Things (IoT), and wireless communication have been advanced due the development of complementary-metal-oxide-semiconductor (CMOS) technology. These developments result in low-power and high-performance integrated circuit (IC) designs for analog and radio-frequency applications especially in the area of new generation handheld devices. With exploration and development of CMOS technology, we could have low cost, small size and low voltage circuitry promising to integrate the whole system on a single chip. The challenges are continuous and imply motivation in exploration of RF Architectures.

SECTION-1
Introduction to RF and Wireless Technology, Basic Concepts in RF Circuits, MOSFET - RF perspective, Transmission media and Reflections, Passive Components - Resistor, Inductor, Capacitor, Series and Parallel RLC networks, S parameters.

SECTION-2

Noise, Low Noise Amplifier (LNA), HF Power Amplifier, Mixer, Voltage Controlled OScillator (VCO), Phase-Locked Loop (PLL), Integrated Circuit Fabrication process (various steps), materials, and techniques involved in IC Fabrication.

List of Course Seminar Topics:

1. Mobile RF Communications
2. Wireless Standards
3. Transceiver Architectures
4. Oscillators
5. Noise in Electronics
6. Frequency Synthesizers
7. Power Amplifier - Classes
8. Digital Modulation
9. Multiple Access Techniques
10. TCAD Tools for RF Design

List of Course Group Discussion Topics:

1. Impact of On-Chip Interconnections on CMOS RF Integrated Circuits
2. CMOS-compatible RF-MEMS devices for integrated circuit design
3. Impact of semiconductor technology scaling on CMOS RF and digital circuits for wireless application
4. CMOS integrated digital RF MEMS capacitors
5. SiGe BiCMOS and CMOS platforms for Optical and Millimeter-Wave Integrated Circuits
6. Improving Yield on RF-CMOS ICs
7. CMOS LNA for healthcare applications
8. Efficiency improvement techniques for RF power amplifiers in deep submicron CMOS
9. Track-and-Hold circuit in 0.18 µm CMOS process for RF applications
10. Nano-Power CMOS Voltage References for RF-Powered Systems

List of Home Assignments:

Design:

1. Low power CMOS low noise amplifier for wideband wireless systems
2. Differential LNA using 180 nm CMOS Technology
3. Digitally controlled oscillator in 65-nm CMOS technology
4. Design and optimization of a CMOS power amplifier
5. RF MEMS Capacitive Shunt Switch

Case Study:

1. Cryogenic performance of a 3–14 GHz bipolar Si - Ge low-noise amplifier

2. On chip miniaturized antenna in CMOS technology
3. RF Schottky diode in 22-nm CMOS
4. Zero-IF double-balanced mixer for WiMAX receivers
5. Linearity of RF mixers in GHz applications

Blog

1. RF LDMOS Transistors
2. RF SOI Devices
3. Tri-state inverter based DCO
4. A direct digital-to-RF converter (DRFC)
5. Thermoelectric Generators: Technologies and common applications

Surveys

1. Linear wideband LNA
2. RF transistors: Recent developments and roadmap toward terahertz applications
3. CMOS based capacitive sensors
4. GaN HEMT broadband power amplifiers
5. Materials: Silicon and beyond.

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. RF Microelectronics, 2nd Edition, by Behzad Razavi, Prentice Hall
2. The Design of CMOS Radio-Frequency Integrated Circuits, by Thomas H. Lee.

Reference Books:

1. Journal and Conference papers

MOOCS Links and additional reading material: www.nptelvideos.in

Course Outcomes: The students will be able to

1. differentiate between HF and LF MOSFET model
2. Calculate S - parameters
3. perform impedance matching
4. identify various LNA topologies
5. list the techniques of improving MIXER linearity
6. Draw the basic block schematic of PLL

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1	3	1	0	0	2	2	1	2	2	1
2	3	2	1	1	3	1	0	0	2	2	1	2	2	1
3	3	2	1	1	3	1	0	0	2	2	1	2	2	1
4	3	2	1	1	3	1	0	0	2	2	1	2	2	1
5	3	2	1	1	3	1	0	0	2	2	1	2	2	1
6	3	2	1	1	3	1	0	0	2	2	1	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 - level 5
CO2 - level 3
CO3 - level 4
CO4 - level 3
CO5 - level 4
CO6 - level 2

Future Courses Mapping:

RF Circuit Design, CMOS Mixed Circuit Design

Job Mapping:

This course will begin with the notion of Radio Frequency, CMOS and Integrated Circuits (in fact, the whole course will revolve around these three words). Brief contents - MOS device (from RF perspective), RF Architectures, Passive Components, HF Amplifier design, Low Noise Amplifier (LNA), Phase Locked Loop (PLL), Mixers, Oscillators, etc. Alongside, the students will also learn about some fundamentals like impedance matching, power measurements, bandwidth estimation and so on. The course will also glance through the captivating Integrated Circuit Fabrication process and the various steps, materials, and techniques involved in IC Fabrication. Overall, the course will enhance knowledge of the learner about Radio Frequency Design which is applied in most of the jobs available in ALL Wireless and Telecommunication based companies designing RF products.

FF No. : 654

CS4213: NETWORK SECURITY

Course Prerequisites: Computer Networks

Course Objectives:

1. Learners must be able to discover the programming bugs that will be malicious code, they also must be able to explain various attacks and resolve the bugs to mitigate the treats.
2. Learners must be able to apply various cryptographic techniques to secure the systems developed.
3. Discover and explain various authentication and authorization methods with the access control
4. Articulate the use of various standard security protocols for the layered architecture.
5. Formulate mathematical solutions to security problems
6. Articulate the security threats to critical infrastructures

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:
Digitization and widespread use of internet communication, most of the users on the network are vulnerable to the various attacks. It is need of time to know the various types of attack and vulnerabilities which lead to attack. Also it becomes of paramount importance to study the techniques to secure the network and transfer of data through the network. It is very important at this time to know how to secure the transmission of the data.

SECTION-1
Introduction to Attacks and Hacking: Introduction to Security: Vulnerabilities, Threats, Threat Modeling, Risk, attack and attack types, Avoiding attacks, Security services. Trustworthiness, Ethical issues and practices, Tradeoffs of balancing key security properties - Confidentiality, Integrity, and Availability. Protocol Vulnerabilities: DoS and DDoS, session hijacking, ARP spoofing, Pharming attack, Dictionary Attacks. Software vulnerabilities: Phishing, buffer overflow, Cross-site scripting attack, Virus and Worm Features, Trojan horse, Social engineering attacks, ransomware, SYN-Flooding, SQL- injection, DNS poisoning, Sniffing, **Cryptography:**

Private key cryptography: Mathematical background for cryptography: modulo arithmetic, GCD (Euclids algorithm), algebraic structures (Groups, Rings, Fields, Polynomial Field). Role of random numbers in security, Importance of prime numbers

Data Encryption Standard: Block cipher, Stream cipher, Feistel structure, round function, block cipher modes of operation, S-DES, Attacks on DES, S-AES, AES.

SECTION-2

Public key cryptography: RSA: RSA algorithm, Key generation in RSA, attacks on RSA. Diffie-Hellman key exchange: Algorithm, Key exchange protocol, Attack. Elliptic Curve Cryptography (ECC): Elliptic Curve over real numbers, Elliptic Curve over Zp, Elliptic Curve arithmetic. Diffie-Hellman key exchange using ECC. .

Authentication and Authorization: Network Access Control: Network Access Control, Extensible Authentication Protocol, SHA-512, Kerberos, X.509 authentication service

IP Security, Database Security, File Security, Mobile Security

Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application

Email security: PGP and SMIME

List of Course Seminar Topics:

1. Blcokchain architecture and its implementation
2. Cloud Security
3. Mobile Security
4. IoT and Security Issues/ Security Models for IoT
5. Darkweb
6. Docker Security

Access control methods for online social media and various organizations

8. Security of Android Vs IOS
9. Machine learning and SCADA Security
10. Security Applications for Smart Cities

List of Course Group Discussion Topics:

1. Security Issues in Android and IOS devices
2. Industry 4.0 and security
3. Blockchain and E-voting system
4. Security of Aadhar Card and other digital cards
5. Automated Home Appliances and Security
6. Programming Bugs and Malicious code in information security
7. Indian Cyber laws and Deficiencies
8. Social Media and Cyber Security
9. Child abuse on online social media and security
10. Need of cyber crime and security in school education.

