College of Engineering, Pune

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

Department of Computer Engineering and I.T.

Curriculum Structure & Detailed Syllabus (UG Program)

Third Year B. Tech. Computer Engineering

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

B.Tech. Computer Engineering

Programme Educational Objectives (PEOs):

I. To create graduates with sufficient capabilities in computer engineering who can become researchers, entrepreneurs and software professionals to satisfy the needs of the core industry, research, academia and society at large.

II. To build ability to continuously learn the latest trends in computer engineering and engage in lifelong learning process.

III. To build engineers aware of professional ethics of the software Industry, and equipped with basic soft skills essential for working in community and professional teams.

Programme Outcomes (POs):

At the end of the program, the graduates will

a. Demonstrate knowledge in fundamentals of computer engineering

b. Have knowledge of the best practices in software engineering, project management and professional work environments.

c. Be aware of professional ethics, environmental and sustainability issues.

d. Able to demonstrate the ability to design creative solutions to real life and most relevant problems faced by the industry and society at large.

e. Able to communicate technical topics in written and verbal forms.

f. Demonstrate their ability to use the state of the art technologies and tools including Free and Open Source Software tools in developing software.

g. Demonstrate good performance in the competitive examinations for higher education.

h. Have the ability for lifelong self-learning.

Programme Specific Outcomes (PSOs)

Students will be able to

1. Demonstrate competence in Programming Technologies.

2. Design, implement, test software solutions in core Computer Engineering areas including Computer Networks, Databases, Systems Software, Computer Architecture, Artificial Intelligence, Software Engineering

3. Acquire and demonstrate skills in emerging area like Information Security, Data Science, Natural Language Processing, Cloud Computing, etc.

Correlation between the PEOs and the POs

PO→ PEO↓	a	b	c	d	e	f	g	h
I	✓	✓	✓		✓	✓	✓	✓
II	✓	✓	✓	✓	✓	✓	✓	✓
III		✓	✓	✓	✓			

Correlation between the PEOs and the PSOs

PSO→ PEO↓	1	2	3
I	✓	✓	
II	✓	✓	
III	✓	✓	

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	BSC	Basic Science Course
2	DEC	Departmental Elective Course
3	HSMC	Humanities, Social Sciences and Management Course
4	IFC	Interdisciplinary Foundation Course
5	IOC	Interdisciplinary Open Course
6	LC	Laboratory Course
7	MLC	Mandatory Learning Course
8	PCC	Programme Core Course
9	SBC	Skill Based Course

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CURRICULUM STRUCTURE OF T. Y. B. TECH

Effective from A. Y. 2020-21

Semester V

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC	CT-21008	Probability and Statistics for Engineers	2	1	0	3
2	MLC	ML-21001	Constitution of India	1	0	0	0
3	HSMC	HS-21001	Entrepreneurship Principles and Process	1	0	0	1
4	HSMC	AS (HS)-2100X	Humanities Open Course - I • English Language Proficiency • Japanese Language • German Language • Etc	2	0	0	2
5	SBC	CT-21009	Software Engineering: Mini Project - Stage 1	0	1	2	2
6	IFC	PE(IF)-21001	Interdisciplinary Foundation Course – III Robotics(Manufacturing Department)	2	0	0	2
7	PCC	CT-21007	Computer Organization	3	0	0	3
8	PCC	CT-21001	Database Management Systems	3	0	0	3
9	LC	CT-21002	Database Management Systems Laboratory	0	0	2	1
10	PCC	CT-21003	Artificial Intelligence	3	0	0	3
11	LC	CT-21004	Artificial Intelligence Laboratory	0	0	2	1
12	PCC	CT-21005	Computer Networks	3	0	0	3
13	LC	CT-21006	Computer Networks Laboratory	0	0	2	1
			Total	20	2	8	25
				30			
			Total Academic Engagement and Credits				**Max. 25**

Minor / Honours courses: Mentioned separately

List of IFC Courses offered to other departments

SN	Course Title	Offered to Department	L	T	P	Credits
1	Data Analytics	Mechanical Engineering	1	0	2	2
2	Fundamentals of Machine Learning	Instrumentation Engineering	1	0	2	2
3	Fundamentals of Operating Systems	Instrumentation Engineering Electrical Engineering	2	0	0	2

Semester VI

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	MLC	ML-21002	Environmental Studies	1	0	0	0
2	HSMC	AS (HS)-2100X	Humanities Open Course - II • Finance for Engineers • Engineering Economics • Industrial Psychology • Etc.	2	0	0	2
3	SBC	CT-21015	Mini project ["D-S-P-T: Design-Simulate- Prototype - Test "]: Software Engineering: Mini project - Stage II	2	0	2	3
4	IOC	IOC-21002	Interdisciplinary Open Course-1 Introduction to Artificial Intelligence	1	0	2	2
5	DEC		Department Elective-I	3	0	0	3
6	LC		Department Elective-I Laboratory	0	0	2	1
7	PCC	CT-21010	Operating Systems	3	0	0	3
8	LC	CT-21011	Operating Systems Laboratory	0	0	2	1
9	PCC	CT-21014	Design and Analysis of Algorithms	3	1	0	4
10	PCC	CT-21012	Data Science	3	0	0	3
11	LC	CT-21013	Data Science Laboratory	0	0	2	1
			Total	18	1	10	
			Total Academic Engagement and Credits	29			23
							Max. 25

Minor / Honours courses: Mentioned separately on next page

Department Elective-I : List of courses

Advanced Data Structures
Advanced Microprocessors
Web Systems and Technologies
Computer Graphics
Digital Signal and Image Processing
Parallel Computer Architecture and Programming
Computational Geometry
Recent Trends in Computer Networks
Courses in association with Industry

Minor in Computer Engineering

(To be offered to students of other departments)

SN	Semester	Course Name	Lectures-Tutorial-Lab-Credits
1	V	Data Structures, Files and Algorithms	3-0-0-3
2	VI	Object Oriented Programming and Design	3-0-0-3

Honours in Data Science (for students of Computer Engineering)

SN	Semester	Course Name	Lectures-Tutorial-Lab-Credits
1	V	Making Sense of Data	3-0-0-3
2	VI	Big Data Analytics	3-0-0-3

Honours in Information Security (for students of Computer Engineering)

SN	Semester	Course Name	Lectures-Tutorial-Lab-Credits
1	V	Fundamentals of Information and Coding Theory	3-0-0-3
2	VI	Ethical Hacking	3-0-0-3

(CT-21008) Probability and Statistics for Engineers

Teaching Scheme
Lectures: 2Hrs/ Week
Tutorials: 1 Hr / Week

Evaluation Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Semester Exam: 60 marks

Course Outcomes

Students will be able to:

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

Course Contents

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

[5 Hrs]

Some of the basic probability distributions: Binomial, Poisson, Exponential, and Normal. Central limit theorem.

[5 Hrs]

Introduction to 'R': Introductory R language fundamentals and basic syntax, major R data structures, Using R to perform data analysis, creating visualizations using R.

[4 Hrs]

Basic statistical inference and hypothesis testing: Estimation, basic tests such as t-test, z-test, F-test, χ2 –test; Non parametric tests: Sign test, Wilcoxon signed rank test.

[6 Hrs]

Regression methods: Simple linear regression and multiple regression.

[4 Hrs]

Engineering applications of statistics: Engineering applications of statistics (Branch Specific (any 2)): Discussion on reliability and quality control. Introduction to random processes, stochastic processes, Markov chains. Machine learning and data science.

[4 Hrs]

Text Books

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

Reference Books

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

References for R Software:

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

(ML-21001) Constitution of India

Teaching scheme
Lectures: 1hr / week

Evaluation scheme
T1: 20 marks
T2: 20 marks
End Semester 60 Marks

Course Outcomes

At the end of the course, student will demonstrate the ability to:

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

Course Contents

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

[5 Hrs]

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

[4 Hrs]

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

[4 Hrs]

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

[2 Hrs]

Text Books

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

Reference Books

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

(HS-21001) Entrepreneurship Principles and Process

Teaching Scheme
Lectures: 1 hrs / week

Examination Scheme
Field Work/Assignments 40 marks
End Sem. Exam: 60 marks

Course Outcomes

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

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

Course Contents

Unit I

Market Research, Types of Companies and Organizations

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

[3 Hrs]

Unit II

Business Finance, Marketing & Digital Marketing

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

[4 Hrs]

Unit III

Sales & Operations Management

Understanding Sales, Pitching Techniques, Sales strategies, Inside Sales v/s Outside Sales, RFP

Operational Basics, Process Analysis, Productivity, Quality

[3 Hrs]

Unit IV

Start-ups

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

[2 Hrs]

Text Books

- The Startup Playbook: Secrets of the Fastest-Growing Startups From Their Founding Entrepreneurs by David Kidder
- True North by Bill George and Peter Sims
- Cardullo,M.W.P.E.(1999).Technological entrepreneurism: Enterprise formation, financing, and growyh. England: Research Studies Press Ltd.

Reference Books

- Kanungo,R.N.(1998). Entrepreneurship and innovation: Models for development (Ed.,Vol.2). New Delhi: Sage.
- Van Nostrand. Verma , J.C.,& Singh ,G.(2002).Small business and industry: A hand book for entrepreneurs. New Delhi: Response-Sage.

- Richard A Brealy & Steward C Myres. Principles of Corporate Finance, McGrawHills, 7th Edn, 2004
- Prasanna Chandra, Financial Management: Theory and Practice,TataMcGrawHills, 6th Edn, 2004I MPandey, Financial Management, Vikas Publishing

Humanities and Social Sciences Open Courses-I

(AS (HS)-21001) English Proficiency Language

Teaching scheme
Lectures: 2 hrs / week

Evaluation scheme
T1&T2: 60 Marks
End Semester: 40 Marks

Course Outcomes

At the end of the course, student will demonstrate the ability to:

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

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

[8 Hrs]

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

[6 Hrs]

Unit 3
Business Writing
Writing Mechanics, Note making, Summarizing, Letter &Email Writing, Business Reports, Statement of Purpose

[8 Hrs]

Unit 4
Employability Enhancement
Job Readiness, Interview Skills and Mock Interviews

[6 Hrs]

Reference books

- Business Communication by ShaliniVerma (2nd Edition) (Vikas Publishing House)
- Communication for Business: A Practical Approach by Shirley Tailor (Longman)
- Communication Skills for Engineers by S. Mishra & C. Muralikrishna (Pearson)
- Communication Skills for Technical Students by T.M. Farhathullah (Orient Longman)
- Enhancing Employability at Soft Skills by Shalini Varma (Pearson)
- Written Communication in English by Saran Freeman (Orient Longman)
- Corporate Communication by JaishriJethwaney (Oxford University Press)
- Business Correspondence and Report Writing, R. C. Sharma & Krishna Mohan (Tata McGraw Hill)
- Essential English Grammar (Intermediate&Advanced) Raymond Murphy (CUP)

(AS (HS)-21002) German Language

Teaching scheme
Lectures:2 hrs / Week

Evaluation scheme
Assignments: 40 Marks
End Sem. Exam: 60 Marks

Course Outcomes

At the end of the course, student will demonstrate the ability to:

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

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

[6 Hrs]

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

[6 Hrs]

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

[6 Hrs]

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

[6 Hrs]

Unit 5
Grammatik (grammar)
Vocab, Verb conjugations, WH-question, verbs, pronounciation, personal pronouns, articles, Singular and Plural, negation.

[6 Hrs]

Reference Books

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

(AS (HS)-21003) Japanese Language

Teaching scheme
Lectures: 2 hrs / Week

Evaluation scheme
Assignments: 40 Marks
End Semester: 60 Marks

Course Outcomes

At the end of the course, student will demonstrate the ability to:

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

Unit 1
Introduction to Japanese Language (Nihongo)
Recognize Japanese Characters Hiragana. Can read /write Hiragana script
Use basic classroom expressions
Exchange greetings Can thank someone or apologize someone
Recognize Japanese Characters Katakana Can read /write Katakana script
Can ask someone to say something again if you don't really understand

About Me & Food
Give simple self introduction Can ask and answer where you live and your age.
Can write your name, nationality, date of birth and occupation in Japanese.

Recognize the parts of a business card
Talk someone briefly about your family using a family photo and answer simple questions such as who is that? Number of family members.
Talk about your favorite foods you like and dislike. Talk about your breakfast.
Can respond when offered a drink. For example saying what you want to drink.
Can look at menu in a fast food restaurant and understand what is available.
Can look at different restaurants' signboards and understand what each place is.

[6 Hrs]

Unit 2
Home & Daily life
Say what kind of house you live in. Say what you have in your home.
Write an e mail inviting someone to your home. Visit/ Welcome a friend.
Ask /say where to put things in the room. Can read the buttons on an electric appliance
Can listen to a simple explanation when being shown around a room and understand the layout.
Recognize the name and address on signs. Talk about your daily routine. Say the time you do something.Talk about your schedule at work for the week.
Can listen to short and simple instructions at work and understand what to do.
Can read a simple, handwritten note at work and understand the instructions.
Can ask someone to lend you something at work .
Can look at a list of equipment and confirm if you have all the items.

[6 Hrs]

Unit 3
Holidays and Days off 1 and Towns
Can give a simple answer when asked about your hobbies and favorite things to do .
Talk about what you do on your days off.
Can read an event poster and find the important information such as the date, time and place.
Can ask and answer questions about whether you are going to an event etc.
Can say when you are available, when you are inviting someone to something or being invited
Recognize station and Taxi signs.
How to get to particular destination using a map
Can say how you go to work and how long it takes.
Describe places in town and location
Can look at common signs in a station and understand what they mean.

[7 Hrs]

Unit 4
Shopping & **Holidays and Days off 2**
Talk about what you want to buy.
Can ask staff in a shopping center etc .Where to go for a certain item and understand the answer .
Can look at discount signs and read the prices.
Make a brief comment on things in a shop.
Can read a short blog / simple e mail
Can talk in simple terms about impressions of the holiday / trip .
Can write a simple post for social media etc . About what you did in holiday.

[6 Hrs]

References Books

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

(AS (HS)-21004) Spanish Language

Teaching scheme
Lectures: 2 hrs / Week

Evaluation scheme
Assignments 40 Marks
End Semester 60 Marks

Course Outcomes

At the end of the course, student will demonstrate the ability to:

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

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

[6 Hrs]

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

[6Hrs]

Unit 3
La ropa (clothing)
Clothing, accessory (as per weather), season + weather, vocabulary, Demonstrative pronouns, how to ask about price, numbers till 1000 .

[6 Hrs]

Unit 4
La hora (Timing)
Mention time, daily routine, making appointments

[6 Hrs]

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

[6 Hrs]

Reference Books

- Aula internacional 1Jaime Corpas, Eva García, AgustínGarmendia, Neus Sans Baulenas (contributor), published by Goyal Publisher's and Distributors Pvt. Ltd.

(CT-21009) Software Engineering (Mini Project) Stage- I

Teaching Scheme:
Laboratory: 2 Hrs/Week
Tutorial: 1 Hr / Week

Examination Scheme:
Continuous evaluation: 70 Marks
End Semester Exam: 30 Marks

Course Outcomes

Students will be able to-

1. Demonstrate the use of tools and technologies used in software project development process.
2. To expose students to FOSS environment and introduce them to use open source tools in developing software.
3. Demonstrate the ability to communicate, solve technical problems, work in teams, and contribute to an ongoing software project.
4. Write test cases for a specified task

Text Books/ Study Material/ Web Resources:

- "Debian New Maintainers' Guide", www.debian.org/doc/manuals/maint-guide
- Pro Git Book https://git-scm.com/book
- Autotools, GNU Manuals www.gnu.org/software/autoconf/
- GNU Gettext Manual https://www.gnu.org/software/gettext/manual/gettext.html
- Advanced Bash Scripting Guide, http://tldp.org/LDP/abs/html/

Suggested List of Assignments

- Write shell scripts for following tasks: convert a CSV file to VCF format, convert a youtube transcript to SRT format, find the top 10 size files created in last 20 days, move all duplicate files (except one) from a folder to a target location, etc.
- Write shell scripts or scripts in any language of your choice, to run conformance tests on a software of your choice.

