INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

Ver.1-(31-07-2021)

Elective Courses Syllabus – Monsoon 2021

Code	Course Name	Credits	Faculty
SC3.320	Advanced Biomolecular Architecture	3-1-0-4	Deva Priyakumar
CS3.402	Advanced Computer Networks	3-1-0-4	Ankit Gangwal
CS4.404	Advanced Data Systems	3-1-0-4	Krishna Reddy P
CS7.501	Advanced NLP	3-1-0-4	Manish Shrivastava
CE1.604	Advanced Structural Design	3-1-0-4	Sunitha P
CS3.306	Algorithms and Operating Systems		Lini Thomas
CE4.601	Applied Regression Analysis	3-1-0-4	Venkateshwarlu M
EC2.401	Analog IC Design	3-1-0-4	Abhishek Srivastava
CS9.421	Behavioral Research & Experimental Design	3-1-0-4	Vinoo Alluri + Vishnu Sreekumar
SC3.321	Biomolecular Structure Interaction & Dynamics **(20) Prerequisites: ABA, GSC or equivalent**	3-1-0-4	B. Gopalakrishnan
HS1.301	Critical Viewing and Reading	3-1-0-4	Sushmita Banerjee
CL3.202	Computational Linguistics II: Comp semantics and Discourse parsing	3-1-0-4	Dipti M Sharma
CS4.405	Data Analytics I	3-1-0-4	Vikram Pudi
CS4.401	Data Systems	3-1-0-4	Kamal Karlapalem
EC2.407	Design for Testability	3-1-0-4	Ganesh V. Bhutekar, Renia Inc.
CS7.404	Digital Image Processing	3-1-0-4	Ravi Kiran S
CS3.401	Distributed Systems	3-1-0-4	Kishore Kothapalli
CS3.403	Distributing Trust and Block Chains	3-1-0-4	Sujit Gujar
CS9.428	Environmental Science & Technology	3-1-0-4	RC Prasad
HS4.301	Environment & Politics in India	3-1-0-4	Radhika krishnan
CS9.313	Eco-Informatics	3-1-0-4	RC Prasad
CE1.607	Earthquake Resistant Design of Masonry Structures	3-1-0-4	Pravin kumar venkat rao
CS7.504	Fairness, Privacy and Ethics in AI	3-1-0-4	Sujit Prakash Gujar
CE4.501	Finite Element Methods	3-1-0-4	Venkateshwarlu M
MA4.404	Functional Analysis	3-1-0-4	Lakshmi Burra
HS8.201	Gender and Society	3-1-0-4	Sushmita Banerjee
CE5.502	Hydrological modelling and Software Development	3-1-0-4	Shaik Rehana
CS4.406	Information Retrieval & Extraction	3-1-0-4	Vasudeva Varma
CS9.426	Intro to Cognitive Science	3-1-0-4	Priyanka Srivastava + Vishnu Sree kumar

HS2.202	Intro to Psychology	3-1-0-4	Priyanka Srivastava+ Vishnu sree kumar
HS3.201	Introduction to History	3-1-0-4	Ashwin Jayanti
HS1.204	Introduction to Literature	3-1-0-4	Nazia Akhtar
CS9.427	Introduction to Neural and Cognitive Modeling	3-1-0-4	Bapi Raju S
HS2.201	Introduction to Sociology	3-1-0-4	Radhika Krishnan
CE1.605	IS Codes on Design and Structural Safety Assessment	3-1-0-4	Pradeep Kumar R
CS7.503	Mobile Robotics	3-1-0-4	Madhava Krishna
CS1.405	Modern Complexity Theory	3-1-0-4	Girish Varma (50)
SC2.315	Molecular symmetry and quantum mechanics	3-1-0-4	Harjinder Singh
SC1.310	Open Quantum Systems and Quantum Thermodynamics	3-1-0-4	Samyadeb Bhattacharya
CS1.402	Principles of Programming Languages	3-1-0-4	Amey Karkare, IIT Kanpur
EC5.509	Radar Systems	3-1-0-4	K R Sarma
CS3.502	Real-Time Systems	3-1-0-4	Deepak Gangadhran
CS8.501	Research in Information Security	3-0-1-4	Ashok Kumar Das
EC4.401	Robotics: Dynamics and Control	3-1-0-4	Spandan Roy + Nagamanikandan G
SC2.310	Selected topics in Instrumental Analysis	3-1-0-4	Tapan Kumar Sau
CS9.425	Social Science Perspective on HCI	3-1-0-4	Nimmi Rangaswamy
CS4.408	Spatial Informatics	3-1-0-4	Rajan KS
EC5.408	Speech Signal Processing	3-1-0-4	Anil Kumar V+Chiranjeevi Y
EC5.406	Signal Detection and Estimation Theory	3-1-0-4	Praful Mankar
CS7.403	Statistical Methods in AI	3-1-0-4	Anoop Namboodiri
CE1.509	Structural Wind Engineering	3-1-0-4	Shaik Rehana
CS9.424	Technology Product Entrepreneurship	3-1-0-4	Ramesh Logangathan + Prakash Yalla
CE0.501	Theory of Elasticity & Plasticity	3-1-0-4	Pravin kumar venkat rao
CS6.501	Topics in software Engineering	3-1-0-4	Raghu Reddy + Vasudeva Varma + Pankaj Jalote.
MA8.401	Topics in Applied Optimization	3-1-0-4	Pawan Kumar
CL5.401	Topics in SSMT	3-1-0-4	Rajeev Sangal + Manish Shrivastava + Anil V
CS7.502	Topics in Machine Learning **Prerequisite: Statistical Methods in AI**	3-1-0-4	Naresh Manwani
HS1.205	Understanding Raga: Semi Classical Forms of Indian Music	3-1-0-4	Saroja TK
EC5.407	Wireless Communications	3-1-0-4	Ubaidulla

SC3.320 Advanced Bio-Molecular Architecture 3-1-0-4

FACULTYNAME : Deva Priyakumar
TYPE-WHEN : Monsoon semester: Domain core (M Tech I Bioinformatics) + Domain requirement for MS by research/ PhD (Bioinformatics) + Science Elective for B Tech
PRE-REQUISITE : None
OBJECTIVE : First course on the basics of design principles of nature at the molecular level, which would provide breadth in structural and biophysical approaches and 'chemenable' students to understand structures and interactions in Biology

COURSE TOPICS:
• Mole Concept
• Atomic structure and the periodic table
• Quantum mechanical approach to atomic structure and bonding
• Bonding and intermolecular forces
• Nomenclature and isomerism
• Configuration and Conformation
• Structure and properties of molecules
• Computation of energies of molecules and their interactions
• Small biomolecules
• Biological macromolecules: Proteins, Nucleic acids, Lipids and carbohydrate

Syllabus and topic wise Coverage:

ABA 1-2: Design principles of nature – chemistry at the atomic level

Assignment – 1: Introductory lectures – **Due**

ABA 4 ABA 3-4: Structure of atom and

Chemical arithmetic (Practice assignment-1 –

Try out by ABA 4)
Assignment – 2: Chemical Arithmetic – **Due ABA 6**

ABA 5: Quantum mechanical structure of the atom

(Practice assignment -2 – **Try out by ABA 6**

(Work sheet only for M Tech to submit – **Due before Mid-1**

Practice assignment -3 for others)
Assignment – 3: Structure of atoms - **Due ABA 7**

ABA 6: Periodic table and its organization-The electronic configuration of atoms and periodic properties of atoms in their free and bonded state

(Practice assignment -4 – **Try out by ABA 8**
Assignment – 4: Periodic properties – **Due ABA 8**

ABA 7: Bonding and molecular properties -Theories of

bonding Types of bonds and their consequences
Assignment: Bonding (Practice assignment-5 – **Try out by ABA 8)**
Dry lab on structure drawing tool

ABA 8: Bonding and molecular structure -Theories of bonding Electron distribution in molecules and their representation Hybridization Resonance and aromaticity

Assignment - 5: Bonding – **Due ABA 9**

ABA 9: Bonding, structure and intermolecular forces Bond length, bond angle and shape of molecules Dipole moments Intermolecular forces
Assignment - 6: Bonding –**Due ABA**

10 ABA 10: Isomerism

Structural and stereo isomers Nomenclature

Practice Assignment: Isomerism and nomenclature (**Try out before Mid-1**

Assignment – 7: Nomenclature and isomerism I – **Due ABA 13**

Mid 1

ABA 11-13: Configuration and conformation I Chirality and optical activity Representation of configuration and Stereochemical nomenclature

Sugars and carbohydrates
Tutorial
Assignment – 8: Nomenclature and isomerism II – **Due ABA 13**

ABA 14-15: Configuration and conformation III Concept of prochirality

Conformations – energy barriers, torsion angles and representations Conformations of cyclic compounds including cyclic sugars Tutorial

Assignment – 9: Nomenclature and isomerism III – **Due ABA 16**

ABA 16: Structure and properties of molecules

Bond energy and type of bond breaking (Bonding III from resources) Basics of thermodynamics and kinetics Acids and bases Familiarity with the different amino acids and their classification

Tutorial
Assignment – 10: Amino Acid Structure - **Due ABA 18 ABA 17:** Equilibria in aqueous solutions I

General characteristics of amino acids in aqueous solutions

Tutorial
Assignment – 11: Amino Acids and ionic equilibria: **Due ABA 20**

ABA 18: Equilibria in aqueous solutions II Study of buffers Amino acid pK values and isoelectric points (No ionizable side chains) (Practice assignment – Food for thought **Try out by ABA 19)**

Tutorial

Mid-2

ABA 19: Equilibria in aqueous solutions III Amino acid pK values and isoelectric points (ionizable side chains) Tutorial Dry lab on structure building and visualizing tool

ABA 20-22: Study of amino acids and proteins Investigation of dipeptides and torsion angles Levels of protein structure and forces stabilizing them Primary structure and its relation with higher order structure Secondary structure and Ramachandran plot Dry lab on structure visualizing tool

Assignment – 12: Amino acids and proteins **Due ABA 24**

ABA 23-25: Study of nucleic acids DNA-Components, chemical structures Base pairing and hydrogen bonding Types of DNAs A, B, Z and their structure parameters Nucleic acid databases Comparing DNA and RNA Nucleic acid protein interactions Dry lab on structure analysis tool
Assignment – 13: Nucleic acids **Due ABA**

26 ABA 26: Revision

Grading Component	**Weightage (%)**	
	UG (Science Elective)	**M Tech-1 (Bio) (Core)**
Quiz-1	7.5	6.25
Quiz-2	7.5	6.25
Mid Sem Exam	15	12.5
Assignment & Surprise Quizzes	40	40
End Sem Exam	30	25

Lab Exam	-	-
Project/any other evaluation (Domain Supplement: Dry Lab + Theory)	NA	10

PREFERRED TEXTBOOKS: Textbooks: Study material will be provided in the form of pdf files and web content. Also, Atkins and Leach

***REFERENCE BOOKS:** 1. Bio-Chemistry – Stryer
2. Biochemistry – Voet, Voet and Pratt
3.Ralph H. Petrucci, General Chemistry: Principles & Modern Applications, 8th Edition, Addison Wesley Longman (2003)
4.P W Atkins, Elements of Physical Chemistry, 5/E, Oxford University Press (2010)

***PROJECT:** None

OUTCOME: Expected outcome:
1. Ability to carry out chemical calculations
2. Ability to write Lewis and other specialized structural formulae and use them to relate structures with properties
3. Ability to communicate with written structures of biological molecules
4. Ability to understand standard IUPAC nomenclature and numbering
5. Ability to understand structural features including Chirality and prochirality, structure parameters including torsion angles, their definitions and standard values for biomolecules
6. Ability to build molecules in silico and familiarity with some visualization and analysis tools
7. Understand the basis of computability of energetics of molecules and their ensembles
8. Ability to handle files containing structural information of molecules and mine structure databases of biological molecules

REMARKS: Load: Total contact hours ~5 hours per
week Live lectures: Two 1.5 hr lectures per week
Labs and/or Tutorials 1.5 - 2 hr per week
Assignment hours (including lab and reading assignments) around 3-4 hours per week

CS3.402 Advanced Computer Networks 3-1-0-4

Faculty Name: Ankit Gangwal
TYPE-WHEN: Bouquet Core, Monsoon
PRE-REQUISITE: Computer Networks
COURSE OBJECTIVE: Introduce Advance Networking Concepts, Theories and Tools.