List of Home Assignments:

Design:

1. Design a secure system using cryptography techniques for security of multimedia files.
2. Design a secure system using steganography for hiding data files in image/video
3. Design a system for educational institutes using authentication and authorization techniques, also give details about the access control policies that must be implemented for the design of system by various places.
4. Design a secure system using SSL/TLS/IPSec for the various organizations
5. Design a system for the analysis of cyber crime using various cyber forensic techniques and compare each technique with respect to integrity, confidentiality, availability

Case Study:

1. How to improve the security of social media? Write a detail case study
2. Find out the vulnerability issues in educational institutes websites/online systems and give solutions to these problem. Perform a detailed case study of the various issues.
3. Write a detail case study about the banking security flows and solutions to these flows.
4. Give a detail case study of the antivirus system giving the flows and solutions to it.
5. Perform the detail case study of various operating systems used for mobile devices and give a secure solution to one for widely used OS.

Blog

1. Dark Web
2. Crypto currency and Economy
3. Cyber crime and solutions
4. Authentication and Access control for social media

Cyber forensic and Cyber laws

Surveys

1. Survey on various blockchain related issues/ cryptocurrency/ application systems developed using blockchain
2. Survey on various authentication and access control methods for different applications
3. Steganography and Biometric Systems for authentication
4. Survey of various attacks and its effect on Indian economy and its analysis
5. Problems over Integer Lattices: A Study

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. William Stallings; "Cryptography and Network Security-Principles and Practices", 6th Edition , Pearson Education, 2014, ISBN13:9780133354690.
2. Bernard Menezes, "Network Security and Cryptography", 1st Edition, Cengage Learning, 2010, ISBN 81-315-1349-1.
3. Raef Meeuwisse, "Cybersecurity for Beginners", 2nd Edition, Cyber Simplicity, 2017, ISBN- 9781911452157.

Reference Books:

1. M. Speciner, R. Perlman, C. Kaufman, "Network Security: Private Communications in a Public World", Prentice Hall, 2002.
2. Michael Gregg, "The Network Security Test Lab: A Step-By-Step Guide", Dreamtech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.
3. Matt Bishop, "Computer Security: Art and Science", 1st Edition, Pearson, Education, 2002..
4. Charlie Kaufman, Radia Perlman and Mike Spencer, "Network security, private communication in a public world", 2nd Edition, Prentice Hall, 2002.
5. V.K. Pachghare, "Cryptography and Information Security", 2nd Edition, PHI, 2015.

MOOCS Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1) Analyze cryptographic techniques using a mathematical approach by examining nature of attack.
2) Identify and establish different attacks on the system
3) Justify various methods of authentication and access control for application of technologies to various sections of industry and society.
4) Design a secure system for protection from the various attacks for 7 layer model by determining the need of security from various departments of an organization
5) Estimate future needs of security for a system by researching the current environment on a continuous basis for the benefit of society.
6) Analyze various types of threats in the networking attack.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	0	0	3	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	3	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	2	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	2	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	1	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1-Level 4
CO2-Level3
CO3- Level 5
CO4- Level 3
CO5- Level 2
CO6- Level 1

Future Courses Mapping:

Blockchain Technologies, Ethical Hacking and Network Defense, Cloud and Data Security

Job Mapping:
Security Engineer/Network Security Engineer
Information Security Analyst, Cyber Security Analyst
Cyber Security Associate, Manager-Information Security Services
Security Consultant, Penetration Testing Engineer

FF No. : 654

CS4201: CLOUD COMPUTING

Course Prerequisites: Operating Systems, Fundamentals of Computer Networks

Course Objectives:

1. To become familiar with Cloud Computing and its ecosystem
2. To learn basics of virtualization and its importance
3. To evaluate in-depth analysis of Cloud Computing capabilities
4. To give a technical overview of Cloud Programming and Services.
5. To understand security issues in cloud computing

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

Cloud computing to enable transformation, business development and agility in an organization.

SECTION-1
Introduction to Cloud Computing: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Evolution of cloud computing Cloud Computing Architecture: Cloud versus traditional architecture, Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), , Public cloud, Private cloud, Hybrid cloud, Community cloud, Google Cloud architecture, The GCP Console, Understanding projects, Billing in GCP, Install and configure Cloud SDK, Use Cloud Shell, GCP APIs Infrastructure as a Service (IaaS): Introduction to IaaS, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM), Compute options in the cloud, Exploring IaaS with Compute Engine, Configuring elastic apps with autoscaling, Storage options in the cloud, Structured and unstructured storage in the cloud, unstructured storage using Cloud Storage, SQL managed services, Exploring Cloud SQL, Cloud Spanner as a managed service, NoSQL managed service options, Cloud Datastore, a NoSQL document store, Cloud Bigtable as a NoSQL option.

SECTION-2

Platform as a Service (PaaS): Introduction to PaaS, Service Oriented Architecture (SOA). Cloud Platform and Management, Exploring PaaS with App Engine, Event driven programs with Cloud Functions, Containerizing and orchestrating apps with Google Kubernetes Engine
Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS,
Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing and accounting, Billing in GCP
Cloud Security: Introduction to security in the cloud, the shared security model, Encryption options, Authentication and authorization with Cloud IAM, Identify Best Practices for Authorization using Cloud IAM.
Cloud Network : Introduction to networking in the cloud, Defining a Virtual Private Cloud, Public and private IP address basics, Google's network architecture, Routes and firewall rules in the cloud, Multiple VPC networks, Building hybrid clouds using VPNs, interconnecting, and direct peering, Different options for load balancing.

List of Course Seminar Topics:

1. Storage Cost Optimization On Cloud
2. Cloud Security And Cryptography
3. Infrastructure As A Code (IAC)
4. Cloud Computing In Healthcare
5. Serverless Architecture
6. Deployment Of Microservices In Kubernetes Engine
7. RPA Using AWS Cloud
8. Cloud Trends In Supporting Ubiquitous Computing
9. Mobile Cloud Computing
10. Modern Data Center Architecture

List of Course Group Discussion Topics:

1. Data Storage Security in Cloud
2. Cloud Services for SMB's
3. Monitoring Services Provided by GCP and AWS
4. Docker and Kubernetes
5. SaaS vs FaaS (Function as a service)
6. Hybrid Cloud
7. GCP Vs AWS Web Service Architecture
8. Cloud based security issues and threats
9. Authentication and identity
10. Future of Cloud-Based Smart Devices

List of Home Assignments:

Design:

1. Serverless Web App to order taxi rides using AWS lambda.
2. Deploying App on Kubernetes
3. Serverless web Application (GCP Cloud Functions)
4. Demonstration of EBS, Snapshot, Volumes
5. Single Node Cluster Implementation (Hadoop)

Case Study:

1. PayU Migration to AWS
2. Cloud object storage
3. Deployment and Configuration options in AWS
4. Deployment and Configuration options in Microsoft Azure
5. Deployment and Configuration options in GCP

Blog

1. Comparing design of various cloud computing platforms
2. AWS EKS and Google Cloud Functions
3. App Engine
4. Cloud Endpoints
5. Cloud Pub/Sub

Surveys

1. Disaster Recovery in Cloud Computing
2. Cloud Economics
3. Data archiving solutions
4. Salesforce
5. Dropbox

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, “Cloud Computing for Dummies”, Wiley,India.
2. Ronald Krutz and Russell Dean Vines, “Cloud Security”, Wiley-India
3. Gautam Shroff. “Enterprise Cloud Computing”, Cambridge

Reference Books:

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India
2. Antohy T Velte, et.al, "Cloud Computing : A Practical Approach", McGraw Hill.
3. Michael Miller, "Cloud Computing", Que Publishing.
4. Tim Malhar, S.Kumaraswammy, S.Latif, "Cloud Security & Privacy", O'REILLY
5. Scott Granneman, "Google Apps", Pearson

MOOCS Links and additional reading material:

https://nptel.ac.in/courses/106/105/106105167/
https://swayam.gov.in/nd1_noc20_cs55/preview
https://www.coursera.org/specializations/cloud-computing

Course Outcomes:

1. Describe the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing.
2. Explain the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud.
3. Identify problems, and explain, analyze, and evaluate various cloud computing solutions.
4. Choose the appropriate technologies, algorithms, and approaches for the related issues.
5. Display new ideas and innovations in cloud computing.
6. Collaboratively research and write a paper on the state of the art (and open problems) in cloud computing.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	0	3	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	3	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	2	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	2	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	1	0	0	0
6	0	3	0	0	0	0	0	0	0	0	0	0	0	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1- Level 1
CO2- Level 2
CO3- Level 3
CO4- Level 5
CO5- Level 4
CO6- Level 3

Future Courses Mapping:

After completing this course different certifications courses in cloud be taken such as AWS, Azure, Google cloud certifications. One can go for higher studies in specialization of cloud computing and allied subjects.