- Create a git remote repository on any of the git hosting websites, using one of the software you have written so far. In a group of three or more people, carry out the following activities: reporting of bus, assigning of issues, fixing bugs, git branch and git pull requests.
- Localise and/or Internationalize any software and demonstrate your contributions. You may select any existing free software project for the same.
- Configure any of your existing C projects of atleast 500 lines using Autotools or Cmake or scons or any similar tool. You should write the required configuration files (like configure.in, Makefile.am files etc.) and also write a bootstrap program if needed.
- Package your software for Debian, Ubuntu, any Unix or other operating systems. For free software operating systems you should get your packaged software accepted by the respective communities.
- Fix bugs in any existing software, preferably a open source software by participating in the community development process.

This list is a guideline. The instructor is expected to improve it continuously.

IFC courses

(CT (IF)-21001) Data Analytics

Teaching Scheme	**Examination Scheme**
Lectures: 1 Hr/week	Continuous Lab/Project assessment: 40 marks
Laboratory: 2 Hr/wee	Midsem Exam: 30 Marks End-Sem Exam: 30 Marks

Course Outcomes

Student will be able to:

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

Course Contents

Fundamentals of Data Analytics: Descriptive, Predictive, and Prescriptive Analytics, Data Types, Analytics Types, Data Analytics Steps: Data Pre-Processing, Data Cleaning, Data Transformation, and Data Visualization.

[2 Hrs]

Data Analytics Tools: Data Analytics using Python: Statistical Procedures, NumPy, Pandas, SciPy, Matplotlib

[2 Hrs]

Data Pre-Processing: Understanding the Data, Dealing with Missing Values, Data Formatting, Data Normalization, Data Binning, Importing and Exporting Data in Python, Turning categorical variables into quantitative variables in Python, Accessing Databases with Python.

[2 Hrs]

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

[2 Hrs]

Descriptive and Inferential Statistics: Probability distributions, Hypothesis testing, ANOVA, Regression

[2 Hrs]

Machine Learning Concepts: Classification and Clustering, Bayes' classifier, Decision Tree, Apriori algorithm, K-Means Algorithm, Logistics regression, Support Vector Machines, Introduction to recommendation system.

[4 Hrs]

Text Books

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

Reference Books

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

List of Assignments

1. Write a NumPy program to generate an array of 15 random numbers from a standard normal distribution.
2. Write a NumPy program to create a two-dimensional array with shape (8,5) of random numbers. Select random numbers from a normal distribution (200,7).
3. Write a Pandas program to add, subtract, multiple and divide two Pandas Series. Sample Series: [2, 4, 6, 8, 10], [1, 3, 5, 7, 9]
4. Write a Pandas program to convert a NumPy array to a Pandas series.
5. Write a Pandas program to create the mean and standard deviation of the data of a given Series.
6. Write a Pandas program to compute the minimum, 25th percentile, median, 75th, and maximum of a given series.
7. Write a Pandas program to get the day of month, day of year, week number and day of week from a given series of date strings.

8. Consider Iris Dataset, load the iris data into a dataframe and perform following basic operations on it:
    a. print the shape of the data, type of the data and first 10 rows and get the number of observations, missing values and nan values.
    b. Use Scikit-learn to print the keys, number of rows-columns, feature names and the description of the Iris data.
    c. create a 2-D array with ones on the diagonal and zeros elsewhere. Now convert the NumPy array to a SciPy sparse matrix in CSR format
    d. basic statistical details like percentile, mean, std etc. of iris data.
    e. Write a Python program to drop Id column from a given Dataframe and print the modified part. Call iris.csv to create the Dataframe.
    f. create a plot to get a general Statistics of Iris data
9. Consider the same Iris Dataset and perform visualization on the same:
    a. Write a Python program to create a Bar plot and pie plot to get the frequency of the three species of the Iris data.
    b. Write a Python program to create a graph to see how the length and width of SepalLength, SepalWidth, PetalLength, PetalWidth are distributed.
    c. Write a Python program to create a joinplot to describe individual distributions on the same plot between Sepal length and Sepal width. Note: joinplot - Draw a plot of two variables with bivariate and univariate graphs.
    d. Write a Python program to draw a scatterplot, then add a joint density estimate to describe individual distributions on the same plot between Sepal length and Sepal width.
    e. Write a Python program using seaborn to Create a kde (Kernel Density Estimate) plot of sepal_length versus sepal width for setosa species of flower.
    f. Write a Python program to create a box plot (or box-and-whisker plot) which shows the distribution of quantitative data in a way that facilitates comparisons between variables or across levels of a categorical variable of iris dataset. Use seaborn.
    g. Write a Python program to create a Principal component analysis (PCA) of iris dataset.
10. Write a Python program using Scikit-learn to split the iris dataset into 80% train data and 20% test data. Train or fit the data into the model and using the K Nearest Neighbor Algorithm and create a plot of k values vs accuracy.
11. Build a decision tree model that predicts the species of iris from the petal and sepal width and length. Perform model evaluation.
12. Implementing Support Vector Machine (SVM) classifier in Python using the iris features from iris dataset and train an SVM classifier and use the trained SVM model to predict the Iris species type.

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

This list is a guideline. The instructor is expected to improve it continuously.

(CT(IF)-21002) Fundamentals of Machine Learning

Teaching Scheme:
Lectures: 1 Hrs/week
Lab: 2Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will able to:

1. To introduce students to the basic concepts, tools and techniques of Machine Learning.
2. To develop skills of using recent machine learning software for solving practical problems.
3. Analyze and Evaluate the different ML models.
4. Implement ML algorithms to solve real life problems.

Course Contents

Prerequisites: Relevant applied math and statistics: probability theory, probability distribution, Conditional probability, Bayesian probabilities.

Introduction to Machine Learning: Basic concepts, Machine Learning methods: Supervised, Unsupervised, Semi-supervised, Inductive, Reinforcement Learning.

[2 hrs]

Linear Regression: Introduction toLinear regression, Logistic Regression, Naive BayesAlgorithm, Model Selection, Linear basis function model, model assessment, assessing importance of different variables, subset selection. Cross Validations.

[3 hrs]

Hypothesis Design: Types of variables, Types of measurement scales, Constructing the Hypothesis, Null hypothesis, Alternative Hypothesis. Hypothesis testing, type 1 error, Type 2 error, Confidence of Interval.

[3 hrs]

Instance Based Learning: Feature selection, supervised and unsupervised learning, Classification Algorithms: K-Nearest Neighbour Classification and Decision Tree.

[3 hrs]

Neural Network: Introduction, Feed forward network, Network training, Back propagation NN, Regularization, Error Analysis, Deep Neural Network.

[3 hrs]

Text Books

- Tom M. Mitchell, "Machine Learning", First Edition, McGraw Hill Education, ISBN 978-12-5909-695-2
- Andreas C. Müller and Sarah Guido , "Introduction to Machine Learning with Python: A Guide for Data Scientists", First Edition, O'Reilly Media, ISBN 978-14-4936-941-5

Reference Books

- Trevor Hastie, Robert Tibshirani, and Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Second Edition, Springer, ISBN 978-03-8784-857-0
- Christopher M. Bishop, "Pattern Recognition and Machine Learning", Second Edition, Springer, 978-03-8731-073-2
- Hadley Wickham and Garrett Grolemund, "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data", First Edition, O'Reilly, ISBN 978-14-9191-039-9

List of Practical Assignments:

1. Exploratory Data Analysis: Perform following operations on any open dataset available in Python/Kaggle:
    a. Load data into a data frame from a .cvs or any other file format.
    b. Identification of variables and data types.
    c. Display number of rows and columns.
    d. Find Missing Values.
    e. Replace/eliminate missing values
    f. Change column name(s) to short/easy names if required.
    g. Drop unessential columns.
    h. Add new columns
    i. Display first/last few rows.
    j. Find average/min/max of numeric columns.
    k. Find mode of non-numeric columns.
    l. Display unique values in each column.
    m. Display summary of dataframe

2. Plots: Using various plots explore the relationship between attributes of a dataset.

3. Build a Linear Regression Model using *New York Stock Exchange* dataset, to predict. This dataset contains historical data from the New York stock market.

4. Build a Linear Regression Model using *Real estate price prediction* dataset.
   This real estate dataset was built for regression analysis, linear regression, multiple regression, and prediction models. It includes the date of purchase, house age, location, distance to nearest MRT station, and house price of unit area.
   Take a dataset contains 1000 or more row, and each input point contains 3 features. Train a linear regression model on the dataset. Report the coefficients of the best fit model.

5. Developed a logistic regression model to predict whether a produced microchip should be accepted or rejected based on a dataset from quality tests.

6. Create a Data frame having below contents:

Day	Weather	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Cloudy	Hot	High	Weak	Yes
3	Sunny	Mild	Normal	Strong	Yes
4	Cloudy	Mild	High	Strong	Yes
5	Rainy	Mild	High	Strong	No
6	Rainy	Cool	Normal	Strong	No
7	Rainy	Mild	High	Weak	Yes
8	Sunny	Hot	High	Strong	No
9	Cloudy	Hot	Normal	Weak	Yes
10	Rainy	Mild	High	Strong	No

Use Decision Tree algorithm to predict to play or not to play.

Variables	Variable Description
Cdur	Credit duration (in months)
Cpur	Purpose of credit (Business, electronics, etc.)
Camt	Credit amount (in □)
Prop	Properties held by the borrower (real estate, other cars, etc.)
age	Age of the borrower
creditScore	Credit rating of the borrower (bad/good)

7. Use a dataset like 'Credit.csv' contains data existing customers with below attributes Build a k-NN model for classifying the credit rating of the customers based on their credit history. What is the highest accuracy (in %) achieved by this k-NN model.

8. Use the 'iris.csv' dataset, which has four features of a flower, as mentioned below. Determining the optimum number of clusters using K-Means clustering algorithm. Build the algorithm and find the optimum 'k' value, ranging between 1 to 10 by setting the seed value as 111.

Variables	Variable Description
Sepal.Length	Sepal Parameters (Length and Width, in cm)
Sepal.Width	
Petal.Length	Petal Parameters (Length and Width, in cm)
Petal.Width	

What is the optimal number of clusters for the k-means model built using the information given above? Determine the value of between-clusters sum of squares of and the value of the total sum of squares for the k-means model built with the optimal k value.

9. **Train** a neural network classifier using the dataset (https://www.kaggle.com/datasets). Run cross-validation and compute the classification error per fold.
   Also perform a statistical test on the two sets of error observations (one from decision trees and one from neural networks) and report your findings.

10. Add some new emotions to the existing dataset. What changes should be made in decision trees and neural networks classifiers in order to include new classes? Justify

This list is a guideline. The instructor is free to assign new assignments.

(CT(IF)-21003) Fundamentals of Operating Systems

Teaching Scheme:
Lectures: 2 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Write programs to manipulate processes, files, and hardware resources using appropriate system calls.
2. Illustrate the design issues, solutions and complexity of operating system by compiling, modifying an OS kernel, tracing the sequence of activities on processor, data structures of a file system, race conditions, locking mechanisms and storage techniques.
3. Correlate the computer architecture features with operating system design issues.
4. Make design choices for an operating systems with given constraints

Course Contents

Introduction and Operating Systems structures: System programs: compiler, linker, loader. Operating system components, O.S. Services, System Calls, Virtual Machines, Boot Sequence.

[3 Hrs]

Processes and CPU Scheduling: Process concept, interleaved I/O and CPU burst; Process states; Co-operating processes, Thread, Thread libraries, Multithreaded programming, Scheduling, Scheduling criterion, Scheduling algorithms, Interrupts and Interrupt handling.

[4 Hrs]

Inter process Communication: Pipes, Shared memory mechanism, , Asynchronous communication, Signals. POSIX API for IPC and programs using it.

[3 Hrs]

Process Synchronization: Critical section problem, Hardware support for mutual exclusion, Semaphores, Deadlock-principle, Deadlock detection, prevention and avoidance, Classical problems in concurrent programming: Producer-consumer, Reader-writer with and

without bounded buffer. Design of locking primitives like spinlock, semaphore, read-write locks, recursive locks, etc.

[6 Hrs]

Memory management: O.S. and hardware interaction, Swapping, Continuous memory management, paging, Segmentation, Virtual Memory Management, Demand Paging, Page replacement algorithms, Allocation of frames, Kernel memory management

[6 Hrs]

File Management and Storage Structures: File Organization, Concept of files and directories, System calls for file systems, Free space management, Data structures like inode and super block, Virtual file system, Disk layout, Formatting, Recovery

[6 Hrs]

Text Books

- Abranhan Silberschatz, Peter B Galvin, Greg Gagne; Operating System Concepts, Wiley India Students Edition, 8th Edition, ISBN: 978-81-265-2051-0
- Andrew S. Tanenbaum; Modern Operating Systems; Prentice Hall of India Publication; 3rd Edition. ISBN: 978-81-203-3904-0

Reference Books

- Milan Milenkovic; Operating Systems; Tata McGraw Hill; Second Edition. ISBN: 0-07-044700-4
- Maurice J. Bach; The Design of the Unix Opearating System; Prentice Hall of India; ISBN: 978-81-203-0516-8
- Uresh Vahalia; Unix Internals, The New Frontiers; Prentice Hall; ISBN: 0-13-101908-2

List of Assignments

1. Create two virtual machines using virtual box software. One virtual machine will run a GNU/Linux of your choice on it. The other virtual machine will run any non-Linux operating system.
2. Write a minimal version of a shell with the features to handle pipes and handle redirection.
3. Use debugfs tool to locate a file which was recently deleted on an ext2 file system. Write a program, on the lines of debugfs, to browse an ext2 file system and given the complete name name of a file, print it's inode.
4. Write a program using pthreads to demonstrate the producer consumer synchronization problem. Implement appropriate synchronization. Show the different results with and without synchronization.
5. Write a program to demonstrate the usage of signals – show how processes can wait for each other, kill each other, stop and continue each other.

This list is a guideline. The instructor is free to assign new assignments.

(PE(IF)-21001) Robotics (Manufacturing Department)

Teaching Scheme:
Lectures: 2 Hrs/week

Examination Scheme:
Quizzes – 40 marks
End Sem Exam - 60 marks

Course Objectives:

1. To enable students to understand the basic concepts and principles in robotics.
2. To enable students to classify the robot structures, grippers, drives and their design and selection
3. To enable students about kinematics of robot manipulator and transformation analysis.
4. To enable students to understand robot programming and write the programs.
5. To enable students to analyze the trajectory planning of robot joints.
6. To select robots for various applications and perform economic analysis

Course Contents

Unit 1: Basic Concepts in Robotics: Automation and robotics, robot anatomy, basic structure of robots. Classification and Structure of Robotics System: Point to point and continuous path systems. Control loops of robotic system, manipulators, wrist motions and grippers.
Robot End Effectors: Grippers and tools, Types of end effectors-mechanical, magnetic and vacuum, gripper force analysis and gripper design considerations.

[5 Hrs]

Unit 2: Drives and Sensors: Basic control systems, concepts and models, types of drive system- Hydraulic systems, pneumatic and electrical, DC servo motors, analysis, robot activation and feedback components,
Sensors, internal-external sensors, contact and non-contact sensors, position and velocity sensors, Touch and slip sensors, Force and torque sensors, tactile sensors, Proximity and range sensors.