COURSE TOPICS:

Review of Networking Basics; Queuing theory; Advance Topics in IPv4 and TCP; Telecom Networks, Switching Techniques; Multicast Rout ing protocols; IPv6, IPv4 to IPv6; QoS; Network Monitoring – SNMP, RMON; VLAN; VPN; Firewall and IPS Concepts; Network Redundancy, Load Balancers, Caching, Storage Networks; VSAT, GSM/CDMA/WiMax; Ad -Hoc networks, Sensor Networks; Network Simulation.

PREFERRED TEXT BOOKS:

- RFCs and Standards Documents
- Communication Networking – An Analytical Approach, Anurag-Manjunath-Joy
- Probabilistic Modelling by Isi Mitrani

REFERENCE BOOKS:

- TCP/IP Illustrated (Vol.1,2), Stevens
- Data Networks, Bertsekas-Gallager
- An Engineering Approach to Computer Networking by S. Keshav

More books/references will be identified in due course

PROJECT: NA

GRADING:

- Assignments: 20
- Quiz: 20
- MidSem Exam: 20
- End Semester Exam**:** 40

OUTCOME:

- Understanding core concepts/theories/algorithms of computernetworks
- Some hands-on capability on various network devices and tools
- Capability to design and implement a computer network

REMARKS:

Course may have lab component, depending on class strength

CS4.404 Advanced Data Systems 3-1-0-4

Faculty: Krishna Reddy Polepalli
TYPE-WHEN: Advanced elective
PRE-REQUISITE: Database Management Systems, Operating Systems, Computer organization, programming language.
OBJECTIVE:
Database system technology manages (stores and retrieves) disk resident data in an efficient manner. Typical DBMSs have been designed to manage data for banking and retail applications. However, this narrow view of DBMSs has changed significantly during the last two decades to meet the data management requirements of emerging applications from various domains. In this course, we will cover several advanced techniques (new DBMS frameworks for efficient data management and query processing, NoSQL, MapReduce, Stream data management, data integration, query processing, graph data management) for large-scale data management requirements of emerging applications in Internet era.

The objective of this course is to give sufficient background to think about possible solutions to current data management problems. For this we discuss key research papers related to the building of database systems to support traditional and emerging applications.

COURSE TOPICS:

About 25 key research papers related to relational database engine, distributed database engine, Efficient/scalable retrieval, stream processing, NOSQL, map-reduce, graph databases, database integration, and web services.

REFERENCES.

1. Papers from SIGMOD, VLDB, ICDE, IDAR, and database journals.

2. Readings in Database Systems, Fifth Edition - edited by Peter Bailis, Joseph M. Hellerstein, Michael Stonebraker, (We will also discuss few papers from earlier editions)

2. Gray, J., and Reuter, A., Transaction Processing: Concepts and Techniques, Morgan Kaufmann, 1993.

3. Database System Implementation by Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom,

4. Database System Concepts, Abraham Silberschatz Henry F. Korth S. Sudarshan

5. Database Management Systems by Raghu Ramakrishnan and Johannes Gehrke

PROJECT:

Each student has to submit the summary of the research paper. As we are discussing the key papers, each student has to make the presentation of three related important papers written after the publication of the key research paper. It is expected that a student will form a new idea in a comprehensive manner which may lead to publication.
GRADING:

Summary assignments: 20%.
MID: 20%
ENDSEM: 40%
Term paper: 20 %

OUTCOME:
After taking the course, the student will have a comprehensive view about the database system technology. Also, he/she will be able to appreciate the research efforts that have been made to manage emerging database related applications. Further, a student is expectedto get a capability to think about new solutions for ongoing and future data management problems.

REMARKS: The course is aimed at students who wants to pursue research as their career or wants to do jobs related to system building. Under-graduate, post-graduate and PhD students who are interested in doing research can take this course. It is very intensive course. The students are going to get enough base to get new ideas for doing MS, PhD and imagining/building next generation systems for different domains. Contact the instructor, if you need more clarity (e-mail: pkreddy@iiit.ac.in).

List of research papers covered during Spring 2018 (The list will be updated by including latest trends)

1. E. F. Codd: A Relational Model of Data for Large Shared Data Banks (Reprint). Commun. ACM 26(1): 64-69 (1970)
2. System R: Relational Approach to Database Management, ACM Transactions on Database Systems, Vol. 1, No. 2. June 1976
3. Jeffrey Dean, Sanjay Ghemawat: MapReduce: Simplified Data Processing on Large Clusters. OSDI 2004: 137-150
4. Michael Stonebraker, Daniel J. Abadi, Adam Batkin, Xuedong Chen, Mitch Cherniack, Miguel Ferreira, Edmond Lau, Amerson Lin, Samuel Madden, Elizabeth J. O'Neil, Patrick E. O'Neil, Alex Rasin, Nga Tran, Stanley B. Zdonik: C-Store: A Column-oriented DBMS. VLDB 2005: 553-564
5. David J. DeWitt, Shahram Ghandeharizadeh, Donovan A. Schneider, Allan Bricker, Hui-I Hsiao, Rick Rasmussen: The Gamma Database Machine Project. IEEE Trans. Knowl. Data Eng. 2(1): 44-62 (1990)
6. Mohamed F. Mokbel, Chi-Yin Chow, Walid G. Aref: The New Casper: Query Processing for Location Services without Compromising Privacy. VLDB 2006: 763-774
7. Pavan Deolasee, Amol Katkar, Ankur Panchbudhe, Krithi Ramamritham, Prashant J. Shenoy: Adaptive push-pull: disseminating dynamic web data. WWW 2001: 265-274
8. P.Krishna Reddy and Masaru Kitsuregawa, Speculative locking protocols to improve performance for distributed database systems, IEEE Transactions on Knowledge and Data Engineering, September/October 2003, vol. 15. no.5.
9. Seth Gilbert and Nancy Lynch, "Brewer's conjecture and the feasibility of consistent, available, partition-tolerant web services", ACM SIGACT News, Volume 33 Issue 2 (2002), pg. 51–59.

10. Lecture on BIG DATA, SQL, DATA SCIENCE

11. Surajit Chaudhuri Venkatesh Ganti Raghav Kaushik, A Primitive Operator for Similarity Joins in Data Cleaning, Proceedings of the 22nd International Conference on Data Engineering (ICDE'06)
12. Lukasz Golab, Howard Karloff, Flip Korn Avishek Saha, Divesh Srivastava, Sequential Dependencies, VLDB09.
13. Hoang Tam Vo, Ashish Kundu, Mukesh Mohania Research Directions in Blockchain Data Management and Analytics, EDBT 2018.
14. Stephan Börzsönyi, Donald Kossmann, Konrad Stocker: The Skyline Operator. ICDE 2001: 421-430
15. Guoliang Li Human-in-the-loop Data Integration, VLDB 2017.
16. Jessica Lin Eamonn Keogh Stefano Lonardi Pranav Patel, Finding Motifs in Time Series, SIGMOD 2002.
17. Ronald Fagin, Amnon Lotem, Moni Naor: Optimal Aggregation Algorithms for Middleware. PODS 2001
18. Ihab F. Ilyas, George Beskales, Mohamed A. Soliman: A survey of top-*k* query processing techniques in relational database systems. ACM Comput. Surv. 40(4): 11:1-11:58 (2008)
19. Grzegorz Malewicz, Matthew H. Austern, Aart J. C. Bik, James C. Dehnert, Ilan Horn, Naty Leiser, Grzegorz Czajkowski: Pregel: a system for large-scale graph processing. SIGMOD Conference 2010: 135-146
20. Peter Buneman, Adriane Chapman, James Cheney: Provenance management in curated databases. SIGMOD Conference 2006: 539-550
21. Wisam Dakka, Panagiotis G. Ipeirotis, Automatic Extraction of Useful Facet Hierarchies from Text Databases, ICDE2008.
22. Mohamed Y. Eltabakh, Mourad Ouzzani, Walid G. Aref: bdbms - A Database Management System for Biological Data. CIDR 2007: 196-206
23. Sarah Masud, Farhana Murtaza Choudhury, Mohammed Eunus Ali, Sarana Nutanong: Maximum visibility queries in spatial databases. ICDE 2013: 637-648
24. Nilesh Padhariya, Anirban Mondal, Vikram Goyal, Roshan Shankar, Sanjay Kumar Madria: EcoTop: An Economic Model for Dynamic Processing of Top-*k* Queries in Mobile-P2P Networks. DASFAA (2) 2011: 251-265
25. Abhishek Santra, Sanjukta Bhowmick, Sharma Chakravarthy: Efficient Community Re-creation in Multilayer Networks Using Boolean Operations. ICCS 2017: 58-67
26. The Beckman report on database research. Commun. ACM 59(2): 92-99 (2016)

CS7.501 Advanced NLP 3-1-0-4

Faculty Name: Manish Shrivastava
Note: Please use course code for previously existing course
TYPE-WHEN : Monsoon 2021

PRE-REQUISITE : None
OBJECTIVE : To get the students acquainted with the state-of-the-art for NLP by focusing on the advances in the field and their impact on a few applications.

COURSE TOPICS :

- Statistical Machine Translation methods
- Distributed Semantics
- Early Neural Machine Translation models
- Extractive and Abstractive Summarization
- Neural Summarization Methods
- Contextual Distributed Semantics
- Models such as ELMO, BERT, ERNIE and their derivatives
- Applications of Contextual Embeddings in NMT, Summarization and Question Answering

PREFERRED TEXTBOOKS:
None. Mostly research papers.
***REFERENCE BOOKS:**
Statistical Machine Translation by Philip Koehn
Deep Learning by Ian Goodfellow
***PROJECT:**
Titles to be decided based on recent research publications

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**5**
Mid SemExam	**10**
Quiz-2	
End Sem Exam	**20**
Assignments	**15**
Project	**40**
Term Paper (related to project)	**10**
Other Evaluation _____	

OUTCOME:
The students should become aware of the advances in the field of NLP focusing on Natural Language Representations and embeddings. The students would also gain hand-on experience in the design and implementation of some advanced models.

REMARKS:

CE1.604 Advanced Structural Design 3-1-0-4

Faculty Name **:** Sunitha P
Type-when **: Monsoon 2021**

Pre-requisite: Design of RC and Steel Structures (Undergraduate course content)

Objectives:

1. To facilitate understanding of analysis and design concepts of RC and steel structures to control structural behaviour, with focus on seismic loading effects on moment frame and wall-frame structural systems in buildings; and

2. To help compare effects of choice of material of construction on critical design parameters and seismic behaviour.

Course Contents

Analysis: Configuration, Structural Plan Density, Initial proportioning, estimation of loads and load combinations, numerical modelling concepts, interpretation of linear elastic structural analysis and modal analysis results-concept of lateral stiffness.

Design: Design of structural members for loading effects-axial, flexure, shear, torsiondesign for combined effects; Design of RC beam-column joints; Design of steel connections-Joint panel zones; Design of Foundations; Design of Column Bases; Design of Wall-Frame Systems.

Behaviour: Lateral Stiffness, Lateral Strength, Ductility Capacity, Collapse Mechanism and Energy Dissipation Capacity.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	25%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	25%

Select References

[1] American Concrete Institute (ACI), (2014), *Building Code requirements for Structural Concrete* (ACI 318-14), Farmington Hills, MI,USA

[2] American Institute of Steel Construction (AISC), (2016), Seismic Provisions for Structural Steel Buildings, (ANSI/AISC341-16), Chicago, Illinois, USA

[3] American Institute of Steel Construction (AISC), (2016), Specifications for Structural Steel Buildings, (ANSI/AISC360-16), Chicago, Illinois,USA

[4] American Society of Civil Engineers (ASCE), (2010), Minimum Design Loads for Buildings and Other Structures (ASCE 7-10), USA

[5] American Society of Civil Engineers (ASCE), (2013), Seismic Rehabilitation of Existing Buildings, (ASCE/SEI 41-13), Virginia, USA

[6] Agarwal,P., and Shrikande, M., (2010), Earthquake Resistant Design of Structures, PHI Learning Pvt Ltd, New Delhi

[7] Bureau of Indian Standards (BIS), (2000), Indian Standard Plain and Reinforced Concrete - Code of Practice, IS 456:2000, New Delhi, India

[8] Bureau of Indian Standards (BIS), (2007), Indian Standard Code of Practice for General Construction in Steel, IS800;2007, New Delhi, India

[9] Bureau of Indian Standards (BIS), (2016), Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, Code of Practice, IS 13920;2016, New Delhi, India

[10] Bureau of Indian Standards (BIS), (2016), Indian Standard Criteria for Earthquake Resistant Design of Structures, IS:1893;2002-Part 1, New Delhi, India

[11] Elnashai,A.S., and Di Sarno,L., (2008), Fundamentals of Earthquake Engineering, John Wiley and Sons, UK

[12] Gioncu,V., and Mazzolani,M., (2002), "Ductility of Seismic Resistant Steel Structures," SPON Press, Taylor and Francis, New York

[13] Gioncu,V., and Mazzolani,M., (2011), Earthquake Engineering for Structural Design, SPON Press, Taylor and Francis, New York

[14] Park,R., and Paulay,T., (1975b), Reinforced Concrete Structures, John Wiley & Sons, UK

[15] Paulay,T., and Priestley,M.J.N., (1992), Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley and Sons, New York

[16] Salmon, C.G., and Johnson,J.E., (1996), Steel Structures Design and Behaviour, Prentice Hall, NJ

[17] Varghese,P.C., (2010), Design of Reinforced Concrete Foundation, PHI Learning Pvt Ltd, New Delhi

Expected Course Outcome

To demonstrate: (a) for designing a new building, design should reflect the analysis performed, and (b) for assessing an existing building, analysis should assess the design performed.