Job Mapping:

Cloud Architect, Cloud Engineer, Cloud Administrator, Solutions Architect - Cloud Computing - AWS / Kubernetes, Cloud Computing Technical Consultant, Associate Cloud Computing Engineer, Cloud Computing Trainer

FF No. : 654

IT4202: COMPUTER VISION

Course Prerequisites:

Knowledge of Linear Algebra & Different types of Signals, Image Processing

Course Objectives:

1. To introduce the major ideas, methods, and techniques of computer vision
2. To acquaint with Image segmentation and shape representation.
3. To learn pattern recognition.
4. To explore object recognition and its application

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

Computer vision is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to understand and automate tasks that the human visual system can do.

SECTION-1
Image Formation Models : Fundamentals of Image Processing, Monocular imaging system, Radiosity: The „Physics‟ of Image Formation, Radiance, Irradiance, BRDF, color etc, Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading, Photometric Stereo, Depth from Defocus, Construction of 3D Model from images. **Image Processing and Feature Extraction-**Image preprocessing, Image representations (continuous and discrete), Edge detection. **Shape Representation and Segmentation**: Classification of Image segmentation techniques: Image Segmentation: Edge Based approaches to segmentation, Gradient using Masks, LOG, DOG, Canny, Edge Linking, Line detectors (Hough Transform), Corners – Harris, Region Growing, Region Splitting, Medial representations, Multiresolution analysis

SECTION-2

Motion Estimation: Regularization theory , Optical computation , Stereo Vision , Motion estimation , Structure from motion **.**

Object recognition: Object Recognition { Need, Automated object recognition system, pattern and pattern class, relationship between image processing and object recognition, approaches to object recognition. Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Singular Value Decomposition Shape priors for recognition.

Image Understanding: Pattern recognition methods, HMM, GMM and EM

Applications: Photo album – Face detection – Face recognition

List of Projects:

1. Image and Video Enhancement models
2. Human Motion Detection
3. Object Detection Model
4. Face Recognition Model
5. Dynamic Texture Synthesis
6. Image and Video Editing
7. Develop an application for a vision-based security system during day/night time. the system should trigger an audio- visual alarm upon unauthorized entry.
8. Develop motion estimation/ tracking system to recognize object of interest related to one of the following applications. (Automobile tracking/ face tracking/ human tracking)

List of Course Seminar Topics:

1. Various Image Segmentation techniques
2. New trends in Face recognitions
3. Applications of Computer Vision for Traffic management
4. Facial Expression recognitions
5. Gesture recognitions using Computer Vision
6. Autonomous Car
7. Usage of Computer Vision in Robotics
8. AR VR using Computer Vision

List of Course Group Discussion Topics:

1. Object Recognitions,
2. 3-D models and its applications,
3. Image Understanding-Pattern Recognition Models,

4. Face detection models,
5. Image Understanding-Pattern Recognition Models,
6. Image Segmentation

List of Home Assignments:

Case Study:

1. Computer Vision for Smart City
2. Computer Vision for AR AVR
3. Research Areas in Computer Vision
4. Computer Vision for Swastha Bharat
5. Computer Vision in IoT
6. Computer Vision in Health Analytics
7. Computer Vision in wearable computing

Blog

1. Computer Vision for Data Science
2. Computer Vision for Smart Agriculture
3. Computer Vision in Medical Field
4. Usage of AI for Computer Vision
5. Job Opportunities in Computer Vision
6. Usage of Image Processing in Computer Vision, Machine Learning, Deep Learning, and AI

Surveys

1. Computer Vision for Educations
2. Classifications and Recognitions
3. Drone based Surveillance
4. Video Editing
5. Human Motion/Object tracking and detections
6. Computer Vision using High-Performance Computing-Computational
7. Complexity/Time Complexity and Execution time
8. Recent Trends in Computer Vision

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications (CVAA)",
2. Springer, 2010.
3. E. R. Davies, "Computer & Machine Vision," Fourth Edition, Academic Press, 2012.
4. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
5. Rafael Gonzalez & Richard Woods, "Digital Image Processing," 3rd Edition, Pearson publications, ISBN 0132345633.

Reference Books:

1. D. Forsyth and J. Ponce, "Computer Vision - A modern approach," Prentice Hall.
2. E. Trucco and A. Verri, "Introductory Techniques for 3D Computer Vision," Publisher: Prentice Hall.
3. D. H. Ballard, C. M. Brown, " Computer Vision", Prentice-Hall, Englewood Cliffs, 1982.

MOOCS Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1. Extract features from Images and do analysis of Images
2. Generate 3D model from images
3. Understand video processing, motion computation and 3D vision and geometry
4. Apply pre-processing algorithms to acquired images
5. Develop feature descriptor for object detection purpose.
6. Make use of Computer Vision algorithms to solve real-world problems

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	0	2	0	3	0	1	1	2	0	1	1	1	1
2	1	0	2	1	3	1	1	1	2	0	1	2	1	1
3	2	0	2	1	3	2	3	1	2	1	1	2	1	2
4	2	3	2	0	3	0	1	1	2	0	1	1	2	3
5	2	3	2	1	3	1	2	1	2	0	1	2	2	3
6	2	3	2	0	3	0	2	1	2	0	1	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1-Level 2
CO2- Level 3
CO3- Level 4
CO4- Level 2
CO5- Level 4
CO6- Level 5

Future Courses Mapping:

Following courses can be learned after successful completion of this course:
AR VR, NLP,AI, ML, DL, Video Analytics using GPU.

Job Mapping:

Machine Vision Engineer, Associate Data Scientist Computer Vision, Data Scientist-Computer Vision, tensor RT, Keras, Lead Scientist - Image Analytics & Signal Processing - Deep Learning, Software Development Engineer - Image Processing, Image Processing & Computer Vision Engineer, Architect - Video and Image Processing, Lead - Medical Image Analysis Developer, Research Engineer - Computer Vision, , Image Analysis Scientist - Image Processing/Pattern Recognition.

FF No. : 654

IC4215: DCS AND COMMUNICATION PROTOCOLS

Course Prerequisites: Basic automation concept

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

SECTION-1

DCS Introduction: Location of DCS in Plant, advantages and limitations, Comparison of DCS with PLC, DCS components/ block diagram DCS Architecture Functional requirements at each level, Database management.

DCS Hardware: Layout of DCS, Controller Details Redundancy, I/O Card Details Junction Box and Marshalling Cabinets Operator Interface, Workstation Layout different types of control panels, types of Operating Station Programming as per IEC 61131-3, Advantages, Overview of Programming Languages, Device Signal Tags Configuration, Programming for live Process.

Database and Alarm management Database management: Historical data using in log, report and trend display. System status display, Process reports different types of logs and reports. Philosophies of alarm management, alarm reporting, type of alarm generated and accepted of alarms. Functional Layered Models - OSI reference model, System engineering approach, Input / Output Structures, Control Unit Structure, Protocols, Communication principles and modes: network topology, transmission media, noise, cable characteristic and selection; bridges, routers and gateways, Instrumentation and control devices Explain functions of following network devices: Repeater, Hub, Bridge, Switch, Router, Gateway, Access point, Wireless Access points.

SECTION-2

Serial data communications: Serial data communications interface standards, balanced and unbalanced transmission lines, RS-232. standard, RS-449 interface standard, RS-423 interface standard, RS-422 interface standard, Comparison of RS/EIA interface standard ,Universal Serial Bus (USB),Parallel data communication interface standard ISO-OSI Model, Modbus, CSMA/CD, CA protocol, OSI implementation for Industrial communications, Industrial control applications: ASCCII- based protocol – ANSI

HART Communication Protocol:

Architecture - physical, data link, application layer, communication technique, normal and burst mode of communication, benefits of HART.

AS – I (Actuator sensor interface):OSI layer, CAN communication protocol, SPI, I2C

Introduction Fieldbus and ProfiBus: Introduction to Foundation Fieldbus : Physical layer and wiring rules Data Link layer Application layer User layer Wiring and installation practice with Fieldbus Termination Preparation ,Installation of the complete system. Introduction to ProfiBus standard: ProfiBus protocol stack Physical layer Data Link layer Application layer.

List of Tutorials:

1) Develop PID tuning using DCS.
2) Design and development of cascade loop using FBD
3) Apply ratio control strategy on heat exchanger loop using FBD.
4) Develop different control strategy using DCS on boiler drum level control.
5) Develop interfacing serial card to DCS.
6) Study different serial communication protocols.
7) Apply different alarm management on distillation column .
8) Apply alarm system to heat exchanger based on alarm priority.
9) Apply cascade control strategy on heat exchanger loop using FBD
10) Apply ratio control strategy on heat exchanger loop using FBD.

List of Practicals:

1) Tune Delta –V PID control for any single loop process.
2) Develop feed forward control for SLPC using DCS.
3). Develop cascade control for process loop using DCS.
4). Develop override control for process loop using DCS.
5). Develop split range control for process loop using DCS.
6). Develop ratio control for process loop using DCS.
7). Develop three element drums level control using DCS.
8). Develop different boiler interlock using DCS.
9) Develop boiler combustion control using DCS.
10) Develop distillation column control using DCS.