[6 Hrs]

Unit 3: Robot Arm Kinematics: Homogenous coordinates and homogenous transformations, Forward and Inverse kinematics in robot, Denavit Hartenberg convention and its applications Lagrange-Euler formation.

[5 Hrs]

Unit 4 : Robot Programming: Methods of robot programming, lead through, motion interpolation, WAIT, SIGNAL and DELAY commands, branching capabilities and limitations of lead through methods. Robot Language: The textual robot languages, generations of robot programming languages, variables, motion commands, end effectors and sensor commands, computations and operations.

[4 Hrs]

Unit 5: Trajectory Planning: Introduction, Joint Space Scheme, Cubic Polynomials with via points, Blending scheme

[4 Hrs]

Unit 6: Robot Applications in Manufacturing: Material transfer and machine loading/unloading, processing operations assembly and inspection. Concepts of safety in robotics, social factors in use of robots, economics of robots, Telechiric machines and its application.

[4 Hrs]

Text Books

- S. R. Deb.: Robotics Technology And Flexible Automation, Tata McGraw Hill Publishing Co. Ltd.
- P.A. Janakiraman, Robotics and Image Processing, Tata Mcgraw Hill, 1995

Reference Books

- Yoren Koren: Robotics for Engineers, McGraw Hill Book Co., ISBN 0-07-035341-7.
- M. P. Grover, M. Weiss, R. N. Nagel, N. G. Odrey,: Industrial Robotics Technology, ISBN 0-07-100442-4.
- K. S. Fu, C. G. S. Lee, R. C. Gonzaler, Robotics Control, Sensing, Vision and Intelligence, Tata McGraw Hill. 2008, ISBN 13: 9780070226258

(CT-21007) Computer Organization

Teaching Scheme
Lectures: 3Hrs/ Week

Examination Scheme
Assignment/Quizzes: 40 marks
End Semester Exam: 60 marks

Course Outcomes

Students will be able to:

1. Analyze Instruction set architecture, control signals in CPU, Hard wired control & Microprogrammed control units.
2. Apply Booth algorithm for multiplication, floating point number representation & Arithmetic.
3. Describe DRAM technology, cache memory,
4. Justify the need of paging in virtual memory and Secondary Storage.
5. Measure and analyze multiprocessor system & bus arbitration, Instruction pipelining & RISC.

Course Contents

CPU Architecture: Instruction format, control signals in CPU, micro program control unit and hardwired control unit, ALU & sequencer, look ahead carry generator, MIPS ISA

[6 Hrs]

Arithmetic: Integer Arithmetic-multiplication, Booth's Algorithm, division algorithm; Floating point number representation, and floating point arithmetic

[6Hrs]

Memory: Dynamic RAM organization, CACHE memory & it's mapping, cache coherence & MESI protocol, virtual memory, secondary storage, MBR and GPT hard disks, RAID, File system FAT

[8Hrs]

System and memory map: Closely coupled and loosely coupled multiprocessor systems, bus arbitration, co-processor, lower 1MB memory map

[7 Hrs]

Instruction Pipelining: Basic concepts and issues, Introduction to the basic features & architecture of RISC & CISC processors, super scalar processor, MIPS pipeline

[7Hrs]

Multiprocessor: Introduction to Multicores, Multiprocessors and Clusters. Introduction to GPGPU

[6Hrs]

Text Books

- William Stallings, Computer Organization and Architecture, 9/E ISBN-10: 013293633X ISBN-13: 9780132936330©2013 Prentice Hall

- Carl Hamacher, ZvonkoVraesic and SafwatZaky, Computer Organisation, ISBN 0-07-232086-9, MGH 5th edition.

Reference Books

- D. Paterson, J. Hennesy, "Computer Organization and Design: The Hardware Software Interface", 5th Edition MIPS, Morgan Kauffman, 2016 ISBN 9351073378.
- Liu & Gibson, Microcomputer Systems, PHI, ISBN: 978-81-203-0409-3

(CT-21001) Database Management Systems

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Identify and describe various components of DBMS.
2. Construct Entity-Relationship Model for given applications and Relational Model for the same.
3. Design and write best possible or optimal (SQL) query statement for given statement.
4. Apply normalization to database design.
5. Improve efficiency of data retrieval using various storage systems and indexing.
6. Describe concurrency control protocol and solve analytical problems on serializability.

Course Contents

Introduction: Basic concepts, Database system application, Purpose of database systems, View of data, Database languages; Database architecture: Components of DBMS and overall structure of DBMS; Types of databases

[6 Hrs]

Relational Model: Structure of relational databases, Fundamental relational algebra operations, Additional relational algebra operations, Extended relational algebra operations, null values, Modification to database, Other relational languages .

[6 Hrs]

SQL: Basic structure and operations, Aggregate functions, Nested subqueries, Complex queries, views; Cursors in SQL; No SQL databases: Features of NoSQL databases, Types of NoSQL databases.

[6 Hrs]

E-R model: Entity, Attributes, Relationships, Constraints, E-R model design; Relational Database Design: Basic concept of normalization, Decomposition using functional dependencies.

[8 Hrs]

Indexing and Hashing: Basic of query processing; Indices: Concepts, B+ trees and B-tree index file; Static and dynamic hashing.

[6 Hrs]

Transactions: Basic concepts, States, Concurrent execution, Serializability, Recoverability, isolation; Concurrency control: Timestamps and locking protocols, Validation based protocols, deadlock handling; Recovery**:** Log-based recovery, Shadow-paging.

[8 Hrs]

Text Books

- Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database system concepts", Fifth Edition, McGraw Hill International Edition, ISBN 978-0073523323.
- Raghu Ramkrishnan, Johannes Gehrke, "Database Management Systems", Second Edition, McGraw Hill International Editions, ISBN 978-0072465631.

Reference Books

- Rob Coronel, "Database systems: Design implementation and management", Forth Edition, Thomson Learning Press, ISBN 978-1418835934.
- Ramez Elmasri and Shamkant B. Navathe, "Fundamental Database Systems", Third Edition, Pearson Education, 2003, ISBN 978-0321204486.
- Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, "Database Systems: The Complete Book", Second Edition, Pearson, 2008, ISBN 978-0131873254.

(CT- -21002) Database Management Systems Laboratory

Teaching Scheme:
Laboratory: 2 Hrs/Week

Examination Scheme:
Continuous evaluation: 50 Marks
Oral Exam: 50 Marks

Course Outcomes

1. Explain fundamentals and various components of DBMS.
2. Analyze requirements and Design E-R data model by applying different forms of constraints on data for the given application/problem in hand.
3. Think and write best possible or optimal (SQL) query statement for given statement.
4. Explain normalization by applying Normalizations techniques to database .
5. Write high level program to connect database through appropriate API.

Suggested List of Assignments

1. Write simple SQL Queries on the given schema.
2. Write SQL queries using aggregates, grouping and ordering statements for given statements on given schema.
3. Write SQL queries for given schema using Nested Subqueries and SQL Updates
4. Write DDL and DML statements for given statements.
5. Create the schema and constraints on the given relations using given statements.
6. Demonstrate database connectivity through High Level Programming Language.
7. Demonstrate the application of cursor in database.

8. Select any real time problem for database implementation. Draw an ER diagram for the selected problem in hand. Normalise the database up to appropriate normal form.

This list is a guideline. The instructor is expected to improve it continuously.

(CT- -21003) Artificial Intelligence

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Compare AI with human intelligence and traditional information processing and discuss its strength and limitations
2. Apply the basic principles, models and algorithms of AI to recognize, model and solve problems
3. Demonstrate knowledge of basics of the theory and practice of Artificial Intelligence
4. Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.
5. Apply knowledge representation techniques and problem solving strategies to common AI applications.

Course Contents

Introduction: What is AI, History, AI problems, Production Systems, Problem characteristics, Intelligent Agents, Agent Architecture, AI Application (E-Commerce, & Medicine) , AI Representation, Properties of internal representation, Future scope of AI, Issues in design of search algorithms.

[6 Hrs]

Heuristic search techniques: Heuristic search, Hill Climbing, Best first search, mean and end analysis, Constraint Satisfaction, A* and AO* Algorithm**, Knowledge Representation:** Basic concepts, Knowledge representation Paradigms, Structured representation of knowledge, ISA hierarchy, Frame notation, Resolution, Natural Deduction

[6 Hrs]

Knowledge Inference: Introduction, Knowledge representation- Production based system, Forward and Backward reasoning, Knowledge representation using non monotonic logic: TMS (Truth maintenance system) , statistical and probabilistic reasoning, fuzzy logic, structure knowledge representation, semantic net, Frames, Script, Conceptual dependency.

[6 Hrs]

Learning & Planning: What is Learning, Types of Learning (Rote, Direct instruction Analogy, Induction, Deduction), Planning: Block world, strips, Implementation using goal stack, Non linear planning with goal stacks, Hierarchical planning, Least commitment strategy.

[6 Hrs]

Advanced AI Topics: Game playing: Min-max search procedure, Alpha beta cutoffs, waiting for Quiescence, Secondary search, Natural Language Processing (NLP): Introduction, Steps in NLP, Syntactic Processing, Semantic analysis, Discourse & Pragmatic Processing. Perception and Action: Perception, Action, Robot Architecture.

[8 Hrs]

Neural Networks and Expert systems: Neurons and biological motivation. Linear threshold units. Perceptrons: representational limitation and gradient descent training. Multilayer networks and backpropagation, Hidden layers and constructing intermediate, distributed representations, Overfitting, learning network structure, two case studies on expert systems.

[8 Hrs]

Text Books

- Elaine Rich and Kerin Knight, Artificial Intelligence, 3rd Edition, McGraw Hill. ISBN13: 9780070087705
- Eugene, Charniak, Drew Mcdermott, Introduction to artificial intelligence, Addison-Wesley. ISBN 0-07-052263-4.

Reference Books

- Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd Edition. ISBN 0-13-103805-2.
- Herbert A. Simon, The Sciences of the Artificial, MIT Press, 3rd Edition, 1998. *ISBN*: 9780262190510.
- George F Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Edu., 4th Edition. *ISBN*-13: 978-0-321-54589-3.

(CT- 21004) Artificial Intelligence Laboratory

Teaching Scheme:
Laboratory: 2 Hrs/week

Examination Scheme:
Continuous evaluation: 50 Marks
End Semester Exam: 50 Marks

Course Outcomes

Upon successful completion of the course, the students will be able to:

1. Develop an Explaining what is involved in learning models from data.
2. Implement a wide variety of learning algorithms.
3. Apply principles and algorithms to evaluate models generated from data.
4. Apply the algorithms to a real-world problem.

Suggested List of Assignments

1. Implement A* algorithm .
2. Implement AO* algorithm .
3. Implementation of other Searching algorithm.
4. Implementation of Min/MAX search procedure for game Playing .
5. Implementation of variants of Min/ Max search procedure.
6. Implementation of mini Project using the concepts studied in the AI course.

This list is a guideline. The instructor is expected to improve it continuously.

(CT-21005) Computer Networks

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Trace the flow of a network packet over internet
2. Design a network with subnets as specified
3. Discuss and critically evaluate various networking protocols used in Internet
4. Discuss and analyze the problems posed by each layer of TCP/IP stack
5. Analytically compare the state-of-the-art protocols and architectures in computer networks for Internet

Course contents

Introduction to computer networks and Internet: Physical Mediums, Concept of Network Protocols, Layered Architecture, Network core – Packet Switching vs Circuit Switching, Various Losses in the Internet, ISPs, IXPs, Routing, Heterogeneous Networks, Brief History of Computer Networks

[4 Hrs]

Application Layer: Basics of Socket Programming, Transport Layer Programming Interface(TCP, UDP) , Protocols: HTTP (Overview, Persistent and Non-Persistent, Message Format, Cookies, Cachess) , SMTP (Overview, Message Formats) , IMAP, POP, DNS; FTP; Telnet, SSH; Peer-to-Peer Applications, BitTorrent Protocol; Conte Distribution Networks;

[8 Hrs]

Transport Layer: Relationship Between Transport and Network Layer, TCP and UDP; Multiplexing and Demultiplexing; Implementation Overview in OS kernels; Principles of Reliable Data Transfer; Go-Back-N and Selective Repeat; TCP: Segment Structure, Round Trip Time Estimation, Reliable Data Transfer, State Transitions, Flow Control, Congestion Control, Fairness; UDP: Segment Structure

[8 Hrs]

Network Layer, Subnets: Concept of IP Address, Netmask, Subnet; CIDR; Design of a LAN and WAN; Subnetting Problems

[3 Hrs]

Network Layer, Routers,IPv4, IPv6: Functions of a Router: Forwarding and Routing; Inside of a Router: Port Processing, Switching; Queueing: Causes, Delays; IPV4: Datagram Format, Fragmentation; Network Address Translation; IPv6 Introduction; Multicasting

[4 Hrs]

Network Layer, Routing algorithms: Link State, Distance Vector Routing; OSPF, BGP, RIP; Routing Policies

[4 Hrs]

Link Layer: Review of fundamentals of link layer protocols; Ethernet Switches, LANs, Link-Layer Switches, VLANs, Complete tracking of traversal of a packet over internet between two applications

[5 Hrs]

Wireless Networks: Wireless Links and Network Characteristics, Bit Error Rate, SNR; Problems of Wireless Links(Interference, Signal Strength fading, Multipath Propagation, Hidden Terminal problem) , 802.11 (Architecture, MAC protocol, Frame Structure) ,

[8 Hrs]

Text Books

- J.F. Kurose and K. W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson, ISBN-13: 9780201976991
- Behrouz A. Forouzan, Firouz Mosharraf, Computer Networks: A Top-Down Approach, Tata McGraw-Hill Education Pvt. Ltd, ISBN 10: 1259001563 / ISBN 13: 9781259001567
- A S Tanenbaum, "Computer Networks", Pearson Education, ISBN 9788177581652

References

- Larry Peterson Bruce Davie, Computer Networks A Systems Approach, Elsevier, ISBN: 9780123850591
- Kevin R. Fall, W. Richard Stevens, TCP/IP Illustrated, Volume 1: The Protocols, Pearson, ISBN-13: 978-0321336316/ISBN-10: 0321336313
- Behrouz Forouzan, Data Communications and Networking, Tata McGraw-Hill, ISBN-13: 978-0073250328/ISBN-10: 0073250325
- William Stallings, "Data and computer Communication", Pearson Education, ISBN-81-297-0206-1
- Alberto Leon Garcia and Indra Widjaja, "Communication Networks, Fundamental Concepts and Key Architectures", Tata McGraw-Hill, ISBN-10: 007246352X
- Peter Loshin,IPv6 Theory, Protocol, and Practice, Elsevier, ISBN: 9781558608108

(CT- -21006) Computer Networks Laboratory

Teaching Scheme:
Laboratory: 2 Hrs/Week

Examination Scheme:
Term Work: 50 Marks
Oral/End Term Exam: 50 marks

Course Outcomes

Students will be able to:

1. Execute various Networking commands to configure, inspect network on a computing device
2. Demonstrate Socket Programming ability

3. Implement and Execute Packet tracer Programs and analyse all the packets captured
4. Install and configure various Networking applications
5. Write simulations of Networking Protocols using network simulators
6. Design computer networks and sub-networks

List of Assignments

1. Implement a TCP-IP client-server application. The server accepts a string as a request and sends the capitalized version back.
2. Configure network on your computer using DHCP and Static IP. Learn the following networking commands and configuration files: ifconfig, ping,host, traceroute,, telnet, netstat, nslookup, ssh, scp, wget, /etc/resolv.confdf, /etc/hosts, /etc/network/interfaces
3. Install and demonstrate the following networking applications: web server (apache2 or nginx) , ftp server, ssh server, email client (thundereetc. bird, pine, mutt, etc.)
4. Access the website http://go.com (or any website on HTTP, not HTTPS) . Use Wireshark to inspect the flow of packets for a GET request using browser. Identify all packets for this request. Capture the data from all packets and construct the HTML page. Trace the TCP sequence numbers and verify that they match the expected behavior.
5. Send an email using SMTP over the server at new.toad.com (an open SMTP server) .
6. Implement a packet sniffer to capture packets of a specified link layer, network layer, transport layer, or application layer protocol.
7. Write a program to simulate either Go-Back-N or Selective Repeat protocols.
8. Implement a given subnet using ns3 simulator and demonstrate the flow of packets.
9. Design a given subnet using any simulator and demonstrate connectivity among all nodes as specified.
10. Critically analyze the COEP network design and suggest at least one improvement.
11. Create the routing topology specified by instructor and carry out performance evaluation of a specified routing protocol or TCP variant using *ip netns* on Linux.
12. Evaluate the following performance parameters of Linux kernel TCP like receiver advertisement buffer size, initial congestion window, window scaling, using *ip netns.*
13. **Course Mini project:** Implement any one of these: a web server(HTTP Protocol) , email client (IMAP and POP procols) , a bittorrent client, DNS server and client (like nslookup) , etc, simulations of transport layer/network layer protocols; Adding features/bug fixes in apache2/nginx like projects

This list is a guideline. The instructor is expected to improve it continuously.