CS3.306 Algorithms& Operating Systems 3-1-0-4

Faculty: Lini Thomas

Pre-Requisite: Data Structures and Programming

Objective: The plan is to introduce students to the twin topics of algorithms and operating systems. It is planned to be achieved by studying operating systems and switch to its algorithmic aspects to cover algorithmic details. For instance, paging strategies have lot of algorithmic aspects, especially considering also randomized online algorithms. The course will cover algorithms and operating systems in tandem, with one lect ure each week devoted to each of the themes.

Course Topics: Topics in Operating Systems: Basic concepts in Operating Systems, Process management, Memory management, File management, Resource management, Concurrency control, Inter-process communication. Tentative List of Topics in Algorithms: Basic concepts in Algorithms, Design methodologies, Greedy algorithms, Online algorithms with application

to paging and power management, Advanced data structures for file management, Graph algorithms with application to resource management.

Preferred Text Books: 1) Introduction to Algorithms, Thomas H Corner and etc., Printice Hall, 2nd Edition. 2) Operating System Concepts, 8 th Edition, Silberschatz, Abraham and Galvin, Peter, Addison.

Outcome: Students should be able to apply formal concepts of algorithm design to problem solving. They should be able to argue about efficiency of algorithms, important design methodologies, and choose appropriate data structures as required to solve problems coming from VLSI, circuit design, system design, and so on. Given that the application areas may include systems with sizable complexity, multi -user support, and interface with other systems, certain principles of system design arising from the field of operating systems are appl icable. At the end of the course, students should be able to apply OS concepts such as processes, synchronization, memory, and file systems to system design.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	10%
Quiz	-	30%
Open Book Exam/ 30 MinQuiz	-	30%

CE4.601 Applied Regression Analysis 3-1-0-4

Faculty Name: Venkateshwarlu M

When: Monsoon

1. **Prerequisite**: Basic statistics, Matrix analysis, Calculus

2. Detailed Syllabus

Unit 1	Simple regression, Estimation of parameters, Inferences in regression, Analysis of variance, Diagnostic plots.	6 hours
Unit 2	Simple regression, Diagnostic tests, Simultaneous inferences, a comprehensive example, Matrix formulation.	6 hours
Unit 3	General linear regression model, Tests and interval estimates, Diagnostics and remedial measures, An example with two predictor variables	6 hours
Unit 4	Principle of extra sums of squares, Tests for regression coefficients, Standardised multiple regression model, Multicollinearity	6 hours
Unit 5	Polynomial regression models, Interaction regression models, Qualitative predictors, Comparison of regression functions	6 hours
Unit 6	Model-Building process, Example, Model selection, Model validation	6 hours
Unit 7	Model adequacy, Outlying observations, Identifying influential cases, Multicollinearity diagnostics, Example	6 hours

References:

N.R. Draper and H. Smith, Applied regression analysis

D.F. Morrison, Applied linear statistical methods

R.H. Myers, Classical and modern regression with applications

3. Teaching-Learning Strategies

Lectures in classroom, weekly tutorials on problem solving, active learning by students.

4. Assessment Methods and Weightage

Assignments 20, Quizzes 20, Mid Semester 20, End Semester 40 marks.

EC2.401 Analog IC Design 3-1-0-4

FACULTY NAME: Abhishek Srivastava
TYPE-WHEN : Monsoon2021
PRE-REQUISITE : Analog Electronics/Linear Electronic Circuits, Network theory
OBJECTIVE : To make students learn practical CMOS analog IC design with the emphasis on developing intuitive thinking for analog circuit analysis and design.

COURSE TOPICS:
Basics of analog design: MOS model for analog circuits, large signal modeling, incremental modeling, MOS parasitics, mismatches, speed (f_T), passive components for IC design (R, C and L), biasing, negative feedback for biasing, introduction to layout, Gain-BW-Swing-Power-Noise- Area trade-offs.(4)
Amplifier design: Review of single stage amplifiers, single-ended and differential amplifier design, gm/Id design technique, sub-threshold design technique for low power consumption, techniques to increase gain of amplifiers- active loads, cascade, differential amplifier with current mirror load, mirror pole, stability issues and utility of negative feedback in high gain amplifiers.(7)

Operational amplifier design: Review of op amp characteristics, CMRR, offset, single stage op amp, high gain op amps - telescopic, two stage, stability and frequency compensation, fully differential amplifier (FDA), common-mode-feedback, review of low noise, low voltage op amp design techniques. (8)

Other topics: Noise, layout techniques, effect of off-chip components and packaging on IC design, oscillators, phase noise and PLLs.(7)

PREFERRED TEXT BOOKS:

1. B. Razavi, “Design of Analog CMOS Integrated Circuits,” 2nd ed., McGraw Hill,2017.

2. P. E. Allen and D. R. Holberg, “CMOS Analog Circuit Design,” 3rd ed., Oxford,2013.

***REFERENCE BOOKS:**

1. Paul R. Gray & Robert G. Mayor, "Analysis and Design of Analog Integrated Circuits," 4th ed., JohnWily& Sons, 2008.

***PROJECT:** Two course projects will be given

Course Assessment Plan (Monsoon 2021)

Assignments	-	40%
Project	-	40%
Open Book Exam/ 30 Min Quiz	-	20%

CS9.421 Behavioral Research & Experimental Design 3-1-0-4

Faculty Name: Vinoo Alluri + Bapi Raju S
When: Monsoon 2021
OBJECTIVE:
The primary objective of these courses is to acquaint students with fundamentals of experimental design, related research methods, data analyses approaches and techniques. Specifically, the course in Monsoon aims at introducing them to the basic concepts used in research and to scientific research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis. Some other objectives of the course are:

- To develop understanding of the basic framework of behavioral research process.
- To identify various sources of information for literature review for operationalization and data collection.
- To develop an understanding of various experimental designs and techniques.
- To develop an understanding of the ethical dimensions of conducting applied research.
- Appreciate the components of scholarly writing and evaluate its quality.

COURSE TOPICS:

1. Introduction to Research Methods: Qualitative and Quantitative Approaches; Conducting Behavioral Research; Ethics in Research; Institute Review Board (IRB) Process

2. Starting on Research, Experimental Design: Hypothesis Testing, Type I and II errors, Hypothesis-based vs Exploratory Research, Operationalizing Research, Literature Review; Sampling, Types of variables and levels of Measurements, Designing an Experiment; Validity, Reliability and Cross-validation in Research

3. Types of Experimental design: Non-Experimental Designs, Pilot Testing; 4. Data Collection: Surveys Questionnaires; Data Representation: Levels of Measurement, Human Annotation, Different types of design: Simple randomized design, Factorial designs, Simple

repeated measures design, Randomized blocks design, Latin square type designs, Between-subject and within-subject factors in an experiment; Scaling Behavioral Experiments: web and mobile experiments, crowdsourcing, big data, large-scale experiments, citizen science, online data collection (PsiTurk, Mechanical Turk, etc).

4. Data Visualization and Analysis: Descriptive Statistics, Tests of Normality and Data Transformation, Outliers, Collinearity in Data, Data Summarization vs Data Reduction Techniques: Exploratory Factor Analysis, Principal Component Analysis, Discriminant Factor Analysis

5. Introduction to Statistical Analysis: Inferential Statistics-Tests of Difference and Tests of Association: Multi-level tests (ANOVA): nonparametric and parametric tests of difference – chi-square test, Mann Whitney U test, Binomial Sign test, Wilcoxon's T test, Related and Unrelated t tests; nonparametric and parametric tests of association – correlation, regression; Significance testing [NOTE: While this course emphasizes basic descriptive and inferential statistical analysis, the Second part of the course to be offered in Spring would cover Statistical Analysis of Behavioral and Neuroimaging data in more detail].

6. Communicating and Assessing Research: Writing, Poster and general Presentations (formatting of the research paper using APA and IEEE journal/conference formats) PREREQUISITES: Interest in conducting behavioral experiments is desirable. Open only for DD, MS, and PhD students. BTech and MTech students can be admitted based on specific requirements and instructor permission.

REFERENCES:

• Howell, D.C. (1997). Statistical Methods for Psychology (4th ed). Belmont, CA: Duxbury.
• Salkind, N.J. (2009). Exploring Research (8th Ed.). Upper Saddle River, NJ: Prentice Hall.
• Cozby, P. & Bates, S. (2011). Methods in Behavioral Research (11th Ed.), McGraw Hill.
• Coolican, H. (2014). Research Methods and Statistics in Psychology. London: Hodder & Stoughton.
• Passer, M. W. (2017). Research Methods: Concepts and Connections, 2nd ed. New York: MacMillan.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	40%
Any other	-	10%
Open Book Exam/ 30 Min Quiz	-	20%

SC3.321 Biomolecular Structure InteractionsandDynamics 3-0-1-4

Faculty Name : B. Gopalakrishna

Type When : Monsoon-2021

Pre-requisites : Advanced Biomolecular Architecture or General and Structural Chemistry

or equivalent Max. No. of students (limit, if any): Science/Open elective for ‘non CNS’ B. Tech students – no limit.

OBJECTIVE: Navigating the ıSequence ı Structure ı Functionı Space for Biomolecules.

Course Description: ı Structure and properties of biomolecules, ı Interactions between biomolecules, ı Properties of ensembles of biomolecules, ı Reactions and reaction mechanisms, ı Important biochemical reactions, ı Exploration and analysis of biomolecular structures and interactions, ı Molecular modeling and docking ı concepts and techniques, ıDatabases and tools.

Textbook:

1. Bio-Chemistry -Lehninger
2. Bio-Chemistry ıStryer
3. Biochemistry ı Voet, Voet and Pratt Syllabus and topic wise Coverage: LecturesTopics

Week 1

1 -2 Structure and properties of biomolecules: Steric and electronic effects, Electrophiles, nucleophiles, acids, bases and salts, Buffers

Week 2

3 Interactions between biomolecules: Hydrogen bonding and solvation, examples of structure property correlation

Assignment 1 : Due Week 3

Week 2 ı 4

4 ı 7 Properties of ensembles of biomolecules: Elementary concepts of chemical thermodynamics, Equilibrium and kinetics, Ionic equilibriums and chemistry in aqueous solution. Application to stability of proteins, nucleic acids and their interactions. Assignment 2 : Due Week 5

Week 5

8 ı 9 Reactions and reaction mechanisms Classification of reactions and their mechanismsı application to classification of biochemical reactions and their enzymes Assignment 3: Due Week 6

Week 5 ı 6

10 ı 12 Important biochemical reactions Examples from enzyme classes, active site, target specificity, inhibition and activation. Reactions involved in storage and retrieval of energy. Enzyme kinetics.

Assignment 4: Due Weeks 8

Week 7 ı 9

13 ı 18 Exploration and analysis of biomolecular structures and interactions Experimental methods and techniques for analyzing structures and interactions ı NMR, ESR, X- Ray, CD, Fluorescence etc. Detailed structural analysis of some representative proteins, Analysis of DNA and RNA structures,
Assignment 5 and 6: Due Weeks 9 and 11

Week 10 ı 12

19 ı 24 Molecular modeling and docking ı concepts and techniques: Useful concepts in Molecular modeling - Tasks and techniques in molecular modeling, Identification of tasks e.g. alignment, minimization, conformational search, dynamics and simulation etc., Methods of analyzing structures, Methods of prediction and validation of structures
Assignment 7: Due Week 12

Week 13 ı 14

25 ı 28 Databases and tools: Classification of databases, databases of structures and functions, CATH, SCOP, PFAM, Functional domain ı Analysis servers Assignment 8: Due Week 14

Laboratory:

ı Visualization & rendering

ı Building molecules-Physical (Ball & Stick, Paper models), in silico

ı Rendering of various aspects of structures of

biomolecules ı Web based tools

ı Query tools: i) Sequence retrieval, ii) Structure

retrieval ı Protein structure analysis tools:

i) Structure alignment.

ii) Homology search.

iii) Domain assignment.

iv) Fold recognition and analysis

ı Structure prediction tools: i) Secondary structure prediction. (1) Protein. structure. (2) RNA structure

ı Molecular modeling tools: i) Threading. ii) Comparative modeling, Swiss MoD.