List of Projects:

1).To Interfacing of Level/Temperature control loop using Delta-V DCS.
2).To develop communication between HART/MODBUS to DCS system
3). To develop simulation of boiler control
4). To develop simulation of distillation column
5). Section of DCS configuration for Multi process control loop(Flow+Level)
6). Control water level loop using MODBUS and simple AI/AO communication
7) To develop simulation of spray dryer using FBD.
8).To develop simulation of bottle filling plant using FBD.
9).To develop simulation of paint industry using FBD.
10).To develop simulation of packing industry using FBD.

List of Course Seminar Topics:

1).DCS junction box and Marshell cabinet.
2) Alarm managment system in DCS
3) DeltaV trends and faceplate
4) Hub and switch network
5) Serial communication using DeltaV DCS
6) Controller card
7) Different I/O card in DCS
8)PID configuration in Delta-V DCS
9) Database management in DCS
10) Electronic Marshalling in DCS

List of Course Group Discussion Topics:

1) Compare performance for foundation fieldbus and profbus
2) Compare HART and MODBUS communication for control CSTR loop
3) Control water level loop using MODBUS and simple AI/AO communication
4) Latest technology in DCS manufacturing
5) Compare ASI and Profibus DP
6) Compare DCS and PLC for Batch process control .
7) Architecture of different DCS
8) Compare Profibus and HART
9) Compare fieldbus and simple 4-20mA
10 Application of CAN -BUS

List of Home Assignments:

Design:

1.Design boiler interloop in DCS
2.Design of simulation for cascade control of distillation column
3. Develop control strategies for Distillation column
4.Develop serial communication for Process loop
5.Develop SFC logic for control any one chemical plant
6.Develop FBD logic to control Spray dryer
7.Develop FBD logic to control Heat exchanger
8.Develop interface step for DCS and profibus DP communication.

Case Study:

1. Case study - startup sequence of boiler
2. Case study of a distillation column of chemical industry
3. Network Topology used in DeltaV DCS.
4. DeltaV DCS use for serial communication.
5. Visit industry for DCS control plant

6. Automation spray dryer milk powder
7. Autoamtion for Heat exchanger
8. Profibus DP in automobile industry
9. Foundation fieldbus in process industry

Blog

1. Advance control strategies for boiler
2. Comparison of control strategies for distillation column.
3. PID based 3 element boiler control system
4. Use modbus card in DCS for communication
5. DCS system for chemical plant
6. Control strategies for spray dryer
7. Latest trends profibus .
8. Latest trends Foundation fieldbus

Surveys

1. Communication Protocols in DCS
2. Survey of Distillation column
3. Serial data communication in DCS
4. Simulation of petrol chemical plant
5. Automation on Spray dryer
6. Application of Heat exchanger ‘
7. Profibus DP application in industry
8. Foundation fieldbus application in industry

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Computer Based Process Control”, Krishna Kant, Prentice Hall of India.
2. Computer Networks Tannebaum Andrew Pearson, New Delhi, 5th Edition, 2011

Reference Books:

1. Distributed Computer Control for Industrial Automation”, Popovik-Bhatkar, Dekkar Publications

MOOCS Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1) Understand working of DCS system.
2) To understand different DCS hardware.
3) Select medium for various types of data transmission.
4) Understand the Serial data communications.
5) Understand of Modbus and HART communication protocol.
6) Understand of Foundation field bus and profibus protocol.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	0	0	2	0	0	0	0	0	2	2	2
2	3	3	3	0	0	2	0	0	0	0	0	3	2	2
3	2	2	2	0	0	3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Job Mapping:

In automation industry

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus of

Final Year B.Tech.

Electronics & Telecommunication Engineering

"Pattern – D20"

Module - VIII

FF No. : 654

ET4226: ADAPTIVE SIGNAL PROCESSING

Course Prerequisites:

1. Probability and statistics
2. Linear Algebra
3. Digital Signal Processing

Course Objectives:

1. To understand the basic principles of signal modeling methods.
2. To understand different stochastic models
3. To perform linear predictive (LPC) analysis of speech signal
4. To apply Wiener filters for noise cancellation.
5. To apply adaptive filters in channel equalization.

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

Many practical signals are random in nature or modelled as random processes. Adaptive signal Processing involves processing these signals and forms the backbone of modern communication and signal processing systems.

SECTION-1
Stochastic Processes: ensemble averages, jointly distributed random variables, joint moments, independent, uncorrelated and orthogonal random variables, linear mean square estimation. Signal Modeling: Least square method, Pade approximation, Prony's method. Finite data records: autocorrelation and covariance method, Stochastic Models: Autoregressive moving average models, autoregressive models, moving average models. Linear Prediction:Forward linear prediction, backward linear prediction, Levinson-Durbin algorithm, lattice filter, predictive modeling of speech.

SECTION-2

Wiener Filters: Minimum mean square error (MMSE) and orthogonality principle, digital Wiener filter and Wiener-Hopf equations. Applications: filtering, noise cancellation,
Adaptive filtering:FIR adaptive filters: the steepest descent adaptive filter, Lease-Mean-Square (LMS) adaptive filters, convergence of LMS algorithm, normalized LMS. Applications: noise cancellation, channel equalization, adaptive recursive filters.

List of Course Seminar Topics:

1. Parametric models for signal estimation
2. Non- parametric models for signal estimation
3. Autoregressive model to pattern discrimination of brain electrical activity mapping
4. Autoregressive moving average in signal denoising
5. LPC in speech modeling
6. Linear prediction in signal restoration
7. Linear prediction in low bit rate coding
8. Application of Wiener Filter Making Signals Orthogonal
9. Application of Wiener Filter removal of blur in image
10. Adaptive filters in Echo cancelation

List of Course Group Discussion Topics:

1. Signal modeling techniques and its application
2. AM vs ARMA
3. Parametric vs non-parametric methods for signal modeling
4. Forward and Backward linear prediction and their parameters
5. Levinson Derbin and Lattice structure and its time complexity
6. Modeling of speech signal using LPC
7. LMS step size to trade off convergence time and misadjustment
8. Minimum mean square error (MMSE) and orthogonality principle
9. Steepest descent adaptive filter.
10. adaptive recursive filters and optimization of its parameters

List of Home Assignments:

Design:

1. Spectrum estimation using autoregressive modeling
2. Design and implement speech coding using Linear prediction
3. Design and implement Noise cancelling system
4. Design and implement Channel Equalizer
5. System identification and inverse filtering

Case Study:

1. Adaptive filter in Channel equalizer
2. Signal modeling in vibration signal analysis
3. EEG signal modeling using AR model
4. Parametric modeling of EEG signal
5. Structure similarity in images using Wiener filter

Blog

1. Estimation of signal and its applications
2. Adaptive filtering in biological signal processing
3. Prediction of stock prices using Wiener filter
4. Selection and optimization of adaptive filters for ECG noise removal
5. Suppression of cardiac and respiratory noise in MRI time series data

Surveys

1. Autoregressive models in medical signal modeling
2. Least square methods in noise removal applications
3. Linear prediction in Digital communication
4. Wiener filter in acoustic signal modeling
5. LMS algorithm for system Identification

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Simon Haykin, “Adaptive Filter Theory”, 4th edition, Pearson Education
2. Monson Hayes, “Statistical Digital Signal Processing and Modeling”, Wiley India Edition.

Reference Books:

1. Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon, “Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing”, McGrawHill, 2000.
2. Bernard Widrow and Samuel Stearns, “Adaptive Signal Processing”, Pearson Education Asia,2002.

MOOCS Links and additional reading material:

1. https://nptel.ac.in/courses/117/105/117105075/
2. https://nptel.ac.in/courses/108/103/108103158/

Course Outcomes:

1. Apply basic probability theory to model random signals in terms of Random Processes.
2. Determine a model to provide an accurate estimation of the signal.
3. Represent speech signals using linear predictive coding (LPC) algorithms.
4. Formulate the Wiener filter as a constrained optimization problem.
5. Determine suitable LMS step size to trade off convergence time and mis adjustment.
6. Design adaptive filters for different applications such as noise cancelation.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1		1	-	-	--	1	1	-	2	2	-
2	2	2	1		1	-	-	-	2	1	-	-	-	-
3	2	2	1		1	-	-	-	1	1	-	2	2	2
4	3	2	2		2	-	-	-	2	1	-		2	2
5	3	2	2		2	-	-	-	2	1	-	2	2	-
6	3	2	2		2	-	-	-	2	1	-	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

1. **CO1 -** Level 3
2. **CO2 -** Level 4
3. **CO3 -** Level 4
4. **CO4 -** Level 4
5. **CO5 -** Level 5
6. **CO6 -** Level 4

Job Mapping:

Adaptive Signal processing is the enabling technology for the modeling, generation, and interpretation of signals. It is having wide range of applications in communication devices such as mobile phones and wearable device.