(ML-21002) Environmental Studies

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

Teaching scheme
Lectures: 1 hr / week

Evaluation scheme
Periodic Assignments & Tests
Assignment:2 hrs/week

Course Outcomes

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

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

Course Contents

Unit I
Multidisciplinary nature of environmental studies
Definition, scope and importance
Need for public awareness.

[2 Hrs]

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

[8 Hrs]

Unit III
Ecosystems
Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and

decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem:-Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

[6 Hrs]

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

[8 Hrs]

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

[8 Hrs]

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

[7 Hrs]

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

[6 Hrs]

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

[5 Hrs]

Reference Books

- Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

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

Humanities and Social Sciences Open Courses-II

(AS (HS)-21005) Industrial Psychology

Teaching Scheme
Lectures: 2 hrs/week

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

Course Outcomes

1. At the end of the course, student will demonstrate the ability to:
2. determine the psychological factors that influence individual differences at work and appraise the role of research.
3. explain the concepts of motivation and job satisfaction at work and Utilize the elements of organizational culture for enhancing group/team behavior.
4. evaluate the relevance & functioning of leadership & diversity in workforce and acknowledge the multicultural factors influencing workplace behavior.
5. illustrate the process of recruitment & selection and Experiment with the information required to sustain employability.
6. interpret the nuances of Human Factors in Engineering and Analyze its role in their disciplines.
7. measure the behavioral findings from self-lead projects and Propose corrective actions to improve quality of workplace behavior.

Unit 1
Basics of Industrial Psychology (IP)
Difference between IP & Business Programs; Major fields & Employment in IP
Brief History- Scientific Management,Time and Motion Study, Hawthorne Studies,World War I & II
Research in Social Sciences
Individual Differences at Work: Personality, Intelligence, Emotional Intelligence, Creativity & Innovation, Perception & Attitudes

[6 Hrs]

Unit 2

People at Work

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

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

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

Diversity- Multiculturalism- Hofstede's theory, Diversity dynamics

[8 Hrs]

Unit 3

Human Factors Engineering (HFE)

Introduction & Brief History of HFE; Essentials of HFE

Person-Machine Systems- Basic Human Factors: Sensory systems, Perception, Cognition,

Information Processing approach, Memory, Decision Making

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

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

[8 Hrs]

Unit 4

Managing People at Work

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

Recruitment & Selection- Overview, Process, Evaluation

Gearing for Selection- Interviews & Job Search Skills

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

[6 Hrs]

Text Books

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

References

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

(AS (HS)-21006) Personnel Psychology

Teaching scheme
Lectures: 2 hrs /Week

Evaluation scheme
Assignments: 60 marks
End Sem. Exam: 40 marks

Course Outcomes

At the end of the course, student will demonstrate the ability to:

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

Unit 1

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

[6 Hrs]

Unit 2

Motivation

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

[6 Hrs]

Unit 3

Group dynamics

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

[8 Hrs]

Unit 4

Mental health at work place

Occupational stress and conflict and strategies for its management, Emotional Intelligence, spiritual Intelligence

[6 Hrs]

Text Books

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

Reference Books

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

(AS (HS)-21007) Engineering Economics

Teaching Scheme
Lectures: 2 hrs/week

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

Course Outcomes

At the end of the course, student will demonstrate the ability to:

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

Unit 1
Introduction to Economics:
Definitions, basic concepts of economics: Cost, efficiency and scarcity, Opportunity Cost
Types of economics: Micro Economics, Macroeconomics and Managerial Economics.
Difference between micro economics and macroeconomics. Application of Managerial economics

[6 Hrs]

Unit 2
Micro Economics Analysis
Demand Analysis, Supply Analysis, Theories of Utility and Consumers Choice, Cost analysis, Competition and Market Structures. Application of micro economics theories

[8 Hrs]

Unit 3
Macro Economic Analysis
Aggregate Demand and Supply, Economic Growth and Business Cycles, inflation,
Fiscal Policy, National income, theory of Consumption, savings and investments, Commercial and Central banking. Use of macroeconomic theories.

[8 Hrs]

Unit 4
International Economics
Balance of Trade and Balance of Payments, Barriers to Trade, Benefits of Trade/Comparative Advantage, Foreign Currency Markets/Exchange Rates, Monetary, Fiscal and Exchange rate policies, Economic Development.
Application of exchange rate policies

[8 Hrs]

Reference Books

- Macroeconomics: N. Gregory Mankiw, 2018

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

(AS (HS)-21008) Finance for Engineers

Teaching scheme
Lectures:2 hrs / week

Evaluation scheme
Assignments 40 Marks
End Semester 60 Marks

Course Outcomes

At the end of the course, student will demonstrate the ability to:

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

Unit 1
Introduction to Accounting & Finance
Basic elements of financial accounting, cost concepts, preparation of Profit & Loss Account & Balance Sheet & concept of Budgetary control

[6 Hrs]

Unit 2
Read & interpret Financial Statements
As per Schedule III of Companies Act 2013, Financial statement analysis, concept of cash flow statement

[6 Hrs]

Unit 3
Break-even analysis, Risk & Return relationship, time value of money, sources of finance & working capital

[8 Hrs]

Unit 4
Digital Platform such as Net Banking, Cryptocurrency, Algorithm based stock exchange trading, Basics of Money market, capital market, Commodities market, IPO & Regulatory authorities
****Pedagogy:** Lectures and PPTs, Use of basic Excel tools for preparation of final accounts, Annual Reports of companies.

[4 Hrs]

Reference Books

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

(CT-21015) Software Engineering Mini Project Stage- II

Teaching Scheme
Lectures: 2 Hrs / Week
Laboratory: 2 Hrs/Week

Examination Scheme
Quiz/Assignments: 20 Marks
Theory Exam:40 Marks
Project: 40 Marks (Submission in Stages)

Course Outcomes

Students will be able to:

1. Describe fundamental concepts of system development lifecycle through SDLC.
2. Design user interface prototypes for real world scenarios using appropriate methods of analysis and design.
3. Devise procedure to assure the quality and maintainability of the product before and after deployment.
4. Develop skill to transfer acquired knowledge across a wide range of industrial and commercial domains and have a basis for further studies in software engineering or in computing related industries.
5. Analyze real world scenario and apply tools and techniques to produce application software solutions from informal and semiformal problem specifications.
6. Develop an ability to work in a team by communicating computing ideas effectively in writing a technical report.

Course Contents

Software Development process: Software Engineering basics, Software Crisis and Myths, Software Process and development, Software life cycle and Models, Analysis and comparison of various models, agile process

[6 Hrs]

Requirement Engineering: Requirements Engineering, requirement engineering process, Introduction to Analysis model.

[6 Hrs]

System Architecture and Design Overview, Architecture 4+1 view, architecture styles, Design process, quality concepts, Analysis model to Design Model transformation, Standardisation using UML.

[6 Hrs]

Software Metrics: Introduction to Software Metrics, Size-oriented metrics and function point metrics. Effort and cost estimation techniques -LOC-based and Function-point based measures - The COCOMO model.

[6Hrs]

Testing and Maintenance: Validation and Verification activities, Testing Principles and strategies, Testing levels & types- White Box & Black Box Testing, Maintenance, Types of Maintenance.

[6 Hrs]

Laboratory Mini Project Task

Students will carry out one of the following mini projects:

A) Work on an existing free software/open source project and contribute to it in terms of feature improvements or significant bug fixes. The project will be finalised in consultation with the laboratory instructor. The work can be carried out in teams of any size, however individual evaluation will be carried out on individual basis. The contributions should clearly bring out the following:
   1. Use of version control systems
   2. Contributions of each individual member of the team as seen in version control system
   3. Use of industry standard coding practices
   4. Participation in the software development process of the particular software
   5. Writing test cases and testing the software
   6. Deployment changes, Packaging if needed
   7. Acceptance of your contributions by the upstream community.

B) A full-fledged working system in the form of mini project will be implemented following the task list given below. Students in group of two will be working on mini project. After consultation with the course instructor and finalisation of the topic following deliverables are expected under mini-project. Task List for the same is as follows:
   1. Carry out state of art survey, selecting appropriate domain, problem identification, statement formulation based on research problems or real-world problems, industry based problem etc.
   2. Develop workflow graph and carry project estimation, calculation of efforts, project planning (schedule) using automated tools.
   3. Gather requirements and Write the Software Requirement specification (SRS-IEEE specs) document for the project.
   4. Draw different UML diagrams and System architecture for the proposed system. Use different open source tools for design.
   5. Develop Test cases. Propose solution for wrong results in test cases by focusing on regression testing.
   6. Write the constraints, advantages and disadvantages of your project over existing system.
   7. Write the future scope of your project. Develop help manual for maintenance and usability.

Students will be required to submit a technical report written using LaTEX. The technical report will include description of the project/problem, design of the software, description of problems solved and solution design, result analysis of test cases and conclusions. Students will also be required to demonstrate and present their work in a viva-voce.

This list is a guideline. The instructor is expected to improve it continuously.

Text Books

- "Pressman R., "Software Engineering, A Practitioners Approach", 6th Edition, Tata McGraw Hill Publication, 2004, ISBN 007-124083-124083-7.
- "G. Booch, J. Rumbaugh and I. Jacobson. The Unified Modeling Language User Guide, Addison Wesley, 1999.

Reference Books

- "Shari Pfleeger, "Software Engineering", 2nd Edition. Pearson's Education, 2001.
- "Ian Sommerville, "Software Engineering", 6th Edition, Addison-Wesley, 2000
- "Pankaj Jalote, "An Integrated Approach to Software Engineering", Narosa publication house
- "Fred Brooks, "Mythical Manmonths", www.cs.drexel.edu/~yfcai/CS4517/.

Papers

- Fred Brook, "No Silver Bullets", IEEE Software 1987.
- Eric Raymond, "Cathedral and Bazaar ", www.tuxedo.org/~esr/writings.
- David Parnas, "On the Criteria To Be Used in Decomposing Systems into Modules", Communications of the ACM, volume 15, #12, 1972.
- Grady Booch, IEEE software on architecture,IEEE Computer Society.

(IOC-21002) Introduction to Artificial Intelligence

Teaching Scheme:
Lectures: 1 Hr/week
Laboratory: 2 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to

1. Compare AI with human intelligence and traditional information processing and discuss its strength and limitations
2. Apply the basic principles, models and algorithms of AI to recognize, model and solve problems
3. Demonstrate knowledge of basics of the theory and practice of Artificial Intelligence
4. Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.
5. Apply knowledge representation techniques and problem solving strategies to common AI applications.

Course Contents

Introduction: What is AI, History, AI problems, Production Systems, Problem characteristics, Intelligent Agents, Agent Architecture, AI Application (E-Commerce, & Medicine) , AI Representation, Properties of internal representation, Future scope of AI , Issues in design of search algorithms.

[3 Hrs]

Heuristic search techniques: Heuristic search, Hill Climbing, Best first search, mean and end analysis, Constraint Satisfaction, A* and AO* Algorithm**, Knowledge Representation:** Basic concepts, Knowledge representation Paradigms, Structured representation of knowledge, ISA hierarchy

[3 Hrs]

Knowledge Inference: Introduction, Knowledge representation- Production based system, Forward and Backward reasoning, Knowledge representation using non monotonic logic: TMS (Truth maintenance system)

[3 Hrs]

Learning & Planning: What is Learning, Types of Learning (Rote, Direct instruction Analogy, Induction, Deduction) , Planning: Block world, strips, Implementation using goal stack, Non linear planning with goal stacks, Hierarchical planning, Least commitment strategy.

[3 Hrs]

Game playing and Introduction to Machine Learning: Min-max search procedure, Alpha beta cutoffs, waiting for Quiescence, Secondary search, Perception and Action: Perception, Action, Robot Architecture, Machine Learning: Definition of learning systems. Goals and applications of machine learning.

[4 Hrs]

Text Books

- Elaine Rich and Kerin Knight, Artificial Intelligence, 3rd Edition, McGraw Hill. ISBN13: 9780070087705
- Eugene, Charniak, Drew Mcdermott, Introduction to artificial intelligence, Addison-Wesley. ISBN 0-07-052263-4.

Reference Books

- Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd Edition. ISBN 0-13-103805-2.
- Tom Mitchell, Machine Learning, McGraw Hill. *ISBN*-10: 1259096955
- Herbert A. Simon, The Sciences of the Artificial, MIT Press, 3rd Edition, 1998. *ISBN*: 9780262190510.
- George F Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Edu., 4th Edition. *ISBN*-13: 978-0-321-54589-3.

List of Assignments

1. Implement A* algorithm .
2. Implement AO* algorithm .
3. Implementation of other Searching algorithm.
4. Implementation of Min/MAX search procedure for game Playing .
5. Implementation of variants of Min/ Max search procedure.
6. Implementation of mini Project using the concepts studied in the AI course.

This list is a guideline. The instructor is free to assign new assignments.

Department Elective – I

(CT(DE)-21001) Advanced Data Structures

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Design new operations by using advanced data structures such as priority queues, dictionary structures, and multi-dimensional data structures
2. Analyze the time and space complexity of the operations associated with the advanced data structures and there by appreciate the use of these structures
3. Analyze performance of new data structures
4. Propose new customized structures for efficient dictionary.
5. Apply advanced data structures to solve real life problems.

Course Contents

Review of Basic Concepts: Abstract data types, Data structures, Algorithms, Big Oh, Omega and Theta notations, Solving recurrence equations, Amortized complexity

[4 Hrs]

Priority Queues: Leftist Heap, Skew Heaps, Binomial, Fibonacci and Pairing Heaps, Double ended priority queues

[6 Hrs]

Dictionary Structures: Hash Tables, Universal hash functions, Balanced Binary Search Trees, Splay Trees, 2-3 trees, 2-3-4 trees, Red-black trees, Skip lists, Randomized Dictionary Structures, Treaps.

[6 Hrs]

Multidimensional and Spatial Structures: Interval, Segment, Range, and Priority Search Trees, Quadtrees and Octrees, R-trees.