ı Computational tools: i) Geometry optimization and Energy minimization. ii) Molecular

dynamics simulation.

Projects (if any): Labs + Tutorials 1.5 hr per week Assignment hours (including lab and

reading assignments) around 4 hours per week.

Grading:

Grading Component	Weightage (%)
Quiz-1	5
Quiz-2	5
Mid Sem Exam	15
Assignment & Surprise Quizzes	35
End Sem Exam	30
Lab Exam	-
Project/any other evaluation (Domain Supplement: Dry Lab + Theory)	10

Outcome: 1. Review of physicochemical principles at the molecular level 2. From molecules to biochemical systems ı appreciation of principles of kinetics and thermodynamics for understanding mechanisms of interactions and reactions of biomolecules 3. Appreciation of the experimental methods used for exploring structures of biomolecules 3. Understanding of important structural concepts used for the analysis of protein and nucleic acid structures4.

Learning to use and understanding the principles of molecular modeling, docking and molecular dynamics simulations for inferring structures, functions and interactions from sequences ı5.

Familiarity with important structural and functional databases and their usefulness in biological contexts.

Remarks: Total contact hours 4-5 hours per week Live lectures: Two 1.5 hr lectures per week.

HS1.301 Critical Viewing and Reading 3-1-0-4

Faculty Name **:** Sushmita Banerjee
TYPE-WHEN **:**
PRE-REQUISITE **:** None
OBJECTIVE **:** This course is designed as an introduction to texts – literary and cinematic – that engage with the Partition of British India into present day India and Pakistan. Students will be introduced to key historical moments to contextualize the texts they read/view. We will interpret cultural expression in light of ethical, cultural, and historical trauma.

COURSE TOPICS :

Unit 1: History and its ghosts – Political moves, Gandhi, Nehru and the INC; Jinaah and the Muslim League, the state of the people and the State and its people

Unit 2: What were people writing – short stories from Urdu, Hindi and Bangla

Unit 3: Cinema – Popular cinema and its tendencies, the new Nation in the popular imagination, the Partition's afterlives on celluloid.

PREFERRED TEXTBOOKS:

Bose, Sugata and Ayesha Jalal eds. *Nationalism, Democracy, and Development: State and Politics in India.* Delhi: Oxford University Press, 1997.

Butalia, Urvashi. *The Other Side of Silence: Voices from the Partition of India.* Delhi: Penguin, 1998.

Pandey, Gyanendra. *Remembering Partition: Violence, Nationalism and History in India.* Cambridge: Cambridge University Press, 2001.

Veena Das, Arthur Kleinman, Margaret Lock, Mamphela Ramp hele and Pamela Reynolds. eds.. *Remaking a World: Violence, Social Suffering, and Recovery.* Berkeley: University of California Press, 2001.

***REFERENCE BOOKS:**

Bhalla, Alok.ed. *Stories About the Partition of India. Vol.1,2,3.*New Delhi: Indus, 1994.

Jill, Didur. *Unsettling Partition: Literature, Gender, Memory.* Toronto: University of Toronto Press, 2006.

Talbot, Ian. "Literature and the Human Drama of the 1947 Partition." *Partition and Post-Colonial South Asia: A Reader, Vol. II. Eds. Tai Young Tan and Gyanesh Kudaisya*. London: Routledge, 2008.

Caruth, Cathy. *Unclaimed Experience: Trauma and the Possibility of History.*Baltimore: Johns Hopkins University Press, 1996.

Felman, Shoshana. *Testimony: Crises of Witnessing in Literature, Psychoanalysis, and History.* New York: Routledge, 1992.

LaCapra, Dominick. *Writing History, Writing Trauma*. Baltimore: Johns Hopkins University Press, 2001.

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
In-class Quiz x 5	**10% x 5 = 50%**
Term Paper 1	**20%**
Term Paper 2	**20%**
Meaningful Participation	**10%**

OUTCOME: Students will learn to critically engage with literary and filmic texts, understand the Partition and its ramifications, and read popular texts in nuanced and informed ways.

REMARKS: Students are expected to read up to 30 pages a week, watch any video lectures made available, and view films and read literature when required. This class shall deal with material students might disagree with. All informed disagreements, opinions, and discussions are

encouraged. It shall however be the instructor's right to shut down any disrespectful behavior.

CL3.202 Computational Linguistics II 3-1-0-4

Faculty Name: Radhika Mamidi
TYPE-WHEN:
PRE-REQUISITE: CL-1 or NLP-1
OBJECTIVE

To introduce the students to apply the basic concepts of semantics and pragmatics computationally. For this the key notions emphasised are: understanding the structure of texts, meaning in text, contextual interpretation of text and representation of meaning in context.

COURSE TOPICS

1. SEMANTICS: Meaning Representation
1.1. Word meaning: Sense and reference
Lexical semantic relations - Synonymy, Antonymy, Hyponymy, Troponymy, Meronymy, Metaphor and Metonymy; Polysemy and Homonymy.
Semantic fields. Lexical ambiguity. Content words and Function words.
Lexical ambiguity, context variation.
Word Sense Disambiguation

Building resources: Dictionaries, Ontologies, WordNets, VerbNets, VerbFrames
1.2 Formal Semantics : Formal representation of natural language - semantic features, semantic primitives. Variability and unambiguous representation. First order logic; Variables and quantifiers, Lambda notation. Inference. Event, state and time representation. Predicate logic. Proposition. Inference. Notation for representing a proposition.

1.3 Sentence Meaning : Propositional Content and Sentence meaning.
Properties of predicates - reflexive, symmetry, transitive.
Properties of a sentence : analytic, contradiction, entailment.
Semantic Role labelling

Resources: Dependency Treebanks, Propbanks, Framenet.

2. Computational Discourse Analysis
2.1 Discourse Cohesion
Studying Structure of text and coherence, Discourse connectives and relations
Rhetorical Structure theory
2.2. Coreference Chains, anaphora resolution, entity linking.
2.3. Sentiment Analysis. Humour Analysis.

3. Computational Pragmatics:
3.1 Language Understanding; Meaning beyond textual context; speaker's intention and hearer's inference; inference - bridging inferences, causal and spatial inferences, elaborative and restrictive inferences;
3.2 Dialogue Systems, dialogue acts.

3.3 Resources : Discourse Treebank, Coreference chains, dialogue data.

PREFERRED TEXT BOOKS

Daniel Jurafsky & James H. Martin (2000); Speech and Language Processing, Pearson Education/Prentice Hall.
James R. Hurford & Brendan Heasley (1983). SEMANTICS - a course book. Cambridge University Press.
Judith Greene (1986). Language Understanding - a cognitive approach. Open University Press.

REFERENCE BOOKS:

Lyons, John. (1977). Semantics. Cambridge University Press.
Levinson, Stephen C. (1983). Pragmatics. Cambridge University Press.
Leech, Geoffrey. (1983). Principles of Pragmatics. Longman.
Brown, G and Yule, G. (1983). Discourse Analysis. Cambridge University Press. Cutting, Joan (2002). Pragmatics and Discourse: A resource book for students. Allen, James (1994). Natural Language Understanding. Pearson.

PROJECT

Students will do one term project which will include issues related to semantics, pragmatics and discourse.

SEMINAR

Students will be expected to read research papers on various topics and present in class.

GRADING PLAN

Type of Evaluation	**Weightage (in %)**
Quiz-1	**10**
Mid SemExam	**—-**
Quiz-2	**10**
End Sem Exam	**30**
Assignments	**15**
Project	**25**
Seminar	**10**
Other Evaluation _____	

OUTCOME
Students will develop a good understanding of semantic and contextual analysis of texts, computational approaches for parsing a text and the type of data resources for semantic representation.

REMARKS:

CS4.405 Data Analytics I 3-1-0-4

Faculty Name: Vikram Pudi
TYPE-WHEN: CSElective.
PRE-REQUISITE: Data andApplications
OBJECTIVE: Theory and practice of data warehousing and data mining techniques and algorithms.

COURSE TOPICS:
Data Mining Process Data Preprocessing Data warehouse concepts and design Frequent Patterns Mining Classification Clustering

< will not cover ML type-oriented material, including neural networks, and statistical pattern recognition topics>

PREFERRED TEXTBOOKS:

Data Mining: Concepts and Techniques 3rd Edition: Han and Kember,

***REFERENCE BOOKS:**
***PROJECT:**

Compulsory Components:

A group project two students each with following compulsory components on any dataset of theirchoice.

1. CSV file to the datawarehouse
2. Attribute-orientedinduction
3. Frequent patterns
4. Classification
5. Clustering
6. Any other data mining exercise of theirchoice.

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Project	-	45%
Quiz	-	10%
Open Book Exam/ 30 Min Quiz	-	25%

OUTCOME:

A good understanding of theory and practice of data mining concepts and algorithms in a real-world setting.

REMARKS:

A cool first databasecourse.

CS4.401 Data Systems 3-1-0-4

Faculty Name: Kamal Karlapalem
Note: Please use course code for the previously existing course

TYPE-WHEN: Bouquet Core for CSE, offered mainly in Monsoon, and Spring Semesters (depending on interest).
FACULTY NAME : DSAC
PRE-REQUISITE : Data and Applications
OBJECTIVE : Theory and practice of core database system design and implementation.
COURSE TOPICS :
(Please list the order in which they will be covered)

Page/Block Design for storing data
Indices, and index implementation
Query Processing techniques (relational operators) and optimization
Transaction Management, concurrency control, and recovery
A brief introduction to cloud database systems

PREFERRED TEXT BOOKS:
Fundamentals of Database Systems, Elmasri and Navathe, 7th Edition, Person, 2017
Database Systems: The Complete Book, Garcia-Molina, Ullman, Widom 2e

***REFERENCE BOOKS:**

***PROJECT:**
Compulsory Components:

A group project to build a core database system by implementing relational operators, and some techniques of query optimization.

Course Assessment Plan (Monsoon 2021)

Assignments	-	25%
Project	-	45%
Any other	-	30%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	40%

ADBI – As Decided by Instructor

OUTCOME:

A good understanding of system aspects and practice of designing and implementing a database system.

REMARKS:

A cool bouquet course on database systems.

EC2.407 Design for Testability 3-1-0-4

Faculty Name: Ganesh V. Bhutekar, Renia Inc.

TYPE-WHEN: Monsoon 2021

PRE-REQUISITE: A course on Digital Circuits (or) B.Tech

OBJECTIVE: To expose the students to the various techniques adopted to make the testing (complicated) of manufactured ICs. To make the stude nts to take care of the testing aspects into account at the design stage itself.

COURSE TOPICS:

1) Introduction: Testing of electronic gadgets, various types of tests, VLSI design flow, role of modeling and simulation intesting.
2) Faults and fault modeling, detection of faults, fault simulation and its applications, functional testing, exhaustive and non-exhaustive testing, automatic testing procedures.
3) Design for testability: Various features are to be incorporated for carrying out testing from input & output pins, scan architecture, board level testing, signature analysis and testing.
4) Built in Self Test (BIST), BIST concepts, text pattern generation, BIST architectures.
5) Testing of Analog and mixed signal ICs, testing of system on chip.