FF No. : 654

ET4224: MOBILE COMMUNICATION

Course Prerequisites:

Basic Communication system, Wireless Communication

Course Objectives:

1. To provide an understanding of different channel coding techniques.
2. To understand Mobile Internet Protocol.
3. To know the TCP/IP Protocol Suite.
4. To have an insight into Long Term Evaluation System
5. To understand the 5G concepts
6. An ability to compare 4G and 5G for mobile communication

Credits:2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

In today's scenario mobile is need for everyone. That is why it is very much important to know mobile technology. A thorough understanding of mobile communication fundamentals and techniques is essential for anyone whose work is concerned with signal processing applications. Mobile communication begins with a discussion of the different channel coding methods used in mobile communication Also it covers Mobile Network & transport Layer for communication purpose. Mobile Communication covers the fourth generation which covers the Global System for Mobile and Code Division Multiple Access. It also covers the introduction of fifth generation and Long-Term Evolution (LTE). An integral part of the course is MATLAB based computer assignments, which are designed to reinforce theoretical concepts.

SECTION-1
Error control techniques for mobile communication – LBC, Cyclic codes, convolutional codes, concatenated codes, turbo codes, trellis codes, Mobile Network & transport Layer, Mobile IP – IP Packet delivery, Agent Discovery, Registration, Tunneling & encapsulation, reverse tunneling, DHCP, Traditional TCP, Classical TCP Improvements – indirect TCP, Snooping TCP, Mobile TCP, Transmission & retransmission, TCP over 2.5/3G wireless networks.
SECTION-2
4G- Evolution of Mobile Generation and its comparison (GSM & CDMA) Overview of LTE : LTE basics , LTE frame structure, LTE Design parameters with Standardization and Architecture of LTE. VoLTE. 5G – Concept, Spectrum management, Massive centralized RAN, Vehicular Communication, Network Slicing, 5G LTE Narrowband IoT.

List of Course Seminar Topics:

1. Mobile Internet Protocol
2. TCP over 2.5/3G wireless networks
3. Global System for Mobile
4. Code Division Multiple Access
5. Massive centralized RAN
6. Vehicular Communication
7. Network Slicing
8. Spectrum Management
9. Block codes in Diversity techniques
10. 5G LTE Narrowband IoT

List of Course Group Discussion Topics:

1. Different generations in Mobile Communication
2. Different Error control techniques for mobile communication
3. Capacity enhancement in LTE
4. Cell Load aware Energy Saving
5. Energy Saving -4G and beyond
6. 5G system
7. Vehicle to Vehicle Communication
8. Device to Device Communication in LTE
9. Low Latency Communication in
10. LTE Radio Resource Management
11. An Overview and Analysis of Mobile Internet Protocols in Cellular Environments.
12. Transparent settlement model between mobile network operator and mobile voiceover Internet protocol operator
13. Wireless mobile Internet security
14. ATM and Internet protocol
15. Advanced Internet Protocols, Services and Applications
16. The next generation Internet Protocol

List of Home Assignments:

Design:

1. Error Correcting Codes for Satellite Communication Channels
2. Error Correcting Codes for Space Communication
3. Modern error correcting codes for 4G and beyond: Turbo codes and LDPC codes
4. 3G system using convolutional code techniques Wireless Communication Networks

Case Study:

1. Long Term Evaluation
2. Different standards in 3G

3. Different standards in 4G
4. Different standards in 5G
5. 5G-Narrowband IOT

Blog

1. 5G Communication
2. 4G Communication
3. Different generations for mobile communication
4. Long Term Evaluation
5. Error control techniques for mobile communication

Surveys

1. Survey on Error Control Coding Techniques
2. TCP/IP Network Layers and Their Protocols
3. Security for 4G and 5G Cellular Networks: A survey of existing
4. 5G Operator Survey
5. A survey on 5G: The Next generation of Mobile Communication

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Ranjan Bose ; Information Theory coding and Cryptography ;2nd Edition,McGrawHill Publication.
2. Vijay Garg; Wireless Communications & networking ; Morgan Kaufman Series in networking
3. Christopher Cox;An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications ;John Wiley & Sons, Ltd.

Reference Books:

1. Khalid Sayood; Introduction to Data compression ; Morgan Kaufmann Publisher.
2. Jochen Schiller ; Mobile Communications ;2nd Edition, Pearson Publication
3. Saad z Asif ; 5G Mobile communications concepts and technologies ;CRC Press

MOOCS Links and additional reading material:

www.nptelvideos.in
https://www.youtube.com/watch?v=ZZfhPNxEzaA

Course Outcomes:

1. Evaluate the performance of Channel coding techniques.
2. Study Mobile Internet Protocol.
3. Analyze the TCP/IP Protocol Suite.
4. Explain Long Term Evaluation System.
5. Understand the 5G concepts.
6. Describe the 4G and 5G in mobile communication.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	0	0	3	2	0	0	0	2	2	1	0
2	1	2	2	0	0	3	3	0	0	0	3	3	2	3
3	1	2	3	0	0	3	3	0	0	0	2	3	1	0
4	1	2	0	0	0	3	3	0	0	0	0	0	3	0
5	1	2	2	0	0	3	3	0	0	0	2	3	3	0
6	1	2	3	0	0	3	3	0	0	0	3	3	0	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1 - Level 1
CO2 - Level 4
CO3 - Level 3
CO4 - Level 3
CO5 - Level 3
CO6 - Level 2

Future Courses Mapping:

Cognitive Radio, Advances in Digital Communication.

Job Mapping:

In recent scenario, mobile is the need of everyone. Many investors invest money in telecommunication industries. Lot of job openings in wireless communication sector. Some engineers specialize in design; other work in manufacturing, testing, quality control and management. Engineers may serve as field service personnel, installing and maintaining complex equipment and systems. There are many outstanding jobs in technical sales, technical writer and as a trainer. Four major segments of industry are manufacturing, resellers, service organization and end users. The major categories in the communication field are Telephone companies, Radio users (Mobile, Marine, Aircraft etc), Radio and TV broadcast stations and Cable TV companies, Business and industries of satellite, networks etc, Transportation companies(Airline, Shipping, Railroads), Government and Military.

FF No. : 654

ET4245: AUDIO AND SPEECH SIGNAL PROCESSING

Course Prerequisites:

Signals and Systems course and Digital signal processing course

Course Objectives:

1. To understand the basic principles of sound, speech production and perception
2. To apply different methods for time domain and frequency domain analysis of speech signals
3. To understand the concept of cepstrum and to extract cepstral features of speech signals
4. To perform linear predictive (LPC) analysis of speech signal
5. To understand different methods and challenges in designing applications like speech enhancement, speech recognition and speaker identification systems

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

The Audio and speech signal processing course aim to give an elementary introduction to concepts, methods and applications of speech signal processing. It offers a practical and theoretical understanding of how human speech can be processed by computers. It covers the aspects of speech production and speech perception systems and their modelling. Details of algorithms, techniques and limitations of state-of-the-art speech systems will also be presented. It will also cover several applications including speech enhancement, speech coding and speech/speaker recognition systems.

SECTION-1
Anatomy and physiology of speech production. Acoustic phonetics, classification of phonemes used in American English based on continuant/non-continuant properties. Acoustic theory of speech production, sound propagation. Lossless tube model. Time-dependent speech processing. Short-time energy and average magnitude. Short-time average zero crossing rate, Narrow and wide band spectrogram. Speech Vs. silence discrimination. Short-time autocorrelation function, short-time average magnitude difference function. Pitch period estimation. Peripheral auditory system, simplified model of cochlea. Sound pressure level and loudness. Sound intensity and Decibel sound levels. Concept of critical band and introduction to auditory system as a filter bank.

SECTION-2

Basic principles of linear predictive analysis. Solution of LPC equations: Cholesky decomposition, Durbin's recursive solution, lattice formulations and solutions. Applications of LPC parameters as pitch detection and formant analysis. Real Cestrum: Long-term real cepstrum, short-term real cepstrum, pitch estimation, format estimation, Mel cepstrum. Complex cepstrum: Long-term complex cepstrum, short-term complex cepstrum. LPCC and MFCC feature extraction. Applications as complete system for speech recognition or speaker recognition.