[8 Hrs]

Miscellaneous Topics: Persistent Data Structures, Cache-Oblivious Data Structures

[8 Hrs]

Applications: IP Router Tables, Data Structures in Web Information Retrieval, Computational Biology, Geographic Information Systems, Computational Geometry: Geometric data structures.

[8 Hrs]

Text Books

- Introduction to Algorithms; 3rd Edition; by by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein; PHI Learning Pvt. Ltd.; ISBN-10: 0262033844; ISBN-13: 978-0262033848
- Advanced Data Structures; by Prof Peter Brass; Cambridge University Press; ISBN-10: 1107439825; ISBN-13: 978-1107439825

Reference Books

- Handbook of Data Structures and Applications; by Dinesh P. Mehta (Editor) , Sartaj Sahni (Editor) ; Chapman and Hall/CRC; ISBN-10: 1584884355;ISBN-13: 978-1584884354

Internet Resources:

- MIT OpenCourseWare
- https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-851-advanced-data-structures-spring-2012/index.htm
- COP 5536: Advanced Data Structures: Prof. Sartaj Sahni, University of Florida
- https://www.cise.ufl.edu/~sahni/cop5536/

(CT(DE)-21002) Advanced Data Structures Laboratory

Teaching Scheme:
Laboratory: 2 Hrs/Week

Examination Scheme:
Continuous evaluation: 50 Marks
End Semester Exam: 50 Marks

Course Outcomes

Students will be able to:

1. Implement advanced data structures as abstract data types.
2. Design programs for real life problems using advanced data structures.
3. Choose appropriate data structures for a given problem.

List of Assignments

1. Implement abstract data type for a dictionary as specified by the instructor.
2. Implement ADT for a partition.
3. Implement ADT for priority queue.
4. Implement an online path finding algorithm, which given dynamically changing edge weights suggests all possible paths, including the shortest path between any pair of vertices.
5. Write a program to find the convex hull of a set of points.

This is a suggested list. The instructor is expected to improve it continuously.

(CT(DE)-21003) Advanced Microprocessors

Teaching Scheme
Lectures: 3Hrs/ Week

Examination Scheme
Assignment/Quizzes: 40 marks
End Semester Exam: 60 marks

Course Outcomes

Students will be able to:

1. Analyze the protected mode, privilege levels, various descriptors and support for debugging
2. Justify the need of Inter privilege level access mechanism, Multitasking support and paging facility.
3. Describe interrupt handling mechanism
4. Explain the use of MTRRs and PAT
5. Identify features of MMX technology, SIMD Execution Model and virtualization support

Course Contents

System Architecture Overview: Support for operating-system and system-development software. Multitasking capability, subtasks and modularity in entire system, support offers multiple modes of operation, protection amongst OS and application programs, IA-32 architecture, Intel 64 architecture, System-Level Registers and data structures in protected mode, Global and Local Descriptor Tables

[6 Hrs]

Single-level Task: Protection mechanism and privilege in protected mode, IA-32 architecture, Debugging registers, memory management through segmentation and paging, support registers

[6Hrs]

Multilevel Tasks: Inter privilege level access mechanism call gate. Multitasking support, task switching and task gate in IA-32 processor

[7Hrs]

Interrupts and Memory cache control: Interrupt, exception, faults, traps, interrupt handling in protected mode IDT, interrupt gate, trap gate, interrupt handling in protected mode, V86 mode. Extended features of V86, System Management Mode, Memory cache control: caching terminology, memory types and memory type range registers (MTRRs) ; Page Attribute Table (PAT) , assigning memory types to regions of physical memory based on linear address mappings

[8 Hrs]

MMX and Streaming SIMD extensions: MMX technology, SIMD Execution Model, handling out-of-range conditions, execution environment for the SSE, SSE2, Streaming SIMD Extensions 3(SSE3) , Supplemental Streaming SIMD Extensions 3 (SSSE3) and SSE4

[7Hrs]

VMX Support: Intel Hyper-Threading Technology, Multi-core technology, Intel 64 architecture features, Intel Virtualization Technology

[6Hrs]

Text Books

- Liu & Gibson, Microcomputer Systems, PHI, ISBN: 978-81-203-0409-3
- Barry B. Brey, The INTEL Microprocesoors, PHI, ISBN-81-203-1220-1

Reference Books

- Tom Shanley, Protected Mode Software Architecture MINDSHARE, INC. Addison-Wesley Publishing Company, ISBN: 0-201-55447-X(.pdf)
- Intel® 64 and IA-32 Architectures Software Developer's Volumes 1, 2A, 2B, 3A, 3B (.pdf)

(CT(DE)-21004) Advanced Microprocessors Laboratory

Teaching Scheme
Laboratory: 2Hrs/ Week

Examination Scheme
Continuous evaluation: 50 Marks

Oral: 50 marks

Course Outcomes

Students will be able to:

1. Demonstrate programming in real mode and protected mode.
2. Develop a program using SIMD instructions
3. Illustrate MMX/ SSE/ SSE2 instructions

List of Assignments

1. Write an Assembly program to write (store) a string in Video RAM with help of BIOS Interrupts & display the written string on terminal along with the address of written string.
2. Write an Assembly program to write (store) a string in Video RAM without using BIOS
   Interrupts & display the written string on terminal along with the address of written string.
3. Write an Assembly program to accept any key from user & display the value of key pressed. e.g. input – 'a' desired output ---"The key entered is 'a'"
4. Write an Assembly program for boot loader. Display a string "My OS".
5. Write a boot loader which will move from real mode to protected mode. Display message "in real mode ".
6. Write a boot loader which on pressing a key from keyboard transit from real mode to protected mode (Display messages like "in real mode", "press any key to transit into protected mode","in protected mode")
7. Prepare a CASE STUDY on Emulator.
8. Perform matrix operations using MMX/ SSE/ SSE2 instructions.

This list is a guideline. The instructor is expected to improve it continuously.

(CT(DE)-21005) Web Systems and Technologies

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Discuss and critically analyze basic protocols used in World Wide Web.
2. Write client side programming using Javascript, JQuery, Ajax, HTML, CSS
3. Write server side programming using PHP or any server side language.
4. Implement a three tier application using web technologies.
5. Create, publish and test RESTFul web services

Course Contents

Web Essentials: Clients, servers, communication, basic Internet protocols, HTTP Request message, HTTP response message, web clients, generations of web applications, Web server configuration, Debugging tools like Postman

[4 hrs]

Markup languages: HTML: fundamental HTML elements, head, body etc., basic XHTML syntax and semantics, document publishing; CSS: introduction, features, syntax, style properties of text, box, layout, list, table, cursor etc., user defined classes, inheritance.

[4 hrs]

Client-Side Programming: JavaScript: basic syntax, variables and data types, statements, operators, literals, functions; Javascript Objects: properties, references, methods, constructors, arrays, other built-in objects, debugging, host objects, document object model (DOM) , document tree, DOM event handling, browsers Mobile Applications and Clients, Progressive Web Applications

[8 hrs]

Server-Side Programming: PHP: client request, form data, request headers, server response, HTTP status codes, HTTP response headers, sessions, cookies, URL rewriting, separating programming and presentation, connection to databases.

[8 hrs]

Representing Web Data: XML: namespaces, DOM based XML processing, XSL, X Path, XSLT; AJAX: overview, basics, toolkits, security.

[6 hrs]

Web Services: basic concepts, creating, publishing, testing and describing a web service, WSDL, XML services, communicating object data: SOAP, REST.

[4 hrs]

Javascript Frameworks: Introduction to certain frameworks like JQuery, Nodejs, AngularJS, NodeJS, etc.

[**4 hrs]**

Text Books

- Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.

Reference Books

- Marty Hall, Larry Brown,"Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
- Robert. W. Sebesta, "Programming the World Wide Web", Forth Edition, Pearson Education, 2007, ISBN 978-0321489692.
- H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.

Online References

- https://www.w3.org/html/
- HTML, The Complete Reference http://www.htmlref.com/
- http://w3schools.org/
- http://php.net/
- https://jquery.com/
- https://developer.mozilla.org/en-US/docs/AJAX
- http://www.tutorialspoint.com/css/

(CT(DE) -21006) Web Systems and Technologies Laboratory

Teaching Scheme:
Laboratory: 2 Hrs/Week

Examination Scheme:
Continuous evaluation: 50 Marks
Practical Exam:50 Marks

Course Outcomes

Students will be able to

1. Demonstrate ability to install, configure a web server
2. Write programs on client side using HTML, Javascript, AJAX, CSS and git
3. Write programs on server side using PHP or any similar technology and demonstrate the ability to install, configure, query a database server and git.
4. Implement a web application using full stack of basic technologies and git.
5. Demonstrate the use of web APIs in developing applications.
6. Demonstrate the use of Javascript frameworks.

Suggested List of Assignments

All the assignments, will be done using git and a remote repo like gitlab/github.

1. Install, configure, compare and discuss features of any open source web server.

2. Install one of these on your computer, configure and setup a website: Wordpress, Drupal or Moodle.
3. Write a HTML page by hand which looks like the homepage of this website: https://www.freecodecamp.org/ or any specified page.
4. Demonstrate use of CSS on any HTML page. Include elements to handle: page resize, changing colour of clicked links
5. Install mysql-server on your laptop and run AQL queries to do the following: create a database, create a table, insert rows in a table, fetch rows from a table, delete a row, update a row.
6. On any HTML page (may the the one you wrote for freecodecamp.org type) , include a link for Login. Write a login page having login/password fields. Write Javascript code to validate the login-id and password for the following: both are properly formed and at least 6 bytes long; the password contains at least one special case, one capital and one numeric characters; convert the password into it's MD5 hash
7. Write a web page which displays a slide show of images. The page should allow changing the timing for the slideshow, automated slideshow, and clicking next/previous buttons.All code should be in one single file. Submit the HTML file and all image files as one single tar.gz, such that on extracting the file (unzipping) and clicking the HTML file the slideshow should start
8. Develop interactive multiple-choice quiz using HTML, JavaScript, AJAX and PHP.
9. Write a web page which reads the address of a location from the user and displays it on google map. OR Write a web page using twitter API, which accepts a twitter user name as input from user, and shows last 10 tweets by that user.
10. Demonstrate checking of form input data using jQuery.
11. **Course Mini Project:** Add features to any existing web application (e.g. Moodle, Wordpress, Drupal, etc. or a project specified by the teacher) .

This list is a guideline. The instructor is expected to improve it continuously.

(CT(DE) -21007) Computer Graphics

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Attain the knowledge about working principles of different Output devices and categories various graphics drawing algorithms.
2. Analytically compare different types of 2D and 3D graphics transformation functions.
3. Design various algorithms for scan conversion and filling of basic objects and their comparative analysis.
4. To implement various algorithms to scan, convert the basic geometrical primitives for clipping.
5. To define the fundamentals of animation, virtual reality and its related technologies.
6. Comprehend viewing techniques (projections of different views of objects along with elimination of invisible components) .

Course Contents

Introduction: Introduction, Application areas of Computer Graphics, overview of graphics systems, graphics environments. Output Primtives: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Polygon and polygon filling algorithms.

[7 Hrs]

Transformations: 2-D Geometric Transformation: Translation, scaling, rotation, reflection and shear transformations, matrix homogeneous coordinates, composite transforms. transformations between coordinate systems.
3-D Geometric Transformation: Translation, rotation, scaling, reflection and shear transformations, composite transformations. Projections.

[7 Hrs]

2-D Viewing and 3-D Viewing: Viewing pipeline, viewing coordinates, view volume. WINDOWING and CLIPPING: Introduction, viewing transformation. clipping, point and line clipping, clipping algorithms, polygon clipping .
Introduction to curves, curve representation (parametric and nonparametric) , general conic curves.

[6 Hrs]

Visible Surface Detection Methods: Introduction, Classification, hidden line removal algorithms, hidden surface removal method. Modelling concepts and techniques. Sweep Representation, Surfaces and Volumes by rotation of curves and surfaces, fractals.

[7 Hrs]

Light and Color Modelling: Introduction Object-Rendering, Light Modeling Techniques, illumination Model, Shading, Flat Shading, Polygon Mesh Shading, Gaurand Shading Model, Phong Shading, Transparency Effect, Shadows, Texture and Object Representation, Color Models.

[7 Hrs]

Segments and Animation: Introduction to segment table, segment functions. Computer animation: Design of animation sequence, animation techniques, key frame systems, motion specifications. Devices for producing animation, computer assisted animation, video formats, method for controlling animation, animation software.

[6 Hrs]

Text Books

- V. K. Pachghare, "Computer Graphics", Third Edition, Laxmi Publications, ISBN-978-81-318-0565-7
- Malay L. Pakhira, " Computer Graphics, Multimedia and Animation", Second edition, PHI, ISBN-978-81-203-4127-2
- Bhattacharya, Samit, "Computer graphics", ISBN: 9780198096191, New Delhi: Oxford University Press, ISBN-978-01-980-9619-1
- Steven Harrington, "Computer Graphics - A Programming approach", Second Edition, TMH, ISBN 0-07-100472-6
- Donald Hearn and M.Pauline Baker, "Computer Graphics C version", Second Edition, Pearson Education, ISBN 81- 7808-794-4

Reference Books

- Dipti P. Mukherjee, "Fundamentals of Computer Graphics and Multimedia", PHI, ISBN-978-81-203-1446-7
- Shah M. B. and B.C. Rana, "Engineering Drawing And Computer Graphics", Pearson, ISBN-978-81-317-5611-9
- David F Rogers, "Procedural elements for Computer Graphics", Second Edition, Tata Mc Graw Hill, ISBN 0-07-047371-4
- F. Hill, "Computer Graphics: Using OpenGL", Second Edition, Pearson Education, ISBN 81-297-0181-2
- J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice", Second Edition, Pearson Education, ISBN 81-7808-038-9
- Zhigand xiang, Roy Plastock, "Computer Graphics, Schaum's outlines", Second Edition, Tata Mc- Graw Hill Edition

(CT(DE) -21008) Computer Graphics Laboratory

Teaching Scheme:
Laboratory: 2 Hrs/Week

Examination Scheme:
Continuous evaluation: 50 Marks
End Semester Exam: 50 Marks

Course Outcomes

Students will be able to:

1. Apply the basic concepts of computer graphics and to apply various algorithms for generating and rendering graphical figures
2. Implement the concepts of different type of geometric transformation of objects in 2D and 3D and practical implementation of modeling, rendering, viewing of objects in 2D
3. Execute clipping and filling techniques for modifying an object using illumination and color models techniques to graphics.
4. Demonstrate computer graphics animation using latest animation software with improving self-learning ability.

Suggested List of Assignments

1. Implement line drawing algorithm
2. Implement Mid-point circle drawing algorithm and Explain the utilization of 8-way symmetry technique used for arc drawing
3. Implement polygon drawing and filling functions.
4. Execute 2-D and 3-D transformations (translation, scaling and rotation)
5. Execute graphics tools clipping algorithm
6. Implement graphics tools visible surface detection
7. Execute graphics tools for object rendering with light and color modeling
8. Implement controlling techniques for animation

This list is a guideline. The instructor is expected to improve it continuously.

(CT(DE) -21009) Digital Signal and Image Processing

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Describe the components of DSP system, key DSP concepts and how do they relate to real applications
2. Represent discrete-time signals and systems analytically and visualize them in the time domain and frequency domain
3. Analyze images in the frequency domain using various transforms.
4. Evaluate the techniques for image enhancement and image restoration
5. Explain feature extraction techniques
6. Explain the rapid advances in Machine vision

Course Contents

Introduction: Basic elements of digital signal processing (DSP) system, advantage of digital over analog signal processing, summary of DSP applications and introduction to DSP through these application.
Introduction to signal and system and its properties like linearity, time invariance; Linear convolution, properties of linear convolution, A\D conversion process as sampling, Quantization, encoding, sampling theorem.