PREFERRED TEXT BOOKS:

1) Miron Abramollici, Mellin A Breur, Arthur D. Friedman, Digital systems, testing and testable design, Jaico publishing house, 2001
2) Stanley L. Hurst, VLSI Testing, Digital and Mixed Analog / Digital Techniques, Institution of Electrical Engineers, 1998, London, United Kingdom.
3) Michael L. Bushnell, Vishwani D. Agarwal, Essentials of Electronic Testing for Digital & Mixed Signal FLSI Circuits, Springer 2000

***REFERENCE BOOKS:**

1. "VLSI Test Principles and Architectures: Design for Testability", Laung-Terng Wang, Cheng- Wen Wu, Xiaoqing Wen
2. "VLSI Testing", Stanley Leonard Hurst
3. "Electronic Design Automation", Laung -Terng Wang, Yao-Wen Chang, Kwang-Ting (Tim) Cheng
4. "System-on-Chip Test Architectures: Nanometer Design for Testability", L aung-Terng Wang, Charles
5. E. Stroud, Nur A. Touba
6. "Testing of Digital Systems", Jha and Gupta

***PROJECT:**

Course Assessment Plan (Monsoon 2021)

Assignments - 10%

Project	-	25%
Term Paper	-	15%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	30%

OUTCOME: REMARKS:

CS7.404 Digital Image Processing 3-1-0-4

Faculty Name: Ravi Kiran S
TYPE-WHEN: Monsoon 2021

PREREQUISITE: The course assumes some knowledge of basic concepts in Mathematics (Linear Algebra, Probability, Statistics); CS (Programming, Data Structures, Algorithms). Familiarity with

Digital Signal Processing is useful but not mandatory. Knowledge of one of the following scripting systems (MATLAB, Python) will be crucial for timely submission of assignments and project work.

OBJECTIVE: Digital images are now everywhere. There is no limit to the useful applications built by harnessing the information contained in such images. If you are excited to work with images, this course is for you. The goal of the course is to impart strong fundamen tals in image processing algorithms, covering both the theoretical and experimental aspects. This course is also a building block for understanding more advanced topics such as Computer Vision.

COURSE TOPICS:

1. Introduction and Fundamentals of digital imaging
2. Image enhancement in the spatial domain (intensity transforms, histogram processing, spatial filtering etc.)
3. Image enhancement by transformation to a different space (fourier transform, wavelet transform etc.)
4. Geometric Image Processing (transforming spatial geometry of images)
5. Color Image Processing
6. Morphological Image Processing (extracting and analyzing structural properties of images)
7. Image Segmentation
7. Feature-based representation and description
8. Image Restoration and Reconstruction
9. Image Compression
10. Introduction to Video Processing and Motion Estimation

***REFERENCE TEXT: Digital Image Processing (Gonzalez and Woods)**

***PROJECT: The course will include a final project**

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	20%

Term Paper - 15%
Quiz - 35%

OUTCOME:

1) Understand how images are captured, stored and represented in digital machines
2) Understand various approaches for enhancing images
3) Understand various approaches for transforming the spatial geometry of images
4) Understand how color is represented in images, transformation from RGB to other color spaces and respective applications
5) Understand how to extract and analyze structural properties of entities in the image
6) Understand approaches for modelling and removing noise in images
7) Understand how storage space for images can be significantly reduced without noticeable perceptual differences
8) Understand various useful features that can be extracted from images and how they aid in higher-level tasks
9) Study a variety of modern applications in image and video processing
10) Understand theoretical aspects of image processing algorithms (to understand research papers and implement them)
11) Gain hands on experience in developing image processing algorithms
12) Get initiated towards higher-level computer vision tasks

CS3.401 Distributed Systems 3-1-0-4

Faculty Name: Kishore Kothapalli
Foundations: Characterizations of Distributed Systems System Models Networking and Internetworking Inter-Process Communication

Logical Time:
A framework for a system of logical clocks Scalar time, vector time and efficient implementation of vector clocks Synchronization of physical clocks. NTP Global state and snapshot recording algorithms: System model and definition Snapshot algorithms for FIFO channels Middleware: Distributed objects and RMI Termination

Detection:

Termination detection using distributed snapshots A spanning-tree-based termination detection algorithms Distributed mutual exclusion algorithms: Lamport‘s algorithm, Ricart -Agarwala Algoritm Sughal‘s dynamic information – Structure Algorithm Quorum-based mutual exclusion Algorithm Maekawa‘s Algorithm Deadlock detection in Distributed Systems: Modelsofdeadlocks,Knapp‘sclassificationofdistributeddeadlockdetectionalgorithms.Mitchelland Merrit‘s algorithm for single resource model Consensus and agreement algorithm: Problemdefinition.Agreementinafailure-freesystem(synchronousorasynchronous).Agreementin (messagepassing) synchronoussystemwithfailures.Agreementinasynchronousmessagepassingsystemswithfailures.

The syllabus includes the following topics:

- RPC, Google pro to bufs
- Logical clocks, vector clocks, generalized clocks

- Totally ordered multi case
- Mutual exclusion, leader election algorithms
- Deadlock detection/prevention algorithms
- Consensus algorithm, Paxos (possibly Raft)
- Consistency, eventual consistency, monotonic reads, ready our writes, etc
- Failure modes, types of failures
- Distributedtransactions,2phasecommit,3phasecommit
- Cap theorem
- Apache HDFS, MapReduce
- Google Big Table

Amazon DynamoDB
Kafka

Course Assessment Plan (Monsoon 2021)

Assignments	-	25%
Project	-	25%
Quiz	-	30%
Open Book Exam/ 30 Min Quiz	-	20%

Reference Books

1)Ajay D.Kshemkalyaniand Mukesh Singhal Distributed Computing Principles, Algorithms and System‖, Cambridge University Press 2008.

2)SukumarGhosh, ―DistributedSystems–AnAlgorithmicApproach‖,Chapman&HallICRC, 2007.

3)M.L. Liu,―DistributedComputingPrinciplesandApplications‖,Pearson,2004.

4)George Coulouris, Jean Dollimore, Tim Kindbergand Gordon Blair, ― Distributed Systems Concepts and Design‖, Fifth Edition, Pearson 2011.

5)Mukesh Singhaland Niranjan G. Shivaratri, ―AdvancedConceptsinOperatingSystems‖,TMH,1994, 2010

CS3.403 Distributing Trust and Block Chains 3-1-0-4

Faculty Name: Sujit Gujar
TYPE-WHEN: Monsoon 2021

PRE-REQUISITE: Nil OBJECTIVE:

Bitcoin has made a big leap in alternative to centralized financial systems. It is one of the most impressive technological innovation of 21stcentury. There are people who believe it is a gold whereas there is a section of population who believe this is just a bubble. What is that makes bitcoin so interesting? Answer is its underlying blockchain technology that not only enabled a first successful crypto currency but also many real-world applications through smart contracts as blockchain offers a distributed trustworthy append-only ledger that have anonymity. In this course,

we will study about bitcoins, blockchains and smart contracts along with key basic crypto fundamentals. In addition, we will touch base upon other aspects of privacy of database, useful in machine learning, a differential privacy.

COURSETOPICS :

(i) Basic maths (probability theory) and cryptography concepts such as encryption, hashing and Merkel Trees. (Introduction to basic stuff so that course can be self-sufficient).
(ii) What is cryptocurrency? What is bitcoin? How does bitcoin work?
(iii) What is double spending? How is it avoided by proof of work in bitcoins?
(iv) Bitcoin mining: strategies and incentives, and mining pools.
(v) Distributed consensus. Block chain technology.
(vi) Use of block chains to design smart contracts (Ethereum/solidity) and their applications such as secure auction, distributed machine learning, secure crowd sensing etc.
(vii) Other Cryptocurrencies: Altcoins, Zero Cash etc.
(viii) Differential Privacy: Concepts and important results

PREFERRED TEXTBOOKS:

Bitcoin and Cryptocurrency Technologies, Narayanan, Bonneau, Felten, Miller, Goldfeder, Clark, Princeton University Press2016

The Algorithmic Foundations of Differential Privacy, Cynthia Dwork and Aaron Roth

Course Assessment Plan (Monsoon 2021)

Assignments	-	40%
Project	-	10%
Term Paper	-	10%
Quiz	-	40%

OUTCOME:

In this course the participants will learn about bitcoin, security aspects of bitcoins, how alternate cryptocurrencies are proposed to improve certain aspects. Also, the participants will learn what are key concepts behind block chain technology, how to design smart contracts using block chains, program in solidity. The participants should be able to develop new applications using block chaintechnology.

REMARKS: The course has multiple aspects varying from implementation and hands on to reading recent research papers in this domain and present it to broader audience.

CS9.428 Environmental Science & Technology 3-1-0-4

Faculty Name: RC Prasad
TYPE-WHEN: Open Elective for UG and PG – Monsoon
PRE-REQUISITE: Nil

OBJECTIVE: Focus on integrating technology to understand various environmental processes and possible solutions to combat anthropogenic driven environmental degradation and problems.

COURSE TOPICS:

Basic of Environmental Science & Technology: Comprehend environment and its issues Environmental problems and challenges, Environmental Events, Environmental movements

Climate Change: Earth components, Climate system, Climate feedback loops, Climate impact on environment, unexpected climate changes, Climate models.

Co_2, Environmental Stress - Mitigation: Impact on vegetation, carbon sequestration methods – vegetation, ocean and geological sequestration, IPCC, Clean Development Mechanisms.

Environmental Impact Assessment: Procedure, regulations and case studies

Environment and Information technology: Green computation, Green energy, Green engineering and technology, e-waste-disposal mechanism – impact on health

Environmental Legislation & Impact Assessment: Important legislations related with environment; Environmental Auditing; Environmental Ethics

Role of geospatial technology: in assessing environmental degradation

Environmental Economics: Basics of economics, Green accounting- Evolution of process, history, case studies, Accounting of goods and services, Sustainability concepts-weak and strong, Hicksian income concept and green accounting.

PREFERRED TEXTBOOKS:

Khoiyangbam, R.S., and N Gupta. 2012. Introduction to Environmental Sciences. New Delhi: TERI

Y.K Singh 2006. Environmental Science. New Age International (P) Ltd., Publishers Tery Sloan 2016. Introductory Climate Science; Global Warming Explained. New Age International (P) Ltd., Publishers

Clifford Jones 2015 Global trends and patterns in carbon mitigation. (all available as e-books)

Reference Books

1. Environmental Science – The natural environment and human impact (1998): A. R. W. Jackson and J. M. Jackson, Longman
2. Environmental Science (2001): S. C. Santra, New Central Book Agency (P) Ltd
3. Environmental Science (6^{th} ed) (1997): Jr. G. T. Miller, Wadsworth Pub. Co.
4. Dimensions of Environmental and Ecological Economics (2005): N. C. Sahu & A. K.

Choudhury (Ed), Universities Press

***PROJECT:** Simulation and modeling of environmental processes, development of open-source tools related to environmental applications, replication of case studies or working on new problem.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	30%
Any other	-	10%
Open Book Exam/ 30 Min Quiz	-	30%

OUTCOME:

Understanding various environmental issues of concern Identify and evaluate environmental technologies. Comprehend green accounting and evaluation methods for ecosystem goods and services Implications of IT to combat emerging environmental problems.

HS4.301 Environment & Politics in India 3-1-0-4

Faculty Name **:** Radhika Krishnan
TYPE-WHEN : Monsoon 2021
PRE-REQUISITE: UG 3, UG 4. Students who have attended the Introduction to Sociology/ Introduction to Politics courses will be preferred.

OBJECTIVE: This course aims to introduce students to concepts of environmental justice, environmental politics and environmental citizenship. It will touch upon environmental history and the emergence of 'environment' as a concern globally as well as in India. The course will deal with the dynamics around environmental legislation (including legislation related to forests, conservation and climate change), as well as environmental concerns in urban India. It will look at how environmentalism in the global North is substantially different from environmentalism in the global South, by studying their respective demands, agendas, strategies and concerns. This course is essentially intended at understanding environment as a political agenda, the reasons for its emergence and the limitations the environmental movement faces in India and elsewhere.

COURSE TOPICS: (1) Environmental History, Emergence of 'environment' as a discourse (2) Principles of Environmental Justice and Environmental Citizenship (3) Indigeneity and the Environmental Question (4) Environmental Legislation – Land, Air, Water, Forests, Climate Change, Wildlife Conservation (5) Environmental Politics in Urban India

PREFERRED TEXTBOOKS: (1) Archana Prasad (ed.), Environment, Development and Society in Contemporary India: An Introduction (New Delhi: MacMillan India, 2008). (2) Ramachandra Guha and Joan Martinez Alier, Varieties of Environmentalism: Essays North and South (London: Earthscan, 1997).