List of Projects:

1. Speaker identification/verification System
2. Speech enhancement: Enhance noisy speech signal using spectral subtraction method.
3. MATLAB app development for speech signal analysis
4. Vocal Suppression
5. Low bit rate coding
6. Audio steganography
7. Speech synthesis system
8. Voice tracking system
9. Multi microphone-based speech enhancement system
10. Dysarthric speech recognition system

List of Course Seminar Topics:

1. Applications of speech processing in forensic sciences
2. Aircraft noise cancellation system for cockpit
3. Alexa: voice command identification framework
4. Improving the voice quality of dysarthric speech
5. Development of Speech tracking systems
6. Design of hearing aids
7. Speech to speech conversion
8. Melody identification system
9. Low bit rate speech coding
10. Audio steganography

List of Course Group Discussion Topics:

1. Time domain Vs Frequency domain features for speech processing
2. Suitable speech features for discriminating speech and speaker
3. Better features for speech recognition: speech production Vs speech perception
4. Biometric traits: Speech, face, palm, fingerprint

5. Military weapons firing sound elimination
6. Generative models for music generation
7. Designing of a system to mimic sound of different persons
8. Speech to text conversion
9. Audio file formats
10. Text-to-speech conversion
11. Noise cancellation techniques for speech cleaning

List of Home Assignments:

Design:

1. Design a small vocabulary speech recognition system
2. Design a speaker verification system
3. Design a voice-based attendance monitoring system
4. To analyze a dysarthric speech to extract meaningful information
5. Speaker identification from whispered speech

Case Study:

1. Amazon Alexa framework
2. Apple Siri framework
3. Google assistant Framework
4. Interactive voice response system
5. Speech disorders and speech therapy tools

Blog

1. Background noise elimination in speech processing
2. Design of anechoic chambers
3. Voice assistant systems
4. Speech recognition using deep learning
5. Natural speech synthesizers
6. Speech compression
7. Interactive Voice Response (IVR) Technology

Surveys

1. Classification of sounds of Marathi language
2. Speech synthesis techniques
3. Commercial voice interactive systems
4. Voiced based telephone banking
5. Audio compression techniques
6. Pitch identification techniques
7. Speech/audio signal processing in movies.

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Deller J. R. Proakis J. G. and Hanson J. H., "Discrete Time Processing of Speech Signals," Wiley Interscience
2. Thomas F. Quateri , "Discrete-Time Speech Signal Processing: Principles and Practice," Pearson

Reference Books:

1. L. R. Rabiner and S.W. Schafer, "Digital processing of speech signals," Pearson Education.
2. Ben Gold and Nelson Morgan, "Speech and audio signal processing," Wiley
3. Shaila Apte, "Speech and audio processing," Wiley India Publication

MOOCS Links and additional reading material:

1. https://www.ece.ucsb.edu/Faculty/Rabiner/ece259/speech%20course.html
2. https://nptel.ac.in/courses/117/105/117105145/
3. http://www.speech.cs.cmu.edu/15-492/
4. http://www.iitg.ac.in/samudravijaya/tutorials/fundamentalOfASR_picone96.pdf
5. https://cas.tudelft.nl/Education/courses/in4182/index.php
6. http://vlab.amrita.edu/index.php?sub=59&brch=164.

Course Outcomes:

1. Demonstrate discrete time model of speech production system.
2. Detect voiced, unvoiced and silence part of a speech signal.
3. Implement algorithms for processing speech signals considering the properties of acoustic signals and human hearing.
4. Analyze speech signal to extract the characteristics of vocal tract (formants) and vocal cords (pitch).
5. Extract LPC Parameters using Levinson Durbin algorithm.
6. Formulate and design a system for speech recognition and speaker recognition.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	3	1	-	-	2	-	-	-	-	-	-	1	-	-
3	3	2	2	-	-	-	-	-	-	-	-	2	2	--
4	3	1	-	2	2	-	-	-	-	1	-	2	3	-
5	3	1	-	-	1	-	-	-	-	1	-	-	-	-
6	3	3	3	-	1	-	-	-	2	1	-	-	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO Attainment Level:

CO1: Level 2
CO2: Level 3
CO3: Level 3
CO4: Level 4
CO5: Level 4
CO6: Level 5

Future Courses Mapping:

Audio signal and music processing, Natural Language processing.

Job Mapping:

Technology companies are recognizing interests in speech recognition technologies and are working toward making voice recognition a standard for most products. One goal of these companies is to make voice assistants speak and reply with greater accuracy around context and content. There are many job opportunities that one can get after learning this course. Some of the job profiles are: Audio DSP Engineer, Audio signal processing Engineer, Audio codec Engineer, Music signal processing Engineer.

FF No.: 654

ET4246: ELECTRONICS PRODUCT DESIGN

Course Prerequisites:

Understanding of basic electronics components (analog and digital), Awareness of different electronic appliances

Course Objectives:

1. To understand the stages of product design and development.
2. To learn the different considerations of circuit design.
3. To be acquainted with PCB design methods and PCB Design tools.
4. To understand the importance of testing and documentation in product design cycle.

Credits: 2 **Teaching Scheme Theory: 2** Hours/Week

Course Relevance:

Students have innovative concepts to work with. But when it comes to developing a model of the same concept, they do not succeed. This subject is designed to give total insight of various steps in the journey of an idea from concept to realization.

SECTION-1
Philosophy of product design, Concept evolution, Innovative approach based on comparative analysis of available methods / designs, Need analysis and market analysis, Ideation, validation of idea using survey techniques, Product design stages – Product vision and strategy, Product research, Prototype, Build, Analyse, V – model for product design, Types of documentation, Records.
SECTION-2
Post design steps in product – Ergonomics and aesthetics, Packaging, Assembly, Wiring, Sustainability for shocks and vibrations, Safety considerations, Considerations for noise, grounding and shielding, performance verification and efficiency calculation, Debugging and testing, EMI & EMC issues, Reliability – failures and solutions, Case studies
List of Projects: 1. Design a voltage regulator 2. Design an audio amplifier 3. Design analog filter circuit

4. Design SMPS
5. Design analog band stop filter
6. Design counter circuit
7. Design BCD multiplier circuit
8. Design adder, subtractor circuit
9. Design frequency multiplier circuit
10. Design divider circuit

List of Home Assignments:

Design:

1. Design of a power supply
2. Design of an amplifier
3. Design of a filter
4. Design of a BCD adder
5. Design of a counter

Case Study:

1. A transceiver
2. Home automation - appliances
3. Home automation - security
4. Biometric attendance monitoring system
5. Digital lock

Blog

1. Analog and digital design – various aspects
2. Application of electronic products in agriculture
3. Applications of electronic systems in assistive systems
4. Speed, bandwidth in noiseless transmission – various methods
5. Advancements in television system

Surveys

1. Customer need analysis
2. Market need analysis
3. Comparison of various electronic designs
4. Comparison of various mechanical designs
5. Feedback of prototype

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Kim Fowler, "Electronic Instrument Design" Oxford university press.
2. Robert J. Herrick, "Printed Circuit board design Techniques for EMC Compliance", Second edition, IEEE press.
3. J C Whitakar, "The Electronics Handbook", CRC press.

Reference Books:

1. Otto. K and Wood, K, "Product Design", Pearson Education, 2001.
2. Pahl. G and Beitz. G, "Engineering Design", Springer, 1996
3. V.B. Baru R.G.Kaduskar, "Electronic Product Design", Wiley India 2011
4. Tony Ward and James Angus, "Electronic Product Design", Chapman &Hall 1996

MOOCS Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1. Identify various stages of hardware, software and PCB design.
2. Design, prepare PCB layout as per standards and specifications.
3. Optimization of the design, consideration of various aspects.
4. Testing and troubleshooting.
5. Prepare and maintain the documentation.
6. Prototype testing.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	0	3	0	0	2	0	0	1	0	2	1	1	1
2	1	2	3	1	2	2	1	3	1	0	3	1	3	3
3	1	2	3	1	3	2	0	2	0	0	3	1	2	2
4	1	0	3	0	3	2	1	0	1	1	2	1	3	3
5	0	2	3	1	0	1	0	0	1	2	2	1	2	2
6	0	0	3	0	2	1	2	1	0	3	2	1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels
CO1 - Level 2
CO2 - Level 3
CO3 - Level 3
CO4 - Level 4
CO5 - Level 4
CO6 - Level 5

Job Mapping:
Employability in the field of manufacturing, development, start-up, testing field

FF No.: 654

ET4247: BIOMEDICAL ENGINEERING

Course Prerequisites:

Basic Electronics, Sensors and Transducers, Signal and Image Processing

Course Objectives:

1. Understand various Biosignals and Biosensors.
2. Study various Diagnostic and Therapeutic Equipment
3. Methods and tests carried out in the Medical Laboratory.
4. To acquire images using Bioimaging devices.
5. To understand the acquisition of BioImages.
6. Use of LASERS in Biomedical field

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

SECTION-1
Introduction to Biomedical System: Man Machine Interface, Anatomy: Heart, nervous system, respiratory system, different bio signals, electrodes, Grounding and Shielding, Patient Safety. Medical device regulations and standards. **Diagnostic and Therapeutic Equipment:** Cardiac Life support Equipment, Respiratory Care Equipment, ICU & Life Support Equipment, Hemodialyzers and Lithotripters, Diathermy and Radiotherapy. **Laboratory Equipment:** Basic working principle use calibration and maintenance of - Colorimeter, Spectrophotometer, Flame photometer, PH/Blood Gas Analyzer, Pulse Oximeter, and Blood Cell Counters.
SECTION-2
Radiography: X-Ray, generation of CT, spiral CT, mammography, computed radiography (CR). Magnetic resonance imaging: image acquisition and reconstruction, fast imaging methods, functional imaging, FMRI **Ultrasonic Imaging and Nuclear Imaging:** Generation and detection of ultrasound, B-mode, M-mode TM-mode processing, Data acquisition and reconstruction of Doppler image, pulsed wave Doppler, NMI-Radioactive decay modes, data acquisition. **Medical Optics:** Optical properties of tissues, Biophotonic Diagnostics : optical biosensors, glucose analysis, flowcytometry , cellular tissue imaging , Optical Coherence Tomography. Photodynamic therapy applications: LASER tissue welding, LASER in dermatology, neurosurgery, ophthalmology and urology.