[8 Hrs]

Analysis of Signals: Transform domain representation of the signal**,** Fourier transform, Fourier transforms of standard signals, FFT algorithms, direct, divide and conquer approach, radix-2 algorithm

[6 Hrs]

Digital Image Processing fundamentals: Introduction, Image Representation, Monochrome Vision Model, Color Vision Model, Image Sampling and Reconstruction Concepts for monochrome and color Image
Monochrome and Color Image Quantization, Two-dimensional signal processing, Vector-Space Image Representation, Two-Dimensional Fourier Transform, Transform Domain Processing, Fast Fourier Transform Convolution, Discrete Cosine Transform its application in Baseline JPEG

[8Hrs]

Image Improvement Techniques: Image Enhancement, contrast manipulation, Histogram Processing, Image Restoration, Image Denoising

[6 Hrs]

Image Analysis and feature extraction: Edge detection, color edge detection, region and boundary segmentation, object recognition, pattern and pattern classes

[6 Hrs]

Machine Vision: Introduction, definition, Active vision system, Machine vision components, hardware's and algorithms, application of machine vision such as in inspection of parts,

identification, industrial robot control, mobile robot application, Competing technologies, CCD line scan and area scan sensor, Videcon and other cameras, Triangulation geometry, resolution passive and active stereo imaging, laser scanner.

[6 Hrs]

Text Books

- J.G. Proakis, D.G. Manolakis, " Digital Signal processing", 4th edition, Pearson Education, ISBN 0131873741
- Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 2nd edition, Pearson, ISBN 0-201-18075-8
- Pratt W.K., "Digital Image Processing: PIKS Scientific Inside", 4th edition, ISBN:9780471767770

Reference Books

- Ashok Ambardar, "Digital signal processing: A modern introduction", 1st edition, Cenage learning, ISBN 978-81-315-0837-4
- Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, Springer, ISBN: 978-1-4899-3216-7
- Forsyth and Ponce, "Computer Vision – A Modern Approach", Second Edition, Prentice Hall, ISBN-13: 978-0-13-608592-8
- Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, ISBN 978-1-84882-935-0

(CT(DE)-21010) Digital Signal and Image Processing Laboratory

Teaching Scheme:
Laboratory: 2 Hrs/week

Examination Scheme:
Term Work – 50 marks
Oral Exam – 50 marks

Course Outcomes

Students will be able to:

1. Prepare comparative study report of scientific computing tools such as scilab/matlab
2. Implement image processing algorithms
3. Compare image processing algorithms

List of Assignments

1. Generate complex signal and analyze the frequency content using Fourier transform
2. Write a program to perform convolution of two finite length causal sequences
3. Conversion of 24 bit color image to 8 bit, 4 bit, 1 bit image
4. Histogram modification (scaling, offset, amplitude change)
5. Image smoothing, sharpening
6. Edge detection – use of Sobel, Prewitt and Roberts operators
7. Develop color image segmentation algorithm
8. Transform application assignment, baseline JPEG compression technique

This list is a guideline. The instructor is expected to improve it continuously.

(CT(DE) -21011) Parallel Computer Architecture and Programming

Teaching Scheme
Lectures: 3 Hrs / Week

Examination Scheme
Assignment/Quizzes: 40 marks
End Semester Exam: 60 marks

Course Outcomes

Students will be able to:

1. Justify the need of high performance computing.
2. Demonstrate quantitative design principles of parallel computer architectures.
3. Measure and analyze performance through different benchmarks and utilities.
4. Differentiate various parallel computer architectures and programming models.
5. Demonstrate and build a basic cluster setup.

Course Contents

Fundamentals of Performance oriented Architecture Design: Defining Computer Architecture, Trends in Technology, Trends in Cost, Dependability, Measuring, Reporting and Summarizing Performance, Quantitative Principles of Computer Design, Moore's Law, Amdahl's Law, Gustafson's Law, Flynn's Classification of Computer Architectures, Recent Computing Trends, Top 500 Ratings, Fundamentals of Computer Design, Basic and Intermediate concepts of pipelining, Pipeline Hazards, Pipelining Implementation issues.

[5 Hrs]

Instruction-Level Parallelism and its Exploitation: Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Prediction, Scheduling, Overcoming Data Hazards with Dynamic Scheduling, Dynamic Scheduling: Algorithm and Examples, Hardware-Based Speculation, Studies of the Limitations of ILP, Limitations on ILP for Realizable Processors, Hardware versus Software Speculation, ILP Support to Exploit Thread-Level Parallelism.

[8 Hrs]

Data-Level Parallelism in Vector, SIMD: Vector Architecture, Vector Instructions, Vectorizing code, SIMD Instruction Set Extensions for Multimedia, Detecting and Enhancing Loop-Level Parallelism, Introduction to Graphics Processing Units, Example Heterogeneous Architectures and Case Studies.

[7 Hrs]

Memory Hierarchy Design: Basics of Memory Hierarchy, Cache Performance, Basic Cache Optimizations and numericals, Shared and Private Cache, Virtual Memory, Protection and Examples of Virtual Memory, Memory Technology and Optimizations, The Design of Memory Hierarchies, Study of Memory Hierarchies in different Architectures, Case studies.

[7 Hrs]

Thread-Level Parallelism: Introduction to Shared Memory Architectures, Loosely and Tightly coupled multiprocessors, Centralized Shared-Memory Architectures, Snoopy Bus Cache Coherence, Performance of Shared-Memory Multiprocessors, Distributed Shared Memory and Directory Cache Coherence, Basics of Synchronization, Models of Memory Consistency, Examples of Cache Coherence and Consistency.

[7 Hrs]

Parallel Programming Paradigms: Cluster and Network of Workstations (COW and NOW) , Different ways of building a cluster, Parallel Programming Models: Shared Memory, Message Passing, Data Parallel, MPI/PVM, Parallel Algorithm examples: Matrix Multiplication, Sorting, Introduction to Parallel Programming Languages. Case studies of different cluster/ server architectures. Warehouse-Scale Computers: Architecture, Programming Model and Workloads

[6 Hrs]

Text Books

- "John L Hennessy, David A Patterson, "Computer Architecture: A Quantitative Approach", Fifth Edition, Morgan Kaufmann, 2011, ISBN-13: 978-8178672663
- Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture", Third Edition, Tata McGraw-Hill Edition, 2016, ISBN: 978-9339220921.

Reference Books

- D. E. Culler, J. P. Singh, and A. Gupta, "Parallel Computer Architecture", Second Edition, Morgan Kaufmann, 2017, ISBN: 978-1-4987-7271-6.
- Hesham El-Rewini, Mostafa Abd-El-Barr, "Advanced Computer Architecture and Parallel Processing", Wiley, 2005, ISBN: 9780471467403

(CT(DE)-21012) Parallel Computer Architecture and Programming Laboratory

Teaching Scheme
Laboratory: 2 Hrs / Week

Examination Scheme
Continuous evaluation: 50 Marks
End Semester Oral Exam: 50 Marks

Course Outcomes

Students will be able to:

1. Explain basics of performance analysis of computing systems.
2. Demonstrate performance statistics using perf utility.
3. Implement programs using pthreads and OpenMP constructs.
4. Implement message passing programs in distributed environment.
5. Demonstrate the different steps involved in building of a simple cluster.

Suggested List of Assignments

1. Study of different benchmarks used to evaluate performance of different systems.
2. Performance statistics observation using perf utility.
3. Program to execute matrix multiplication using pthreads.
4. Program to execute matrix multiplication using OpenMP and comparison with pthread program.
5. Program to execute Pi computation and prefix sum using OpenMP.
6. Program to execute section, task and synchronization constructs of OpenMP.
7. Case Study of Cluster building steps - MPI Cluster setup and overview of different routines.
8. Program to implement point to point communication using MPI routines.
9. Program to implement collective communication using MPI routines.

10. Program to implement Map-Reduce parallelism for Warehouse Scale Computer.

Reference Books

- Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, Morgan Kaufmann, 2011, ISBN: 978-0-12-374260-5.
- Michael Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill Edition, 2003, ISBN13: 978-0072822564.

This list is a guideline. The instructor is expected to improve it continuously.

(CT(DE)-21013) Computational Geometry

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Demonstrate familiarity with the basic data structures and algorithm design strategies used in computational geometry
2. Demonstrate ability to address implementation issues computational geometry algorithms such as handling degenerate cases
3. Develop and analyze algorithms for simple geometrical problems
4. Apply geometric techniques to real-world problems in areas such as robotics and graphics
5. Carry out time complexity analysis of computational geometry algorithms

Course Contents

Intersections: Introduction to Computational Geometry: The problems studied in Computational Geometry, Applications, terminology, basic Tools. Line Segment Intersection, The Doubly-Connected Edge List, Computing the Overlay of Two Subdivisions, Boolean Operations

[06 Hrs]

Convex Hull Algorithms: Graham's scan, Jarvis Algorithm, a linear expected-time algorithm, applications

[06 Hrs]

Point Location and Triangulation: Point Location and Trapezoidal Maps, Art Gallery Problem, Partitioning a Polygon into Monotone Pieces, Triangulating a Monotone Polygon

[06 Hrs]

Range Searching: 1-Dimensional Range Searching, Kd-Trees, Range Trees, Higher-Dimensional Range Trees, General Sets of Points, Interval Trees, Priority Search Trees, Segment Tree

[08 Hrs]

Arrangements and Duality: Computing the Discrepancy, Duality, Arrangements of Lines, Levels and Discrepancy

[06 Hrs]

Voronoi Diagrams and Delaunay Triangulations: Definition and Basic Properties of Voronoi diagrams, Computing the Voronoi Diagram, Voronoi Diagrams of Line Segments, Farthest-Point Voronoi Diagrams, Triangulations of Planar Point Sets, The Delaunay Triangulation, Computing the Delaunay Triangulation

[08 Hrs]

Text Books

- Mark de Berg, et al., "Computational Geometry: Algorithms & Applications", Springer, 3rd edition, ISBN-13: 978-3540779735
- Joseph O'rourke, "Computational Geometry in C", Cambridge University press, 2nd edition, ISBN-13: 978-0521649766

Reference Books

- Franco P Preparata, et al., "Computational Geometry An Introduction", Springer, ISBN-13: 978-0387961316

Internet Resources:

- NPTEL Course: Computational Geometry
  https://nptel.ac.in/courses/106/102/106102011/

- Lecture Notes by David Mount
  http://www.cs.umd.edu/class/spring2012/cmsc754/lectures.shtml

(CT(DE)-21014) Computational Geometry Laboratory

Teaching Scheme
Laboratory: 2 Hrs / Week

Examination Scheme
Continuous evaluation: 50 Marks
End Semester Exam: 50 Marks

Course Outcomes

Students will be able to:

1. Implement basic and advanced algorithms in the area of computational geometry
2. Demonstrate ability to write code taking care of precision of numbers, boundary conditions, degeneracy etc
3. Verify the implementations for correctness and efficiency by using suitable test data
4. Decide the best possible solution for a given problem under the given constraints
5. Apply the algorithms/concepts studied in the theory course to real life problems

Suggested List of Assignments

1. Area of a polygon
2. Finding closest pair of points

3. Triangulating a polygon
4. Convex hull in two dimensions
5. Convex hull in three dimensions
6. Delaunay Triangulation
7. Segment/ray-segment intersection
8. Segment/ray-triangle intersection
9. Point in polygon
10. Point in polyhedron
11. Intersecting convex polygons
12. Minkowski convolution with a convex polygon
13. Multilink robot arm reachability

This is a suggested list. The instructor is expected to continuously update it.

(CT(DE)-21015) Recent Trends in Computer Networks

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to

1. Explain issues in the design of network topologies and design network systems
2. Analyse different possible solutions for communications at each network layer
3. Simulate working of wired and wireless networks to Explain networking concepts
4. Develop solutions by applying knowledge of mathematics, probability, and statistics to network design problems
5. Explain and Compare various storage and networking technologies
6. Explain the recent advancements in the networking technologies

Course Contents

Internetworking: Routing algorithms evaluations, TCP variants, Quality of Service, Active Queue Management, High-Speed Networks, Performance Modelling and Estimation

[7 Hrs]

IPv6: IPv4 deficiencies, patching work done with IPv4, IPv6 addressing, multicast, Anycast, ICMPv6, Neighbour Discovery, Routing, header compression

[5 Hrs]

Software-Defined Networking and OpenFlow: Centralized and Distributed Control and Data Planes, SDN Controllers, Data Center Concepts, Network Function Virtualization, Mininet, Programming SDNs, Openflow Switch, Wire Protocol, Openstack Neutron plug-in

[6 Hrs]

Ad Hoc Wireless Networks: MAC Protocols for Ad Hoc Wireless Networks, Routing Protocols for Ad Hoc Wireless Networks, Multicast routing in Ad Hoc Wireless Networks,

Transport Layer and Security Protocols for Ad Hoc Wireless Networks, Quality of Service in Ad Hoc Wireless Networks.

[8 Hrs]

Storage and Networking: Storage and Networking Concepts, Fiber Channel Internals, Fiber Channel SAN Topologies, Fiber Channel Products, IP SAN Technology, IP SAN Products, Management of SANs, SAN Issues

[7 Hrs]

Advancements in CN: Fundamentals of MPLS (RFC 3031) and GMPLS, SNMP, 5G architecture, Named Data Networks (NDN), Content-Centric Networking (CCN), IoT

[8 Hrs]

Text Books

- Thomas D Nadeau and Ken Grey, Software Defined Networking, O'Reilly, 2013
- https://tools.ietf.org/html/rfc8200
- https://tools.ietf.org/html/rfc3031
- Mani Subramanian, Timothy A. Gonsalves, N. Usha Rani; Network Management: Principles and Practice; Pearson Education India, 2010 References
- William Stallings, High-Speed Networks and Internets, Pearson Education, 2nd Edition, 2002.
- C. Siva Ram Murthy, B.S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall, 2004
- Muthukumaran B, Introduction to High-Performance Networks, Tata Mc Graw Hill, 2008
- Tom Clark, Designing Storage Area Networks, A Practical Reference for Implementing Fibre Channel and IP SANs, Addison-Wesley Professional, 2nd Edition, 2003.
- For 5Garchitecture: https://www.3gpp.org/
- For NDN: https://named-data.net/
- Recent papers and RFCs on advancement in Computer Networks

(CT(DE)-21016) Recent Trends in Computer Networks Laboratory

Teaching Scheme:
Laboratory: 2 Hrs /week

Examination Scheme:
Term Work: 50 marks
Oral Examination: 50 marks

Course Outcomes

1. Relate theory with practice by performing programming assignments
2. Get proficiency in designing network topology solutions
3. Get proficiency in a variety of tools and environments like ns-3, NeST
4. Analyse various networking algorithms and implementation to solve a networking problem
5. Work on the individual assignments to get the
6. Imbibe good programming practices Suggested

Suggested List of Assignments

1. Create a simple dumbbell routing topology setup over the Linux kernel
2. Evaluate the performance of intra-domain routing algorithms using ns-3 or Linux kernel
3. Evaluate the performance of different TCP variants over ns-3 or ip netns
4. Perform a Wireshark packet sniffing experiment.
5. Do the network analysis using NMAP - the Network Mapper.
6. Using Mininet tool for the SDN topology
7. Implement a web proxy that passes requests and data between multiple web clients and web servers.
8. Create a topology using ip netns with the help of IPv6 addresses and perform the operations related to different next headers
9. Evaluate the performance of different Ad Hoc routing protocols e.g., AODV, DSDV, etc,.
10. Setup the NDN testbed (https://named-data.net/)

This list is a guideline. The instructor is expected to improve it continuously.