***REFERENCE BOOKS**:
1.Alpa Shah, In the Shadows of the State: Indigenous Politics, Environmentalism and Insurgency in

Jharkhand, India (New Delhi: Oxford University Press, 2011).
2. Amit Prakash, Jharkhand: Politics of Development and Identity (New Delhi: Orient Longman, 2001).
3. Amita Baviskar, In the Belly of the River: Tribal Conflicts over Development in the Narmada Valley (New Delhi: Oxford University Press, 2004 [reprint, 1995]).
4. Andrew Dobson, Environmental citizenship and pro- environmental behavior (Rapid research and evidence review, The Sustainable Development Research Network, 2010).
5. Anil Agarwal et.al., State of India's Environment: The First Citizens' Report (New Delhi: Centre for Science and Environment, 1982).
6. Anil Agarwal, The Anil Agarwal Reader Volume I (New Delhi: Centre for Science and Environment, 2008).
7. Anil Agarwal, The Anil Agarwal Reader Volume II (New Delhi: Centre for Science and Environment, 2008).
8. Anil Agarwal, The Anil Agarwal Reader Volume III (New Delhi: Centre for Science and Environment, 2008).
9. Archana Prasad, Environmentalism and the Left: Contemporary Debates and Future Agendas in Tribal Areas (New Delhi: Left Word Books, 2004).
10. Darryl D'Monte, Temples or Tombs? Industry Versus Environment Three Controversies (New Delhi: Centre for Science and Environment, 1985).
11. Jairam Ramesh, Indira Gandhi: A Life in Nature (New Delhi: Simon and Schuster, 2017).
12. Joan Martinez-Alier, The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation (New Delhi: Oxford University Press, 2005).
13. John Bellamy Foster, Marx's Ecology: Materialism and Nature (Kharagpur: Cornerstone Publications, 2001).
14. Madhav Gadgil and Ramachandra Guha, This Fissured Land: An Ecological History of India (New Delhi: Oxford University Press, 1992).
15. Mahesh Rangarajan (ed.), Environmental Issues in India: A Reader (New Delhi: Pearson Longman, 2008).
16. Mahesh Rangarajan and K. Sivaramakrishnan (eds.), India's Environmental History: A Reader Volumes 1 and 2 (New Delhi: Permanent Black, 2013).
17. Mukul Sharma, Green and Saffron: Hindu Nationalism and Indian Environmental Politics (New Delhi: Permanent Black, 2012).
18. Raka Ray and Mary Katzenstein (eds.), Social Movements in India: Poverty, Power, and Politics (Lanham, MD: Rowman and Littlefie, 2005).
19. Ram Dayal Munda and S. Bosu Mullick (eds.), The Jharkhand Movement: Indigenous Peoples' Struggle for Autonomy in India (Denmark: International Work Group for Indigenous Affairs, 2003).
20. Ramachandra Guha, Environmentalism: A Global History (New Delhi: Oxford University Press, 2008).
21. Ramachandra Guha (ed.), Social Ecology (New Delhi: Oxford University Press, 1994).
22. Rohan D'Souza, Drowned and Dammed: Colonial Capitalism and Flood control in Eastern India (1803-1946) (New Delhi: Oxford University Press, 2006).
23. Sanjay Sangvi, The river and life – story of the Narmada Bachao Andolan (Kolkata: Earthcare Books, 2002).
24. T.K. Oommen (ed.), Social Movements Part II: Concerns of Equity and Security (New Delhi: Oxford University, 2010).
25. Wolfgang Sachs, Environment and Human Rights (Wuppertal: Wuppertal Institute for Climate, Environment, Energy, 2003).
26. W.M. Adams, Green Development: Environment and sustainability in the Third World (London and New York: Routledge, 2001).

***REFERENCE ARTICLES/DOCUMENTS:**

* ILO Convention 169 concerning Indigenous and Tribal Peoples in Independent Countries.
* ILO, 'Indigenous & Tribal Peoples' Rights in Practice. A guide to ILO Convention No. 169' (2009).
* J. Tarter, 'Some live more downstream than others', in J. Adamson et.al. (eds), The Environmental Justice Reader (Arizona: University of Arizona Press, 2002), 213-228.
* P. Mohai et.al, 'Environmental Justice', Annual Review of Environment and Resources 34 (2009): 405-430.
* 'The Principles of Environmental Justice', First National People of Color Environmental Leadership Summit (1991).

United Nations Declaration on the Rights of Indigenous Peoples. 2008.

***PROJECT**: None.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	
Mid Sem-2 Exam	20%
End Sem Exam	40%
Assignments	
Project	
Term Paper (In Lieu of Mid Sem-1)	2 Assignments (20%)
Other Evaluation (Term Paper and Presentation)	20%

OUTCOME: Students are expected to get an overview of the various debates around environment in India. Through an overview of global and Indian environmental history, an introduction to environmental legislation and environmental politics, they will be asked to think about the contexts in which the 'environmental discourse' operates. Students are expected to critically reflect upon the political construction of 'environment' in India, along with its limitations. REMARKS: The course will be based on lectures and the students will be expected to read books and articles mentioned in the reading list. Students will be expected to write assignments/tutorials in class, on various questions discussed in class. The term paper is expected to be an original work, reflecting on the dynamics of environment in the Indian context.

CS9.313 Eco-Informatics 3-1-0-4

Faculty Name : RC Prasad
TYPE-WHEN : CS Elective for UG and PG - Monsoon
PRE-REQUISITE : **Nil**
OBJECTIVE : Application of computational techniques in understanding , ecological processes

related to resource management, spatial distribution and modeling

COURSE TOPICS:

Ecological Informatics: An Introduction

Ecology: Basic concepts of ecology; Intro on Geographical ecology

Ecological Applications of Qualitative reasoning, fuzzy logic, unsupervised ANN, Genetic Algorithms, Evolutionary computation, adaptive agents to current ecological management issues . – Case studies

Spatial Ecology- Pattern and Processes: Basics of geospatial technology, models and application

Ecological modeling – Theory and Models in ecology, Resource Management, Case studies

Other topics: Biodiversity informatics, Wetland informatics, Agro informatics, Forest informatics.

PREFERRED TEXT BOOKS:

Friedrich Recknagel (2003) Ecological Informatics Understanding Ecology by Biologically-Inspired Computation. ISBN 978-3-662-05152-8 ISBN 978-3-662-05150-4 (eBook) Friedrich Recknagel (2006) Ecological Informatics Scope, Techniques and Applications DOI 10.1007/978-3-662-05150 Wen-Jun Zhang. (2012) Ecological modeling .ISBN 978-1-62417-275-5 (eBook). Published by Nova Science Publishers, Inc. † New York Virginia H. Dale. (2003) Ecological modeling for resource management. ISBN 0-387-95493-7. Springer-Verlag New York Berlin Heidelberg

***PROJECT:** Simulation and modeling of ecological processes, development of open source tools related to ecological applications, replication of case studies.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz	**10**
Mid Sem-1	**20**
End Sem Exam	**30**
Assignments	**15**
Project	**25**

OUTCOME:

Integrating ecology and informatics in understanding and forecasting ecosystem functioning and processes. Comprehend concepts and tools for analysis and synthesis of ecological data .

CE1.607 Earthquake Resistant Design of Masonry Structures 3-1-0-4

TYPE-WHEN: Monsoon Semester

FACULTY NAME: Dr. P. Pravin Kumar Venkat Rao

PRE-REQUISITE: Strength of Materials, Structural Analysis, Structural Design (RC or steel), and preferably Seismic design of Structures

OBJECTIVE: The course aims at elucidating theories on mechanical behaviour of masonry assemblages under different actions and introduces students to working stress and limit state approaches to analysis and design of unreinforced, reinforced, confined masonry structures for gravity and lateral loads, including earthquake loads. The course will also briefly address behaviour of masonry infill walls and procedures for structural assessment and strengthening of existing masonry structures.

COURSE TOPICS:

1. Behaviour of Masonry Structures During Past Earthquakes: Common modes of failure, effect of unit shapes and mortar type, effect of roof and floor systems; Common deficiencies.
2. Material Properties: Masonry units- stones, brick and concrete blocks, hollow and solid units; Manufacturing process; Mortar, grout and reinforcement; Various tests and standards.
3. Masonry Under Compression: Prism strength, Failure mechanism, types of construction and bonds; Eccentric loading; Slenderness – effective length and effective height, effect of openings; Code provisions.
4. Masonry Under Lateral Loads: In-plane and out-of-plane loads, bending parallel and perpendicular to bed joints; Shear and flexure behaviour of piers; Test and standards; Analysis of perforated shear walls, lateral force distribution for flexible and rigid diaphragms; Arching action; Combined axial and bending actions.
5. Earthquake Resistant Measures: Analysis for earthquake forces, role of floor and roof diaphragm; Concept and design of bands, bandages, splints and ties; Reinforced masonry; Vertical reinforcement at corners and jambs; Measures in random-rubble masonry; Confined masonry; Code provisions.
6. Masonry Infills: Effect of masonry infills on seismic behaviour of framed buildings; Failure modes; Simulation of infills – FEM and equivalent strut; Safety of infills in in-plane action – shear, compression and buckling; Out-of-plane action, arching; Code provisions.
7. Retrofitting of Masonry Building: Techniques of repair and retrofitting of masonry buildings; IS: 13935 provision for retrofitting.

REFERENCE BOOKS:

1. Drysdale, R. G., Hamid, A. H. and Baker, L. R., “Masonry Structure: Behaviour and Design”, Prentice Hall, Englewood Cliffs (1994).
2. Schneider, R.R. and Dickey, W. L., “Reinforced Masonry Design”, 3rd Ed, Prentice Hall (1994).
3. Paulay, T. and Priestley, M. J. N., “Seismic Design of Reinforced Concrete and masonry Buildings”, John Wiley & Sons (1995).
4. Amrhein, J. E., “Reinforced Masonry Engineering Handbook,” Masonry Institute of America, CRC Press (1998).
5. Hendry, A. W., “Structural Masonry”, Macmillan Press Ltd. (1998).

6. "Prestandard and Commentry for the Seismic Rehabilitation of Buildings," FEMA 356, Federal Emergency Management Agency, Washington, D.C.9 (2000).
7. Tomazevic, M., "Earthquake Resistant Design of Masonry Buildings", Imperial Colleges Press (2000).
8. Donald Anderson and Svetlana Brzev, "Seismic Design Guide for Masonry Buildings," Canadian Concrete Masonry Producers Association (2009).

GRADING PLAN:

Class Quiz - 40%
Assignments - 30%
Project – 20%
Attendance – 10%

OUTCOME: At the completion of this course, the student shall acquire knowledge, insight into relevant theories and acquainted to principles of earthquake resistant design and construction for various types of masonry structures. They will also be able to do the seismic safety evaluation and suggest the retrofit measures for masonry structures using codal provisions.

CS7.504 Fairness, Privacy and Ethics in AI 3-1-0-4

Faculty Name: Dr. Sujit Prakash Gujar
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:

Course: Statistical Methods in AI,
Knowledge: Machine learning, probability theory, Complexity Theory and Advanced Algorithms

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

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

CO-1 Understand sources of unfairness in AI systems
CO-2 Demonstrate familiarity with different notions of individual fairness as well as group fairness
CO-3 Synthesize algorithms designed to ensure individual fairness such as envy-free ness, proportionality, max-min share etc. and apprehend the complexities involved in ensuring
CO-4 Create algorithms methods to mitigate discrimination based on sensitive attributes such gender/race/age etc. (group fairness) for fairness measures such as disparate impact, equalized odds, accuracy equity, predictive parity etc.
CO-5 Explain the attacks on the machine learning models and databases to interpret the data
CO-6- Apply different techniques using differential privacy to ensure privacy of individuals leading to transparency in the system

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	2	1	3	1	3	1	2	1	2	2	3	1	2
CO2	1	1	1	2	1	1	1	2	1	2	1	3	3	2	1	2
CO3	2	3	3	2	1	1	1	3	2	1	1	3	2	2	1	2
CO4	2	3	3	3	1	1	1	3	3	2	1	3	2	2	3	3
CO5	1	1	2	2	1	1	1	1	1	3	1	2	3	2	1	2
CO6	2	3	3	2	1	1	1	3	2	2	1	3	2	2	2	3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Bias in the data, causality, Individual fairness vs group fairness
Unit 2: Individual fairness: envy free ness, max-min share, proportionality. Algorithms to achieve them such as round robin, cycle elimination, etc.
Unit 3: Impossibility of fair classifier with perfect calibration
Unit 4: Group fairness (equalized odds, disparate impact, accuracy parity, predictive parity). Different preprocessing, post processing techniques and over all approach to build AI to mitigate discrimination
Unit 5: Differential Privacy (DP), Need for newer privacy measures, especially when federated learning is on rise. Possible attacks even data is anonymized
Unit 6: Techniques such as Laplace mechanism, gaussian mechanism, local DP, Bayesian DP

Reference Books:

1. Solon Barocas, Moritz Hardt, Arvind Narayanan, 'FAIRNESS AND MACHINE LEARNING Limitations and Opportunities'.

2. Cynthia Dwork and Aaron Roth, 'The Algorithmic Foundations of Differential Privacy'.

And also, relevant recent papers.