List of Projects:

1. To design and testing of ECG signal
2. To design and testing of EEG signal
3. To design and testing of EMG signal
4. Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthoven Triangle.
5. Design, testing and calibration of Digital pH meter using glass electrode.
6. Spectrum analysis & Noise removal of biomedical signals
7. To measure the components in EEG Signal and Heart Rate Variability in ECG signal simultaneously to understand the inter-relations amongst various physiological parameters
8. Design and testing of PFT
9. Design and testing of Contactless body temperature system.
10. Design of single channel Holter Recorder
11. Design of Bio - Telemetry system
12. Design and testing of Multiparameter Monitor.

List of Seminar Topics:

1. Technological Advancement in telehealth
2. Role of IoT in Biomedical
3. Internet of Medical Things
4. Signal Processing in Medical Field
5. Image Processing and pattern recognition in Biomedical
6. Advancements in Biosensors
7. Fiber optic Biosensors
8. Safety and security in Biomedical
9. Biochemistry advancements
10. Role of technology in pandemic situations

List of Group Discussion Topics:

1. How to fill the gap between medical and engineering technologies
2. How to improve research and development culture in Biomedical Engg field in India
3. Robotic surgery
4. Can AI replace Humans
5. Impact of Pandemics on Biomedical Industry
6. Why Biomedical Engg field is not developed in India
7. Will everything automatic be accepted by the medical field?
8. Why is there no UG in the Biomedical field in India?

List of Home Assignments:

Design:

1. Electronic stethoscope
2. Non contact temperature sensor
3. Electronic BP system
4. Develop an APP to monitor relatime body parameters
5. Electronic Medical Record - EMR

Case Study:

1. Security in Biomedical data and records
2. Heart valves
3. Physiology of fMRI Brain Imaging
4. Data management in Biomedical Engineering
5. Rehabilitation - future
6.

Blog

1. Heroes of COVID - 19
2. Safety of frontliners of Pandemics treatments
3. Future of AI in Biomedical Engineering
4. Wearable devices and miniaturization
5. Recent trends in Biosensors

Surveys

1. Advancement in Biosensors
2. Recent trends in Telehealth
3. Role of various unions in biomedical engineering
4. Changes ECG Recordings
5. Data formats for Biomedical Information

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Khandpur R. S., Handbook of Bio-Medical Instrumentation, Tata McGraw Hill, 2nd Ed., 2003.
2. Joseph J.Carr and John M. Brown, Introduction to Biomedical equipment technology, John Wiley and sons, New York, 1997.
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice-Hall, 1993.

4. S Webb, "The Physics of Medical Imaging", Adam Highler, Bristol Published by CRC Press, 1988.
5. Ed., Tuan Volume Dinh, “Biomedical Photonics Handbook”, CRC Press, 2003.

Reference Books:

1. John G. Webster Encyclopedia of Medical Devices and Instrumentation
2. Rangaraj M. Rangayyan, Akay Metin(Editor),Biomedical Signal Analysis: A Case Study Approach, Wiley Interscience, 2001.
3. Hykes, Heorick, Starchman, Ultrasound physics and Instrumentation MOSBY year Book.
4. Zhi-Pei Laing and Paul C. Lauterbur, Principles of Magnetic Resonance imaging –A signal processing perspective, Metin Akay (Editor), IEEE press, New York, 2000.
5. Koebmer K R, "Lasers in Medicine", John Wiley & Sons,

MOOCS Links and additional reading material: www.nptelvideos.in

Course Outcomes:

1. Specify methods for interfacing sensors to electronic systems in biomedical applications.
2. Design and test the basic Diagnostic and Therapeutic Equipment
3. Specify different methods used in pathology lab to conduct various tests.
4. Recognize the image acquisition and reconstruction methods in radiography.
5. Acquire and reconstruct the Doppler images.
6. Apply knowledge of LASER in various applications of the medical field.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	2	-	1	-	-	-	-	-	1	1	1
2	3	1	1	2	2	-	1	1	-	-	-	1	1	1
3	3	2	2	2	-	-	1-	-	-	-	-	2	2	--
4	3	1	1	2	2	-	-	-	-	1	-	2	3	-
5	3	1	1	2	1	-	1	-	-	1	-	1	1	2
6	3	3	3	2	1	-	1	-	2	1	-	1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels
CO1 - Level 2
CO2 - Level 3
CO3 - Level 3
CO4 - Level 3
CO5 - Level 3
CO6 - Level 3

Future Courses Mapping:
Mention other courses that can be taken after completion of this course.

Job Mapping:
The following are examples of specialty areas within the field of biomedical engineering:
Bioinstrumentation uses electronics, computer science, and measurement principles to develop instruments used in the diagnosis and treatment of medical problems.
Biomaterials is the study of naturally occurring or laboratory-designed materials that are used in medical devices or as implantation materials.
Biomechanics involves the study of mechanics, such as thermodynamics, to solve biological or medical problems.
Clinical engineering applies medical technology to optimize healthcare delivery.
Rehabilitation engineering is the study of engineering and computer science to develop devices that assist individuals recovering from or adapting to physical and cognitive impairments.
Systems physiology : uses engineering tools to understand how systems within living organisms, from bacteria to humans, function and respond to changes in their environment.

FF No. : 654

IT4201::Design and Analysis of Algorithms

FF No.: 654

ET4248: ADHOC NETWORKS

Course Prerequisites:

Computer networking, Design, and analysis of Algorithms

Course Objectives:

1. Understand the concept of mobile ad hoc networks, design and implementation issues and available solutions.
2. Demonstrate the routing mechanisms and three classes of approaches: proactive, on-demand, and hybrid.
3. Understand the clustering mechanisms and different schemes that have been employed, e.g., hierarchical.
4. Explain sensor networks and their characteristics. This includes design of MAC layer protocols, understanding of power management, query processing, and sensor databases.
5. Demonstrate the designing and implementing ad hoc network functionality using network simulation tools

Credits: 2 **Teaching Scheme** Theory: 2 Hours/Week

Course Relevance:

This course is offered for those who are interested in understanding and building systems support mechanisms for mobile computing systems including client-server web/database/file systems, and mobile ad hoc and sensor networks for achieving the goal of anytime, anywhere computing in wireless mobile environments.

SECTION-1

Introduction to Ad Hoc Wireless Networks: Characteristics of MANETS, Applications of MANETS, Challenges.

Routing In MANETS: Topology based versus position-based approaches, Topology based routing protocols, and position based routing, other routing protocols

Data Transmission In MANETS: The broadcast storm, Multicasting, Geocasting. TCP Over Ad Hoc Networks: TCP protocol overview, TCP and MANETS, Solutions for TCP over Ad Hoc

SECTION-2

Basics of Wireless Sensors And Applications: The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications.
Data Retrieval In Sensor Networks: Classification of WSNs, MAC Layer, Routing Layer, High-Level Application Layer Support, Adapting to the Inherent Dynamic Nature of WSNs.
Security: Security in Ad Hoc Wireless Networks, Key Management, Secure Routing, Cooperation in MANETs, Intrusion Detection Systems
Sensor Network Platforms and Tools: Sensor network Hardware, Sensor Network Programming Challenges, and Node-Level Software Platforms.