(CT- -21010) Operating Systems

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Write programs to manipulate processes, files, and hardware resources using appropriate system calls.
2. Illustrate the design issues, solutions and complexity of operating system by compiling, modifying an OS kernel, tracing the sequence of activities on processor, data structures of a file system, race conditions, locking mechanisms and storage techniques.
3. Correlate the computer architecture features with operating system design issues.
4. Make design choices for an operating systems with given constraints
5. Discuss suitable changes to existing implementations of operating systems for new features.

Course contents

Introduction and Operating Systems structures: Operating system components, O.S. Services, System Calls, Virtual Machines, Special purpose operating systems, Open-source operating systems, Boot Procedure, Partitions, MBR, GPT, UEFI. Source code of boot loader.; System Services; Linkers and Loaders; Operating system structures; Calling convention and Executable file formats;

[6 Hrs]

Processes and CPU Scheduling: Process concept, interleaved I/O and CPU burst; Process states; Co-operating processes, Thread, Thread libraries, Multithreaded programming,

Scheduling, Scheduling criterion, Scheduling algorithms, Multi processor scheduling, Real time scheduling, Interrupts and Interrupt handling. Source code of interrupt handling and scheduler and it's dependence on hardware features.

[6 Hrs]

Process Synchronization: Critical section problem, Hardware support for mutual exclusion, Semaphores, Deadlock-principle, Deadlock detection, prevention and avoidance, Classical problems in concurrent programming: Producer-consumer, Reader-writer with and without bounded buffer. Design of locking primitives like spinlock, semaphore, read-write locks, recursive locks, etc. Source code of spin locks, semaphores, read-write locks.

[8 Hrs]

Inter process Communication: Pipes, Shared memory mechanism, Streams, Asynchronous communication, Signals. A shell program using system calls and pipes.

[4 Hrs]

Memory management: O.S. and hardware interaction, Swapping, Continuous memory management, paging, Segmentation, Virtual Memory Management, Demand Paging, Copy-on-write, Page replacement algorithms, Allocation of frames, Thrashing, Kernel memory management, SVR4 architecture, Unified buffer cache. Case study of x86 architecture and implementation of segmentation and paging in an OS kernel, code of fork(), exec(), sbrk(), etc.

[10 Hrs]

File Management and Storage Structures: File Organization, Concept of files and directories, System calls for file systems, Space allocation issues, Free space management, Data structures like inode and super block, Virtual file system and related object oriented concepts, Disk layout, Formatting, Recovery, NFS, Efficiency and performance, Distributed file systems, Disk Structure, Disk Scheduling, RAID. Case study of a file system like ext2.

[6 Hrs]

Text Books

- Abranhan Silberschatz, Peter B Galvin, Greg Gagne; Operating System Concepts, Wiley India Students Edition, 9th Edition, ISBN: 978-81-265-2051-0
- Andrew S. Tanenbaum; Modern Operating Systems; Prentice Hall of India Publication; 3rd Edition. ISBN: 978-81-203-3904-0
- xv6, a simple, Unix-like teaching operating system, Russ Cox, Frans Kaashoek, Robert Morris; E-book

Reference Books

- Milan Milenkovic; Operating Systems; Tata McGraw Hill; Second Edition. ISBN: 0-07-044700-4
- Maurice J. Bach; The Design of the Unix Opearating System; Prentice Hall of India; ISBN: 978-81-203-0516-8
- Uresh Vahalia; Unix Internals, The New Frontiers; Prentice Hall; ISBN: 0-13-101908-2

(CT- -21011) Operating Systems Laboratory

Teaching Scheme:
Laboratory: 2 Hrs/week

Examination Scheme:
Continuous evaluation: 70 Marks
End Semester Exam: 30 Marks

Course Outcomes

Students will be able to

1. Implement features in code of an existing operating system.
2. Demonstrate ability to use existing system programs to inspecting operating system features.
3. Demonstrate the ability to implement system programs.
4. Demonstrate ability to create and solve race conditions using synchronization primitives.
5. Write programs using system calls and IPC.

Suggested List of Assignments

1. Install two operating systems in dual boot mode using virtual machines. One OS will run a GNU/Linux of your choice on it. The other virtual machine will run any non-Linux operating system.
2. Write a minimal version of a shell. The shell should be able to a) execute a program without the complete path name b) handle pipes c) handle redirection d) handle signals
3. Use debugfs tool to locate a file which was recently deleted on an ext2 file system.
4. Write a program, on the lines of debugfs, to browse an ext2 file system and given the complete name name of a file, print it's inode.
5. Download linux kernel source code, compile it and reboot your system with the newly compiled kernel. Add a dummy system call to the Linux kernel. Write a conformance test to test your system call.
6. Implement a list type. Write a code using pthreads for concurrent insertions to the list and demonstrate the problem of race. Then rewrite the program to show how race conditions can be solved by using proper synchronization primitives.
7. Write a program which results in a guaranteed deadlock among it's threads. Kill the threads using operating system's commands to solve the deadlock.
8. Write a program using pthreads to demonstrate the producer consumer problem. Implement appropriate synchronization. Show the different results with and without synchronization.
9. Write a program which acts as a chat application between two users on the same computer, using shared memory.
10. Implement the lseek() system call in xv6 kernel.
11. Rewrite the kernel memory manager in xv6 kernel, that is rewrite the kmalloc() and kfree() using another data structure.
12. **Suggested list of course projects:** Implement mkfs, fsck for ext2 file system; Implement a multithreading library using 1-1, many-many, many-one implementation on Linux; Any of the xv6 based projects: implement demand paging, implement ext2 filesystem, Implement signals, Implement shared memory, Implement Kernel threads, Implement mmap(), etc.

Suggested list of demonstrations by instructor.

1. Trace and explain completely the output of strace on running a "Hello World" C program.
2. Write a program to demonstrate the usage of signals – show how processes can wait for each other, kill each other, stop and continue each other.
3. Demonstrate the changing memory map of a process, by using the contents of the /proc file system, and creative use of malloc() function in the code of the process.
4. Demonstrate that not unmounting a file system results in loss of data. Recover possible data using fsck and restore file system consistency. Analyze the recovered data.

   This list is a guideline. The instructor is expected to improve it continuously.

(CT- 21014) Design and Analysis of Algorithms

Teaching Scheme:
Lectures: 3 Hrs/week
Tutorial: 1 Hr/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Derive and solve recurrences describing the performance of recursive algorithms
2. Analyze worst-case running times of algorithms using asymptotic analysis
3. Demonstrate familiarity with standard design techniques and popular algorithms
4. Decide and apply a design technique that would be most suitable to solve a given problem, justify the technique used and analyze the resultant algorithm
5. Formalize and abstract from a given computational task relevant computational problems, reduce problems and argue about complexity classes

Course contents

Introduction: Objectives of time and space analysis of algorithms; Order notations (O, Ω, θ notations) ; (Best average and worst case) time complexity of algorithms such as bubble sort, selection sort, insertion sort, heap sort etc.; Time complexity of recursive programs using recurrence relations.

[06 Hrs]

Design Techniques-I: Divide and Conquer: Quicksort, Mergesort, Strassen's matrix multiplication, finding convex hull; Greedy Algorithms: Knapsack problem, Job sequencing with deadlines, Optimal merge patterns, Single source shortest paths.

[06 Hrs]

Design Techniques–II: Dynamic Programming: All pairs shortest paths, 0-1 Knapsack, Traveling salesperson problem, Chained matrix multiplication, Longest common subsequence, Bellman-Ford algorithm.

[06 Hrs]

Design Techniques–III: Backtracking: N-queens problem, Hamiltonian cycles, Graph Coloring; Branch-and-Bound: 0/1 Knapsack problem, Traveling salesperson problem

[06 Hrs]

Selected Algorithms from various areas: String Matching: The naïve string-matching algorithm, The Robin-Karp algorithm, The Knuth- Morris-Pratt algorithm; Number -Theoretic algorithms: GCD algorithm, Chinese remainder theorem, Primality testing**;** Network Flow Algorithms: Ford-Fulkerson algorithm, Push-relabel algorithm

[06 Hrs]

Amortised Analysis: Aggregate analysis, accounting method, potential method, dynamic tables; Fibonacci heaps: measurable-heap operations, decreasing a key and deleting a node, bounding the maximum degree; Binomial heaps

[06 Hrs]

Complexity Theory: Lower-bound arguments: Comparison Trees – sorting, Oracles and adversary arguments – merging, finding largest and second largest number in an array; NP-hard and NP-complete problems, proving NP-completeness using reduction technique (e.g. SAT, Independent Set, 3VC, Subset Sum, etc)

[06 Hrs]

Tutorial (Option-1)

Tutorial sessions will consist of solving numerical problems based on the algorithms discussed in theory lectures, discussions around finding complexities of algorithms similar to ones studied in the theory lectures.

Tutorial (Option-2)

1. Solving recurrence relations using different methods such as substitution, recurrence tree, master theorem
2. Numerical problems related to heapsort
3. Tracing of algorithms Quicksort and Mergesort
4. Numerical problems on fractional knapsack, job sequencing with deadlines, Huffman coding, optimal merge pattern
5. Numerical problems on finding shortest paths using Dijkstra's algorithm, finding minimum spanning tree using Prim's and Kruskal's algorithm
6. Numerical problems on dynamic programming – finding optimal way of multiplying a matrix chain, finding longest common subsequence in given two strings
7. Numerical problems on 0/1 knapsack, all pairs shortest paths, Bellman-Ford algorithm
8. Numerical problems on string matching algorithms – Naive, KMP
9. Numerical problems on branch-and-bound technique (0/1 knapsack, travelling salesperson problem)
10. Numerical problems on backtracking technique (n-queens problem, graph coloring, finding Hamiltonian path in a graph, travelling salesperson problem)
11. Numerical problems on network flow algorithms (Ford-Fulkerson and Push-relabel)
12. Finding amortized complexity of a given algorithm
13. Problems related to application of reduction technique to prove a certain problem is NP-complete
14. Recap of the entire course contents

Text Books

- Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, 2nd edition (2008) , ISBN-13: 978-8173716126
- Thomas Cormen, Charles Leiserson, Ronald Rivest and Cliford Stein, "Introduction to Algorithms", PHI, 3rd edition, ISBN-13: 978-8120340077

Reference Books

- Gilles Brassard and Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN-13: 978-8120311312
- Jon Kleinberg and Éva Tardos, "Algorithm Design", Pearson Education India, ISBN-13: 978-9332518643

(CT-21012) Data Science

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs/ Week	Assignment/Quizzes: 40 marks
Laboratory: 2 Hrs/Week	End Semester Exam: 60 marks

Course Outcomes

Students will be able to:

1. Classify and recognize different types of data
2. Analyze problems in structured framework
3. Determine appropriate data analysis techniques for problem at hand
4. Identify visualization for the data analysis problem
5. Analyze different types of data for inferring meaning

Course Contents

Introduction: Introduction to Data Science, Examples, Data Sources, Challenges, Applications, Introduction to Data Modeling, Statistical Data Modeling, Computational Data Modeling, Statistical limits on data- Bonferroni's principle.

[6 Hrs]

Data gathering and preprocessing: Data gathering: structured and unstructured data, data preprocessing: structured and unstructured data, types, attributes, data cleaning, data integration, data reduction, transformation, discretization.

[8 Hrs]

Exploratory Data Analysis: Descriptive and inferential statistics, Chart types- Single var: Dot plot, Jitter plot, Error bar plot, Box-and-whisker plot, Histogram, Kernel density estimate, Cumulative distribution function, Two variable: Bar chart, Scatter plot, Line plot, Log-log plot, More than two variables: Stacked plots, Parallel coordinate plot, mean, variance.

[6 Hrs]

Data Modeling: What is data model? Function approximation, hypothesis representation, objective / loss function, linera regression, logistic regression, gradient descent.

[8 Hrs]

Similarity Measures, Distance Measures and Frequent Itemsets: Feature extraction - TF, IDF, TF-IDF, Hash functions, Similarity measuring techniques- Shingling, Min-hashing, Locality Sensitive hashing, Distance measures- Triangle Inequality, Euclidean Distance, Cosine Distance, Jaccard Distance, Edit Distance measures, Frequent Itemsets, the Market-Basket Model, Association Rules, A-Priori Algorithm, PCY (Park-Chen-Yu) Algorithm

[6 Hrs]

Data Streams: Stream data model, stream sources, stream queries, issues in stream processing, sampling data in a stream, stream filtering: bloom filter

[6 Hrs]

Text Books

- "Mining of Massive Datasets", Jure Leskovec, Anand Rajaraman, and Jeffery David Ullman, Cambridge University Press, 2 edition (13 November 2014) , ISBN-10: 1107077230, ISBN-13: 978-1107077232
- "Data Mining: Concepts and Techniques", Jiawei Han, Micheline Kamber, 3rd Edition, Morgan Kaufmann, ISBN-13: 978-9380931913

Reference Books

- "Foundations of Data Science", Avrim Blum, John Hopcroft, and Ravindran Kannan, Hindustan Book Agency, (online free version) January 2020, ISBN-10: 9386279800
- "Introduction to Machine Learning", Ethem Alpaydin, PHI Learning Pvt Ltd, Third edition, 2016, ISBN-978-81-203-5078-6

(CT-21013) Data Science Laboratory

Teaching Scheme
Laboratory: 2 Hrs/ Week

Examination Scheme
Continuous evaluation: 50 Marks
Mini Project: 25 marks
End Semester Exam: 25 Marks

Course Outcomes

Students will be able to:

1. Describe data analysis problem in structured framework
2. Determine appropriate data analysis techniques for problem at hand
3. Identify visualization for the data analysis problem
4. Analyze different types of data for inferring meaning
5. Apply learnt techniques to solve real life problems

Suggested List of Assignments

1. Choose a data set and perform following steps for the selected problem statement. (Mini project)
   a. Define problem statement
   b. Data gathering
   c. Data preprocessing
   d. Data exploration and analysis
   e. Data modeling
   f. Model evaluation

   Some samples are listed as follows:
   i. Exacerbations in Chronic Obstructive Pulmonary Disease: Identification and Prediction Using a Digital Health System
   ii. Ad2Vec: Similar Listings Recommender for Marketplace
   iii. Clothes Classification with the DeepFashion Dataset and Fastai
   iv. recommendation lab applications for some select commercial applications
2. Select existing achieved tasks in open online platforms or social competitions and demonstrate the competition result comparisons. (minimum 3 tasks) .

This list is a guideline. The instructor is expected to improve it continuously.

Minor in Computer Engineering

(CT(MI)-21001) Data Structures, Files and Algorithms

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Programming Tasks/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1 Write neat code by selecting appropriate data structure and demonstrate a working solution for a given problem.
2 Demonstrate the ability to implement different data structures with variety of implementations.
3 Analyze and compare given algorithms for time and space complexity.
4 Handle all possible cases in designing an algorithm.
5 Demonstrate the ability to write modular and re-usable code.

Course Contents

Introduction: Concept of Data types and Abstract Data types; Characteristics of an algorithm; Analyzing programs; Frequency count; Time and space complexity; Big 'O' and 'Ω" notation; Best, average and worst cases; Programming language provided data types, operations on various data types; Dangling pointers and garbage memory

[4 Hrs]

Arrays, Searching and Sorting: Searching: linear and binary search algorithm; Hashing: hashing functions, chaining, overflow handling with and without chaining, open addressing: linear, quadratic probing; Sorting: bubble sort, selection sort, quick sort, merge sort, insertion sort. Time complexity analysis of searching and sorting techniques.