5.Teaching-Learning Strategies in brief: (4 to 5 sentences):

This course is good mix of mathematical foundations of ethical AI and practice. Hence, it will involve lot of discussion in class. The students will be expected to solve problems in the class regularly and will also be tested through surprise quizzes. To enable group based

learning and better exposure, the students will be assigned two programming assignments, reading assignment and use case study. These activities will be in groups. Also students will be asked to scribe the lectures – produce high quality notes for a lecture assigned to the group that can be used by other students.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Type of Evaluation	Weightage (in %)
Mid Sem Exam	15
End Sem Exam	25
Quizzes (Option of Reading Assignment + Viva in lieu of in class quizzes)	15
Programming Assignments (2)	15
Reading Assignment	10
Use Case Development	10
Scribes	5
Course Participation	5

CE4.501 Finite Element Methods 3-1-0-4

1. **Prerequisite:** Calculus, Linear algebra

2. Detailed Syllabus

Unit 1	Galerkin method, Axially loaded bar, Heat conduction in one dimension, Heat conduction with convection transfer.	6 hours
Unit 2	Poisson equation, Triangular element, Rectangular element, Heat conduction in two and three dimensions.	6 hours
Unit 3	Variational functional, Ritz method, Euler-Bernouli beam, Finite element solution of beam	6 hours
Unit 4	Basic equations of elasticity, Torsion problem, Finite element solution of torsion problem, Plane stress	9 hours
Unit 5	Isoparametric elements — one dimensional, two dimensional, triangular; Numerical integration	9 hours
Unit 6	Helmholz equation, Natural frequencies	3 hours
Unit 7	Parabolic equations, Hyperbolic equations	3 hours

References:

J.N. Reddy, An introduction to the finite element method

S.S. Rao, The finite element method in engineering

Y.W. Kwon, The finite element method

3. Teaching-Learning Strategies

Lectures in class room, weekly tutorials on problem solving, active learning by students.

4. Assessment Methods and Weightage

Assignments 20, Quizzes 20, Mid Semester 20, End Semester 40 marks.

MA4.404 Functional Analysis 3-1-0-4

Faculty Name: Lakshmi Burra
TYPE-WHEN :
PRE-REQUISITE : Mathematics 1/11
OBJECTIVE : Functional analysis is the branch of mathematics concerned with the study of spaces of functions. This course is intended to introduce the student to the basic concepts and theorems of functional analysis and its applications.

COURSE TOPICS :

- Introduction to Analysis:
- Some elementary Concepts: Metric Spaces, Open Set, Closed Set, Neighborhood, Convergence, Cauchy Sequence

- Linear spaces and linear bounded operators; Normed linear spaces and inner product spaces

- Banach spaces

- Hilbert spaces

- Adjoint, Normal, Unitary Operators Normal and Unitary operators, Projections.

- Fixed Point Theory: some applications

PREFERRED TEXTBOOKS: E. Kreyszig, *Introductory Functional Analysis with Applications*, John Wiley & Sons, New York, 2001

A Guide to functional Analysis by Steven G Krantz

REFERENCE BOOKS:

1. **Real and Functional Analysis** Author: **Lang**, Serge
2. **A course in Functional Analysis Author Conway J B**

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Project	-	30%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	30%

OUTCOME: To extend basic notions from calculus to metric spaces and normed vector spaces, Function spaces, dual spaces.

REMARKS:

HS8.201 Gender and Society 3-1-0-4

Faculty Name **:** Sushmita Banerjee
TYPE-WHEN **: Monsoon**
PRE-REQUISITE **:** None
OBJECTIVE **:** To introduce students to basic concepts in gender theory and Feminist practice and help students locate themselves using these concepts. Literature and film shall be taught to demonstrate the various ways in which popular culture establishes, represents, perpetuates, and occasionally disrupts gender roles.

COURSE TOPICS :

Unit 1: Core concepts and terms

Differences between terms like Gender, Sex, Normative and Non-normative sexuality, Trans-bodies.

Unit 2: Power, Ideology and Intersectionalities

Concepts of Power, Ideology, Patriarchy, and Privilege. What are intersectionalities, and why is it important to study them when we study gender? Gender and Class – what do we mean by class; how class modifies/intensifies the experience in the workplace, science, education, home Gender and Caste – what do we mean by caste; how class modifies/intensifies the experience in the workplace, science, education, home.

Unit 3: Representation of Gender

A: Who writes women? Short Stories on, about, and by women.
B: Films - Three films. Popular representations of women. How does the popular visual circulation affect gender politics.

PREFERRED TEXTBOOKS:

Adichie, Chimamanda Ngozi (2014). We Should All Be Feminists. Fourth Estate.
Beauvoir, Simone (1997), ""Introduction" to The Second Sex", in Nicholson, Linda, The Second Wave: a Reader in Feminist Theory, New York: Routledge, pp. 11–18.

Menon, Nivedita (2012), *Seeing Like a Feminist.* New Delhi, Penguin.

***REFERENCE BOOKS:**

Bhasin, Kamla (1999), Understanding Gender. India, Kali for Women.

Butler, Judith (1990), Gender Trouble: Feminism and the Subversion of Identity, New York: Routeledge.

Freedman, Estelle B. (ed) The Essential Feminist Reader. New York: Modern Library, 2007.

McCann, Carole R. and Seung-Kyung Kim, eds. Feminist Theory Reader: Local and Global Perspectives. New York: Routledge, 2003.

Mazumdar, V. *Emergence of Women's Question and Role of Women's Studies.* New Delhi: Centre for Women's Development Studies, 1985.

Kumar, Radha (2002), *A History of Doing: Movements for Women's Rights and Feminism inIndia, 1800-1990.* India, Kali For Women.

Tharu, Susie and K. Lalita eds. *Women Writing in India: 600 B.C. to the Present. I and II. Delhi: Oxford University Press, New York: Feminist Press and London: Harper Collins, 1990-1993.*

Uberoi, Patricia (2006) Freedom And Destiny: Gender, Family, And Popular Culture In India. USA: Oxford University Press.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-2 Exam	**20%**
End Sem Exam	**30%**
Assignments	**20%**
Term Paper	**30%**

OUTCOME: Students will have increased familiarity with contemporary issues in genderdiscourse. They will be able to question their prior opinions and think in more informed ways about the nature of gender relations, individual roles, and socio-cultural formations.

REMARKS: Students are expected to read up to 30 pages a week and attend film screeningswhen required.

CE5.502 Hydrological modelling and Software Development 3-1-0-4

Faculty Name: Shaik Rehana.
TYPE-WHEN: Open Engineering Elective-Monsoon
PRE-REQUISITE : Nil
OBJECTIVE: To develop a detailed understanding about water resources systems and various modelling techniques involved to study water quantity, quality and demands. Development and real-world application of various water resources software technologies, information, and decision support systems.

COURSETOPICS :

- **Introduction:** fundamentals of fluid mechanics and open channel flows; hydrology, rainfall and runoff processes and hydro-climatology.
- **Water Resources Systems**: river basin and urban hydrology, river water quality modelling, flood and drought management, irrigation and reservoir operation and climate change.
- **Technologies and Software**: Opensource public domain software based on Microsoft

Windows environment: US Environmental Protection Agency's EPANET, Qual2k, SWMM; Matlab Tools: Air2stream; Windows based decision support system: WEAP

- **Development and Application of Software**: Real-world applications at various scales for water resources management

PREFERRED TEXTBOOKS:

- Subrahmanya, K., 2008, Engineering Hydrology, Tata Mc Graw Hill Pub. Co., New Delhi.
- Chow, V. T., Maidment and Mays, L. A., 2010, Applied Hydrology, Tata Mc Graw Hill Pub. Co., NewYork.
- Haan T. C., *Statistical Methods in Hydrology*, East West Publishers,1998.
- SK Som and G Biswas, Introduction to Fluid Mechanics and FluidMachines

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 and 2 Exams	**30**
End Sem Exam	**30**
Assignments	**15**
Project/Assignments	**25**

OUTCOME:

Integrating wind induced responses in the design of various structures such as tunnels, tall buildings etc.

CS9.426 Intro to Cognitive Science 3-1-0-4

Faculty Name: Vishnu Sreekumar + Priyanka Srivastava
Note: Please use course code for previously existing course
TYPE-WHEN: Monsoon Semester (Aug-Dec)

PRE-REQUISITE: None (Open mind, Enthusiasm and Motivation!)

OBJECTIVE: The focus of this course is to understand the relationship between mind and behavior or brain and behavior. The objective is to give an appreciation for various Cognitive and Emotional processes that brain/mind sub -serves, what is known currently about these, the experimental methods used in unraveling these processes and finally some Philosophical and theoretical issues related to Mind and Consciousness. This is the first course in Cognitive Science that prepares the ground for students so that they can take other courses that focus on Computational / Mathematical Models, more detailed issues related to Cognitive Neuroscience, applications in Human-Computer Interaction, Neuroimaging

Methods, etc. Apart from understanding the principles of Cognitive Science, the course requires students to actually conduct experiments on human subjects to study any one of the topics covered in the class as part of the Project.

COURSE TOPICS: Introduction, History of Cognitive Science, Basics of Human Brain Anatomy, Learning and Development, Movement and Action, Vision and Attention, Auditory processes, Memory, Reasoning and Decision Making, Emotion, Language and Speech, Cognitive Disorders, Basic issues in Philosophy of Mind and Consciousness.

PREFERRED TEXTBOOKS: (PDF copies of material from the following will be made available for reading) Berm¾ez, J. L. (2010). Cognitive Science: An Introduction to the Science of the Mind, Cambridge University Press. Friedenberg, J. and Silverman. G. W. (2006). Cognitive Science: An Introduction to the Study of Mind, Sage Publications (First Edition) Kandel, E.R., Schwartz, J. H., Jessell,

T. M., Siegelbaum, S. A., Hudspeth, A. J. (2012). Principles of Neural Science, (Fifth Edition), McGraw Hill.

***REFERENCE BOOKS:** Bechtel, W., & Graham, G. (Eds.). (1998). A Companion to Cognitive Science. Malden, MA: Blackwell. Gazzaniga, M., Ivry, R. B., & Mangun, G. R. (2002). Cognitive neuroscience: the biology of the mind. Cambridge: MIT press. Thagard, P. (2005). Mind: Introduction to Cognitive Scienc e, Cambridge, MA: MIT Press. Marr, D. C. (1982). Vision: A Computational Investigation into the Human Representation and Processing of Visual Information. San Francisco: W. H. Freeman. Searle, John R. (2005). Mind: A Brief Introduction (Fundamentals of Philosophy Series), Oxford University Press.

***PROJECT:** Students will be assigned projects where small groups have to take up one topic from the course topics. The group will design and conduct experiments on human subjects and then process /analyze and inter pret the data collected from the experiments. Performance assessment will be based on Group presentation, Viva and a Final report submission.

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Project	-	30%
Term Paper	-	25%
Quiz	-	20%
Any other	-	5%

OUTCOME: At the end of the course, students will have an appreciation of the principles of Cognitive Science and theoretical issues related to Mind and Consciousness. It is expected that students would acquire both the knowledge of the state-of-the-art in Cognitive Science and also practical experience and

appreciation of how empirical studies are conducted to investigate human behavior.

REMARKS:

HS2.202 Intro to Psychology 3-1-0-4

Faculty Name: Vishnu Sreekumar + Priyanka Srivastava
Type when: Monsoon 2021
Pre-requisite: None Course Topics:
Objective: The aim of the course is to introduce various research -driven topics in psychological science. This course will help you understand how we perceive, think, feel and act, both as an individual as well as a social-cultural being. Emphasizing the role of critical thinking, empirical investigation and research design in psychology, this course will specifically highlight how psychological phenomena and processes are scientifically investigated.

Topics:

1. Introduction to Psychology
2. The Matter of the Mind
3. Evolutionary Psychology
4. Human Development
5. Sensation, Perception, Attention, and Awareness
6. Consciousness
7. Learning
8. Memory
9. The Social Mind
10. Motivation and Emotion
11. Stress, Coping, and Health

Books:

1. **Psychology: from Inquiry to Understanding, 3ed. 2014., by Lilienfeld, Lynn, Namy, & Woolf.**

Teaching approach: The course will be lecture cum seminar course. Students will be introduced to undergraduate-level introductory topics and issues in psychology. Relevant lecture videos and reading material will be provided before each topic.