List of Course Seminar Topics:

1. Evaluation of wireless Local Area Networks
2. Tips for Implementing a Wireless Network
3. Reliability of Wireless Sensor Networks
4. Traffic Profiling in Wireless Sensor Networks
5. Intrusion detection and monitoring for wireless networks.
6. Insecurity of Wireless Networks
7. Dynamic Ad-hoc Wireless Network
8. Time Synchronization in Wireless Sensor Networks
9. Community Wireless Networks
10. Source Localization Using Wireless Sensor Networks

List of Course Group Discussion Topics:

1.Issues in Implementing a Wireless Network
2. Availability Issues in Wireless Visual Sensor Networks
3. Routing protocols in wireless sensor networks.
4. Dynamic Ad-hoc Wireless Network
5. Wireless Sensor Networks for Ambient Assisted Living

List of Home Assignments:

Design:

1. Structural health monitoring using wireless sensor networks
2. Intrusion detection and monitoring for wireless networks.
3. Traffic prediction using wireless cellular networks
4. Semantic Infrastructure for Wireless Sensor Networks
5. Wireless sensor network for monitoring soil moisture and weather conditions

Case Study:

1. Distributed Estimation, Coding, and Scheduling in Wireless Visual Sensor Networks
2. Data aggregation in wireless sensor networks using the SOAP protocol
3. Efficient data communication protocols for wireless networks
4. Application of Wireless Sensor Networks to Automobiles
5. Nanotechnology enabled sensors and wireless sensing networks

Blog

1. Opportunistic Carrier Prediction for Wireless Networks
2. Wireless Network Security Vulnerabilities and Concerns
3. Wireless Local Area Networks: The Next Evolutionary Step.
4. Cognitive Radio Wireless Sensor Networks: Applications, Challenges and Research Trends
5. Performance Evaluation of a Routing Protocol in Wireless Sensor Network

Surveys

1. Wireless Sensor Network Applications for the Combat Air Forces
2. Research on dynamic routing mechanisms in wireless sensor networks.
3. High-speed digital wireless battlefield network
4. An underwater optical wireless communication network
5. Potential uses of a wireless network in physical security systems.

Assessment Scheme:

Mid Semester Examination - 30 Marks
Home Assignment - 10 Marks
End Semester Examination - 30 Marks
Comprehensive Viva Voce - 30 Marks

Textbooks:

1. Ad Hoc and Sensor Networks: Theory and Applications, Carlos de Morais Cordeiro and Dharma Prakash Agrawal, World Scientific Publications / Cambridge University Press,2006.
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science Imprint, Morgan Kauffman Publishers, 2005.

Reference Books:

1. Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy and B. S. Manoj, Pearson Education, 2004.
2. Guide to Wireless Ad Hoc Networks, Sudip Misra, Isaac Woungang, and Subhas Chandra Misra, Springer International Edition, 2011.
3. Wireless Sensor Networks – Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, Taylor & Francis Group, 2010.
4. Wireless Ad hoc Mobile Wireless Networks-Principles, Protocols and Applications, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008.
5. Wireless Ad hoc and Sensor Networks–Protocols, Performance and Control, Jagannathan Sarangapani, CRC Press, Taylor & Francis Group, 2007.

Course Outcomes:

1. Understand the concept of Ad Hoc Wireless Networks.
2. Estimate the MAC protocols for GSM and wireless LANs.
3. Classify and explain about the mobile IP Network and transport layer protocols for mobile networks layer.
4. Develop new ad hoc network applications and algorithms or protocols.
5. Apply the protocols and platforms mobile computing
6. List out the Advanced technologies for developing the mobile networks.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1	-	2	-	-	-	-	-	-	-	1	1
2	2	3	1	-	2	-	-	-	-	-	-	1	1	1
3	3	2	1	-	2	-	-	-	-	1	-	2	1	1
4	3	2	1	2	2	-	-	-	-	1	-	2	1	1
5	2	2	-	-	2	-	-	-	1	1	-	-	1	2
6	2	2	-	-	2	-	-	-	1	1	-	-	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1:- Level 2
CO2:- Level 3
CO3:- Level 3
CO4:- Level 2
CO5:- Level 3
CO6:- Level 3

FF No. : 654

ET4262: MAJOR PROJECT

Course Prerequisites: Basic Electronics, Physics, Engineering Mathematics, Statistics, Programming Languages

Course Objectives:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.
4. To engage students in rich and authentic learning experiences.
5. To provide every student the opportunity to get involved either individually or as a group to develop team skills and learn professionalism.
6. To develop entrepreneurship attitude

Credits: 10 **Teaching Scheme** Lab: 20 Hours/Week

Course Relevance:

Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. Students can be evaluated for higher order skills of Blooms taxonomy like ‘analyze, design and apply’. This course is capable of imparting hands-on experience and self learning to the students which will help them throughout their career. It emphasizes on learning by doing for a complete project life cycle, requirement analysis, realistic planning and transforming ideas into product. This is a step ahead in line with national policy of Atmanirbhar Bharat.

Major-Project Guidelines:

- The Major-project is a team activity having 3-4 students in a team. This is electronic product design work
- The Major-project may be a complete hardware or a combination of hardware and software work. The software part in Major-project should be less than 50% of the total work.
- After interactions with course instructor and based on comprehensive literature survey / requirement analysis, the student shall identify the title and define objectives of the Major-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 meet the timelines on design, development and testing of the proposed work.
- 6. The student is instructed to have discussion with faculty instructor on standard practices used for electronic circuit / product design, converting the circuit design into a complete electronic product, PCD design using suitable simulation software, estimation of power budget analysis of the product, front panel / user interface design and mechanical aspects of the product.
- Completed Major-project and documentation in the form of Major-project report is to be submitted at the end of the semester. The project group will deliver the presentation of the Project Work which will be assessed by the panel.

Note: The student can identify a technological problem in the following sectors (The list is open ended):

1. Social relevance (Agriculture/ Water Management / Transportation / Waste Management / etc.)
2. Renewable Energy (Solar / Wind / Waves / etc.)
3. Green Technology (Carbon footprint / Pollution control / etc)
4. Assistive System for Weaker People (Blind / Deaf / Handicap assistive)
5. Security Enhancement (Cyber Security / Forensics) 6. Government Projects (Smart City / Smart Grid / Smart Gram / Swach Bharat / etc.)

Core Technology domains identified for E&TC Engg are as below. However, this list can be extended as per the need of project and multidisciplinary approach

1. VLSI Design
2. Embedded System
3. Signal Processing
4. Communication Engineering
5. Machine Learning

Assessment Scheme:

Mid Semester Examination - 30 Marks

End Semester Examination - 70 Marks

MOOCS Links and additional reading material:

www.nptelvideos.in

https://worldwide.espacenet.com/

Course Outcomes:

1. Review the literature to formulate problem statement to solve real world problems.
2. Apply knowledge of technology and modern tools to design solution considering sustainability and environmental issues.
3. Manage project ethically as team member/ lead.
4. Demonstrate effectively technical report/ research paper/ prototype/ patent.

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	1	0	0	3	1	3	0	2	2	2
2	3	3	3	3	3	3	3	2	1	2	0	2	3	3
3	0	1	1	1	0	2	0	3	3	3	3	2	0	0
4	3	1	1	1	0	0	0	3	1	3	3	2	1	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels

CO1-Level 3

CO2- Level 4

CO3- Level 3

CO4- Level 4

FF No. : 654

ET4265: Industry Internship
ET4263: Research Internship
ET4264: Project Internship
ET4266: International Internship

Credits: 16 **Teaching Scheme** Lab: 32 Hours/Week

Industry/ Research/ Global Internship is an educational innovation seeking to link industry experience with university instruction. Internship enables students to acquire learning by applying the knowledge and skills they possess in open-ended real-life situations of a rapidly changing needs and challenges in a professional workplace. Internship provides the required platform for experiential and cooperative learning and education, by providing students with an opportunity to work on industry assignments, under the guidance of professional experts and under the supervision of faculty. Students are offered 18 weeks industry internship to enhance their skillset and get exposure of industry front. Internship facilitates and promotes partnership and intellectual exchange between academia and industry.

Course Outcomes:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, analyze, formulate and develop projects with a comprehensive and systematic approach.
3. Cooperate with diverse teams and effectively communicate with all the stake holders.
4. Produce solutions within the technological guidelines and standards.
5. Develop effective communication skills for presentation of project related activities.

Assessment Scheme:

Mid Semester Examination - 30 Marks
End Semester Examination - 70 Marks

CO PO Map:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	1	1	2	2	3	3	3	2	3	3	3
2	1	1	1	1	1	2	2	3	3	3	2	3	3	3
3	1	1	1	1	1	2	2	3	3	3	2	3	3	3
4	1	1	1	1	1	2	2	3	3	3	2	3	3	3
5	1	1	1	1	1	2	2	3	3	3	2	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels:

CO1:- Level 1
CO2:- Level 1
CO3:- Level 1
CO4:- Level 1
CO5:- Level 1
CO6:- Level 1