[8 Hrs]

Files: Files handling: various library functions for handling files; system call interface and library interface; Different file formats like csv, pdf, odt, etc; Text and binary files; Programs to copy, concatenate, rename files; Programs to handle existing file types; arguments to main() ;

[6 Hrs]

Stacks and Queues: Stack and queue as ADT; Operations on stack and queue; Implementations using arrays and dynamic memory allocation; Application of stack for expression evaluation, expression conversion; Recursion and stacks; Problems like maze and knight's tour.

[6 Hrs]

Lists: List as ADT; Concept of linked organization of data against linked list; Singly linked list, doubly linked list, circular linked list; Representation & manipulations of polynomials/sets using linked lists; Dynamic memory management; Representation of sparse matrix; Addition and transpose of sparse matrix; Polynomials; Representing Numbers

[8 Hrs]

Trees: Basic terminology; Binary trees and its representation; Binary tree traversals (recursive and non recursive) and various operations; Insertion and deletion of nodes in binary search tree; Applications of trees.

[8 Hrs]

Text Books

- E. Horowitz, S. Sahni, S.Anderson-freed, "Fundamentals of Data Structures in C", Second Edition, University Press, ISBN 978-81-7371-605-8
- B. Kernighan, D. Ritchie, "The C Programming Language", Prentice Hall of India, Second Edition, ISBN 81-203-0596-5
- Y. Langsam, M. Augenstin and A. Tannenbaum, "Data Structures using C", Pearson Education Asia, First Edition, 2002, ISBN 978-81-317-0229-1

Reference Books

- Ellis Horowitz, S. Sahni, D. Mehta "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi 1995 ISBN 16782928
- Jean-Paul Tremblay, Paul. G. Soresan, "An introduction to data structures with Applications", Tata Mc-Graw Hill International Editions, 2nd edition 1984, ISBN-0-07-462471-7

(CT(MI)-21002) Object Oriented Programming and Design

Teaching Scheme:
Lectures: 3 Hr/week

Examination Scheme:
Programming Tasks/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes

Students will be able to:

1. Design a class hierarchy using object oriented thinking for a given problem.
2. Create object oriented application code for a given problem.
3. Write small pieces of code demonstrating various object oriented programming concepts.
4. Compare, annotate, and comment on various object oriented programming concepts.
5. Demonstrate ability to write concurrent programs for given problems.

Course Contents

Introduction: Various programming paradigms: Procedural, object-oriented, logic and functional, concurrent programming. Classes, Objects, Methods; Data types provided by OO languages; Input/Output mechanisms; Abstract Data Types; Private, public, protected members; **[8 Hrs]**

Encapsulation; Constructors, Destructors; Polymorphism; Access specification

[6 Hrs]

Inheritance; Multiple Inheritance; Class hierarchies; Virtual Functions;

[8 Hrs]

Templates; Generic Programming; , Packages; Interfaces. Iterators; Containers.

[8 Hrs]

Exception Handling & File I/O: Exception handling, Exception types, file I/O.

[6 Hrs]

Multi-Threaded Programming: Concurrent Programming, Basic Concepts of Concurrent Programming, Threads. Design: Unified Modelling language; use case diagrams; Class Diagrams;

[6 Hrs]

Text Books

- Cay S Horstmann and Gary Cornell, Core Java Vol-1 and Vol-2, 9th Edition, Pearson Education India, ISBN-10: 9332518904 and 9332518890
- Bjarne Stroustrup, The C++ Programming Language, 3th Edition, Pearson Education, ISBN-10: 8131705218
- M. Ben Ari, "Principles of Concurrent Programming, 1989

Reference Books

- Herbert Schilt, "JAVA Complete Reference", 7th Edition, Tata McGraw Hill, ISBN: 9780070636774
- Sharon Zakhour, Scott Hommel, Jacob Royal, Isaac Rabinovitch, Tom Risser, Mark Hoeber, "The Java Tutorial,"Addison Wesley Professional, 2006, Print ISBN-10: 0-321-33420-5
- Eckel B., "Thinking in Java", 3rd Edition, Pearson Education, 2012

- E. Balagurusamy, Object Oriented Programming with C++, 6th Edition, McGraw Hill, ISBN-10: 125902993X

Honours in Data Science

(CT(HO)-21001) Making Sense of Data

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each
End-Sem Exam – 60 marks

Course Outcomes

Students will be able to:

1. Identify different types of data,
2. Analyze numerous amount of data.
3. Apply pre-processing on data
4. Understand the different data analytics tools
5. Visualize the data

Course Contents

Introduction:
Overview, Sources of Data, Process for Making Sense of Data. Describing Data: Observations and Variables, Types of Variables, types of data, Data Distributions: Discrete Distributions such as Binomial, Poisson, Geometric etc.; Continuous Distributions such as Exponential, Normal etc.; Expectation: Moments; Central Limit theorem and its significance; Some sampling distributions like chi-square, t, F

[06Hrs]

Statistical Inference: Estimation - Introduction, classical methods of estimation, single sample: estimating the mean and variance, two samples: estimating the difference between two means and ratio of two variances; Tests of hypotheses - Introduction, testing a statistical hypothesis, tests on single sample and two samples concerning means and variances; ANOVA - One–way, Two–way with/without interactions.

[08Hrs]

Data Analytics Tools
Data analytics using Python: Statistical Procedures, NumPy, Pandas, SciPy, Matplotlib

[08Hrs]

Data Pre-Processing
Understanding the Data, Dealing with Missing Values, Data Formatting, Data Normalization, Data Binning, Importing and Exporting data in Python, Turning categorical variables into quantitative variables in Python, Accessing Databases with Python.

[06 Hrs]

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

[06Hrs]

Text Books

2. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, Wiley 2009.
3. Glenn J. Myatt, Wayne P. Johnson, Making Sense Of Data II A Practical Guide To Data Visualization, Advanced Data Mining Methods, And Applications,Wiley 2009

References

1. H. Davenport, Jeanne G. Harris and Robert Morison, "Analytics at Work: Smarter Decisions, Better Results", Harvard Business Press, 2010
2. Anil Maheshwari, "Data Analytics made accessible," Amazon Digital Publication, 2014.

(CT(HO)-21003) Big Data Analytics

Teaching Scheme
Lectures: 3 Hrs/ Week

Examination Scheme
Assignment/Quizzes: 40 marks
End Semester Exam: 60 marks

Course Outcomes

Students will be able to:

1. Explain the need of Big Data, challenges and technology stack of big data.
2. Explain and work on Hadoop Framework and ecosystems.
3. Explain and Analyze Big Data using Map Reduce programming framework in both Hadoop and Apache Spark.
4. Analyze large datasets using Apache Pig.
5. Perform Data Querying and Analysis on large datasets using Apache Hive.

Course Contents

Introduction to Big Data: Types of Digital Data, Overview of Big Data Analytics, Evolution of Big Data, Characteristics of Big Data - Volume, Variety, Velocity, Veracity, Valence, Value, Applications of Big Data, Challenges with Big data, Introduction to Enabling Technologies for Big Data.

[5 Hrs]

Big Data Technology Stack: Introduction to Big Data Technology Stack, Overview of Big Data distribution packages, Introduction to Big Data Platforms, Big Data Storage Platforms for Large Scale Data Storage, CAP Theorem, Eventual Consistency, Consistency Trade-Offs, ACID and BASE, Overview of Zookeeper and Paxos, Cassandra.

[7 Hrs]

Apache Hadoop: History of Hadoop, Overview Apache Hadoop and Apache Spark, Hadoop Storage Framework – Hadoop Distributed File System (HDFS) , HDFS Architecture, HDFS Concept, Hadoop Data Processing Framework – Map Reduce, Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features, MapReduce Programming Model with Spark.

[8 Hrs]

Introduction to Big Data Streaming: Big Data Pipelines for Real-Time computing, Introduction to Apache Spark Streaming, Kafka, Streaming Ecosystem, Spark Components, Resilient Distributed Dataset and data frames.

[7Hrs]

Apache PIG: What is ETL, Introduction to Apache PIG, Execution Modes of PIG, Comparison of PIG with SQL and No-SQL Databases, PIG Data Types, Data Models in PIG, Grunt, PIG Latin, Overview of PIG User Defined Functions

[7 Hrs]

Apache HIVE: Introduction to Apache Hive, Hive Architecture and components, Hive Metastore, Comparison with Traditional Databases, HiveQL, Hive Partition, Hive Bucketing, Tables(Managed and External)

[6 Hrs]

Text Books

- "Big Data Analytics", Seema Acharya, SubhasiniChellappan, Second Edition, 2019, Wiley India Pvt.Ltd, ISBN 978-81-2657-951-8.
- "Hadoop: The Definitive Guide", Tom White, Fourth Edition, 2015, O'Reilly, ISBN 978-93-5213-067-2.

Reference Books

- "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Bill Franks, First Edition,2012, John Wiley & sons,ISBN: 978-1-118-20878-6
- "Mining of Massive Datasets", Jure Leskovec, Anand Rajaraman and Jeffrey David Ulman, Second Edition 2016, Dreamtech Press, ISBN - 978-13-1663-849-1
- "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Bart Baesens, First Edition 2014, Wiley, ISBN: 1118892704
- "Big Data Glossary", Pete Warden, First Edition 2011, O'Reily, ISBN
- "Harness the Power of Big Data The IBM Big Data Platform ",Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , Annotated Edition 2012, Tata McGraw Hill Publications, ISBN 978-0071808170
- "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Michael Mineli, Michele Chambers, Ambiga Dhiraj, First Edition 2013, Wiley Publications, ISBN 978-1118147603
- "BigDataAnalytics: Disruptive Technologies for Changing the Game", ArvindSathi, MC Press, 2012, ISBN 1583473807

Honours in Information Security

(CT(HO)-21002) Fundamentals in Information and Coding Theory

Teaching Scheme
Lectures: 3 Hrs / Week

Examination Scheme
Assignment/Quizzes: 40 marks
End Semester Exam: 60 marks

Course Outcomes

Students will be able to:

1. Apply information theory and linear algebra in source coding and channel coding
2. Comprehend various error control encoding and decoding techniques
3. Analyze the performance of error control codes
4. Apply convolution codes for performance analysis & cyclic codes for error detection and correction
5. Demonstrate applicability of Shannon's security, wiretap model, degraded wiretap model and calculation of secrecy capacity.

Course Contents

Source Coding
Introduction to Information Theory, Uncertainty and Information, Average Mutual Information and Entropy, Information Measures for Continuous Random Variables, Relative Entropy, Source Coding Theorem, Huffman Coding, Shannon-Fano-Elias Coding, Arithmetic Coding, The Lempel-Ziv Algorithm, Run Length Encoding, Rate Distortion Function, Entropy Rate of a Stochastic Process.

[6 Hrs]

Compression techniques
Introduction to Image Compression, The JPEG Standard for Lossless Compression, The JPEG Standard for Lossy Compression, Video Compression Standards, Project Ideas based on the above topics **[6Hrs]**

Channel Capacity and Coding
Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, Parallel Gaussian Channels, The Shannon Limit, Channel Capacity for MIMO Systems, Capacity Region for Multiple Access Channels, Random Selection of Codes

[6Hrs]

Error Control Coding
Linear Block Codes for Error Correction, Introduction to Error Correcting Codes, Matrix Description of Linear Block, Equivalent Codes, Parity Check Matrix, Decoding of a Linear Block Code, Syndrome Decoding, Error Probability after Coding (Probability of Error Correction) , Hamming Codes, Low Density Parity Check (LDPC) Codes, Optimal Linear Codes, Maximum Distance Separable (MDS) Codes, Bounds on Minimum Distance, Space Time Block Codes

[6 Hrs]

Cyclic Codes
Introduction to Cyclic Codes, Polynomials, The Division Algorithm for Polynomials, A Method for Generating Cyclic Codes, Matrix Description of Cyclic Codes, Quasi-Cyclic Codes and Shortened Cyclic Codes, Burst Error Correction, Fire Codes, Golay Codes, Cyclic Redundancy Check (CRC) Codes, Circuit Implementation of Cyclic Codes

[6 Hrs]

Convolutional Codes
Tree Codes and Trellis Codes, Polynomial Description of Convolutional Codes (Analytical Representation) , Viterbi Decoding of Convolutional Codes, Turbo Codes, Turbo Decoding

[5 Hrs]

Physical Layer Security
Introduction to Physical Layer Security, Shannon's Notion of Security, The Wiretap Model, Learning Review, The Gaussian Wiretap Model, Secrecy Capacity in Wireless Channels, Cooperative Jamming

[5 Hrs]

Text Books

- "Information Theory, Coding & Cryptography", Ranjan Bose, Third Edition, 2016, McGraw Hill India, ISBN-13: 978-9385880568.
- "Elements of information theory" Thomas M. Cover, and Joy A. Thomas, John Wiley & Sons, 2012.

Reference Books

- "Algebraic Codes for Data Transmission", R. E. Blahut, Cambridge University Press Cambridge, UK, 2003
- "Error Control Coding - Fundamentals and Applications", S. Lin and D.J. Costello Second Edition, Pearson Education Inc., NJ., USA, 2004.
- "Algebraic Coding Theory: Revised Edition", Elwyn R. Berlekamp, World Scientific, 2015.

(CT(HO)-21004) Ethical Hacking

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs / Week	Assignment/Quizzes: 40 marks
	End Semester Exam: 60 marks

Course Outcomes

Students will be able to:

1. Identify legal and ethical issues related to vulnerability and penetration testing.
2. Report on the strengths and vulnerabilities of the tested network.
3. Exploit the vulnerabilities related to computer system and networks using state of the art tools and technologies
4. Execute a penetration test using standard hacking tools in an ethical manner

5. Evaluate best practices in security concepts to maintain confidentiality, integrity and availability of computer systems

Course Contents

Introduction to Hacking
Ethical hacking process, Hackers behaviour & mindset, Maintaining Anonymity, Hacking Methodology, Information Gathering, Active and Passive Sniffing, Physical security vulnerabilities and countermeasures. Internal and External testing. Preparation of Ethical Hacking and Penetration Test Reports and Documents.

[10 Hrs]

Social Engineering and Attacks
Social Engineering attacks and countermeasures. Password attacks, Privilege Escalation and Executing Applications, Network Infrastructure Vulnerabilities, IP spoofing, DNS spoofing, Wireless Hacking: Wireless footprint, Wireless scanning and enumeration, Gaining access (hacking 802.11) , WEP, WPA, WPA2.

[10 Hrs]

Application Vulnerabilities and Attacks
DoS attacks. Web server and application vulnerabilities, SQL injection attacks, Vulnerability Analysis and Reverse Engineering, Buffer overflow attacks. Client-side browser exploits, Exploiting Windows Access Control Model for Local Elevation Privilege. Exploiting vulnerabilities in Mobile Application

[10 Hrs]

Introduction to Metasploit
Metasploit framework, Metasploit Console, Payloads, Metrpreter, Introduction to Armitage, Installing and using Kali Linux Distribution, Introduction to penetration testing tools in Kali Linux. Case Studies of recent vulnerabilities and attacks.

[10 Hrs]

Text Books

- "Ethical Hacking and Penetration Testing Guide", Baloch R, CRC Press, 2015.
- " Hacking for Dummies " Beaver, K., Third edition John Wiley & Sons, 2013.

Reference Books

- "Network Forensics Tracking Hackers through Cyberspace ", Davidoff, S. and Ham, J., Prentice Hall, 2012.
- "Computer Forensics JumpStart", Michael G. Solomon, K Rudolph, Ed Tittel, Broom N., and Barrett, D, Willey Publishing Inc, 2011