In this course, we'll use online lectures from active scientists in the field of Psychological Sciences from MIT and University of Toronto. I have planned to follow MIT and C oursera, Introduction to Psychology Course for lectures, followed by twice a week active discussions in our scheduled classes. Mostly the lectures will be considered from Coursera videos on Introduction to Psychology by Prof. Joordens, except topic 10 and 11, which will be covered from MIT opencourseware (OCW) by Prof. Gabrielli.

To ensure the participation of each student, each student will be given a chance to briefly talk about the topic based on the assigned readings. Each student will be required to d o at least one presentation.

Assignments: This exercise will consist oftwo brief write-ups (about 1000-1500 words) about psychological phenomena that will be assigned to them based on our everyday experiences. For instance, some of the questions will be as following:

1. How media affect the way we think? 2. Do we freely choose our actions or are they determined beforehand by factors beyond our awareness and control? 3. How our brain sculpted? 4. How do we develop an attitude about people, things, and events? 5. How your behavior get shaped? 6. Are there laws of perception?

The purpose of the assignment is to evaluate the conceptual mapping of the everyday phenomenon to psychological investigation and scope of generalization. This exercise will involve critically review of peer-reviewed journal articles and/or book chapters and state their position in reference to the topic assigned to them. General feedback will be given to students after evaluation.

Project: In this exercise students will be required to conduct an empirical study to understand the psychological phenomena or processes by employing the research methods used in psychological sciences. Students will be encouraged to replicate the classic psychological studies and get mesmerized with similar / contradictory findings.

Course Assessment Plan (Monsoon 2021)

Assignments	-	25%
Project	-	30%
Term Paper	-	25%
Quiz	-	20%

Outcome: By the end of the course students will be able to:

1. understand the research issues in Psychological Science
2. conduct an empirical investigation, by employing experimental or non -experimental approach and result interpretation

Remarks:

Maximum number: 35-40 students

Online Courses Link – massive open online courses

1. Coursera – Prof. Steve Joordens, Univesity of Toronto, Ontorio, Canada (https://class.coursera.org/intropsych -001)
2. CMU – Open Learning Initiative – Prof. … with Norma Bier director of OLI group.

3. Yale University – Prof. Paul Bloom , Lectures available on Youtube. (https://www.youtube.com/playlist?list=PL6A08EB4EEFF3E91F&feature=plcp)
4. MIT – Prof. John Gabrieli (http://ocw.mit.edu/courses/brain -and-cognitive-sciences/9- 00sc-introduction-to-psychology-fall-2011/index.htm)
5. edX – Dr. Janeen Graham (https://courses.edx.org/courses/course -v1:SMES+PSYCH101x+2T2015/courseware/f3763236185c4c41ac182ad823e70b64/5e6428fae8ed446ba4ca1f07f80bc9c1/)

HS3.201 Introduction to History 3-1-0-4

Faculty Name: Aniket Alam
TYPE-WHEN: Humanities Elective, Monsoon 2021
PRE-REQUISITE:

ObJective: This course intends to introduce the non -historian student to the discipline of history and equip him/her with some ideas of how to look at the contemporary world with a historical perspective.

COURSE TOPICS:(1) Development of the ideas of memory, past and his tory;
(2) Conception of time;
(3) Making of the modern discipline of history;
(4) The main theories of history;
(5) The main methods of history.

PREFERRED TEXTBOOKS: E. H. Carr: *What is History*.
Marc Bloch, *The Historian's Craft* .

***REFERENCE BOOKS:** Romila Thapar, *Time as a Metaphor of History: Early India*.
Bernard S. Cohen, "History and Anthropology: The State of Play". Chapter in *An Anthropologist among the Historians and Other Essays* .

Ranajit Guha, "On Some Aspects of the Historiography of Colonial India". Chapter one in *Subaltern Studies* Vol1.
Mircea Eliade, *The Myth of the Eternal Return: Cosmos and History* .
***PROJECT:** Written analysis of either one film or novel or a contemporary news event using historical methods.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**20%**
Mid Sem-2 Exam	**20%**

End Sem Exam	**40%**
Assignments	
Project	**20%**
Term Paper	
OtherEvaluation_____	

OUTCOME: The student will be able to identify the main theories and methods of the discipline of history. S/he will also be use some of these to understand and explain contemporary events.

REMARKS: The course will be divided into two parts. Part One will consist of lectures and readings which will introduce the students to the readings and also give information about the main theories and theoreticians of history. The readings will total about 250 printed pages. Part Two will consist of class discussions and group presentations, based on analysing films, novels and contemporary new reports using ideas and methods learnt in part one.

CS9.427 Introduction to Neural and Cognitive Modeling 3-1-0-4

Faculty Name: Bapi Raju S
TYPE-WHEN: Monsoon semester
FACULTY NAME: Dr. S. Bapi Raju

PRE-REQUISITE:
Interest in Neuroscience and Cognitive Science, Basic background in Calculus, Probability and Statistics, Linear Algebra, Ordinary Differential Equations and aptitude for programming.

OBJECTIVE:

This is an introductory course on computational models used in Neuroscience and Cognitive Science. The emphasis is on multiple scales (three levels) of modeling – Single Neuron-level, Network-level and Abstract (Connectionist) models. The course emphasizes the need for and role of theory and computation in Neuroscience and Cognitive Science.

COURSE TOPICS:

Part I: Introduction to Neuroscience; Compartmental models of neuron; Spiking Neuron models. Part II: Neural population codes; information representation; neural encoding and decoding; hierarchy and organization of sensory systems; Spiking Network models of sensory systems; Neuroplasticity and learning. Part III: Introduction to Hebbian, Competitive and Error-driven learning rules; Neural Network models of Perception, Attention, Memory, Language and Executive Function.

PREFERRED TEXTBOOKS:

REFERENCE BOOKS:

1) R. O'Reilly & Y. Munakata (2000). Computational Explorations in Cognitive Neuroscience: Understanding the Mind by Simulating the Brain. MIT Press.
2) J. M. Bower and D. Beeman (2003). The Book of GENESIS: Exploring Realistic Neural Models with the GEneral NEural SImulation System, Internet Edition.
3) Peter Dayan and L. F. Abbott (2005). Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems. MIT press.
4) Thomas Trappenberg (2009). Fundamentals of Computational Neuroscience. 2nd edition, OUPOxford.
5) Daniel S. Levine (2018). Introduction to Neural and Cognitive Modeling: 3rd Edition, Routledge, USA.
6) V. Srinivasa Chakravarthy (2019). Demystifying the Brain: A Computational Approach. 1st Edition, Springer, Singapore.
PROJECT: (see below)

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	30%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	20%

OUTCOME:

At the end of the course, students will have an appreciation of models used in Neuroscience at multiple levels of resolution and would acquire familiarity with programming environments that implement them. Although the course stands independently by itself, it adds computational perspective to courses such as Introduction to Cognitive Science and Introduction to Cognitive Neuroscience.

REMARKS:

HS2.201 Introduction to Sociology 3-1-0-4

Faculty Name : Radhika Krishnan
TYPE-WHEN : Monsoon 2021
FACULTY NAME : Radhika Krishnan
PRE-REQUISITE : **UG 3, UG4**

OBJECTIVE: This course aims to introduce students to basic concepts and theories in the field of sociology, while briefly discussing various sociological methods. It will introduce students to sociological approaches to various social institutions such as caste, class, tribe, family, religion and gender. It will also touch upon sociological approaches to politics, urbanisation, industrialisation, development and ecology.

COURSE TOPICS:

(1) Sociological concepts
(2) Sociological methods
(3) Study of social institutions in India
(4) Sociology of Politics, urbanisation, industrialisation and development

PREFERRED TEXT BOOKS:

Anthony Giddens, *Sociology* (Malden: Polity Press, 2009).

***REFERENCE BOOKS:**

Alpa Shah, *In the Shadows of the State: Indigenous Politics, Environmentalism, and Insurgency in Jharkhand, India* (Durham, NC: Duke University Press, 2010).
Carol Upadhyay, *Reengineering India: Work, capital, and class in an offshore economy* (Delhi: Oxford University Press, 2016).
Friedrich Engels, *The origin of the family, private property and the State* (New Delhi: Penguin, 2010).
Gail Omvedt, *Dalit Visions: the Anticaste movement and Indian Cultural Identity* (New Delhi: Orient Blackswan, 2006).
Indu Banga (ed.), *City in Indian history* (New Delhi: Manohar, 1991).
M.N. Srinivas, *Social Change in Modern India* (New Delhi: Orient Longman, 1985).
Nivedita Menon (ed.), *Gender and Politics in India* (New Delhi: Oxford University Press: 2001).
Ramachandra Guha (ed.), *Social Ecology* (New Delhi: Oxford University Press, 1994).
Shilpa Phadke et. al., *Why Loiter: Women and Risk on Mumbai Streets* (New Delhi: Penguin, 2011).
Uma Ramaswamy, *Work, Union and Community: Industrial man in South India* (Delhi: Oxford University Press, 1983).

***REFERENCE ARTICLES:**

Will be shared with students during the course of the semester. Each module in this course will have a reference reading list which can be used by students.

***PROJECT:** None.

Course Assessment Plan (Monsoon 2021)

Assignments	-	50%
Term Paper	-	30%
Quiz	-	20%

OUTCOME: The student will get an overview of theories, concepts and methods in Sociology. The lectures, discussions, readings and projects will enable the student to relate to contemporary debates and to engage with the complexity of contemporary Indian society. Apart from understanding various social institutions in India, s/he will grapple with modern sociological concerns related to gender, the urban space, industrialization and the ecological contradictions of development.

REMARKS: The course will be based on lectures and the students will be expected to read the

material mentioned in the reading list.

CE1.605 IS Codes on Design and Structural Safety Assessment 3-1-0-4

Faculty Name **:** Pradeep Kumar R

TYPE-WHEN **:** Monsoon

PRE-REQUISITE: Reinforced Concrete Design,Strl Analysis, EQE

OBJECTIVE: To understand and interpret the codes and use them in design

COURSE TOPICS: IS 16700-2017: Criteria for Structural Safety of Tall Concrete Buildings (8 classes)

a. General requirements
b. Loads and load combinations
c. Structural analysis of tall buildings
d. Structural design of tall buildings
e. Foundations for tall buildings
f. Non-structural elements in tall buildings
g. Recommendations for monitoring deformations in tall buildings

2. IS 1893-2016: Criteria for Earthquake Resistant Design of Structures (6 classes)
   a. General principles
   b. Design criteria
   c. Design of buildings
   d. Regular & Irregular buildings
3. IS 13920-2016: Ductile Design & Detailing of RC structures subjected to seismic forces – Code of Practice (5 classes)
   a. General specifications
   b. Beams, Columns & Inclined members
   c. Special Confinement reinforcement
   d. Beam-column joint
   e. Special shear walls
   f. Gravity columns in buildings
4. IS15988-2013: Seismic evaluation & strengthening of existing RC Buildings - Guidelines (5 classes)
   a. Preliminary evaluation
   b. Detailed evaluation
   c. Seismic strengthening

BOOKS:

- IS 16700-2017: Criteria for Structural Safety of Tall Concrete Buildings
- IS 1893-2016: Criteria for Earthquake Resistant Design of Structures
- IS 13920-2016: Ductile Design & Detailing of RC structures subjected to seismic forces – Code of Practice
- IS 456-2000 Plain and Reinforced Concrete - Code of Practice

- IS15988-2013: Seismic evaluation & strengthening of existing RC Buildings -Guidelines

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	20%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	30%

OUTCOME:

- Student will be confident in interpretation the current version and all future versions of the above codes.

REMARKS: None

CS7.503 Mobile Robotics 3-1-0-4

Faculty: Madhava Krishna
TYPE-WHEN: Elective-Monsoon
OBJECTIVE:

The course introduces the student to fair detail on the basic modules for automating a mobile robot such as state estimation, visual odometry and mapping, planning, and collision avoidance. The course draws upon state of the art practices in probability and statistical methods, optimization techniques and shows how they are dovetailed to a robotics setting. The course has a strong coding component in the form of assignments wherein the student is expected to simulate and implement the algorithms taught in class.

COURSE TOPICS:

Vision: Rigid body transformations, Projective geometry, Camera modelling, Camera calibration, Two - view geometry, Stereo, Triangulation, Resection, Visual odometry, Bundle adjustment

State estimation: Bayesian filters - Kalman filter, Extended Kalman filter, Localization and Mapping using EKF

Path planning: AI-style planning, Kinematics, Randomized planning, Trajectory optimization, Collision avoidance in dynamic environments

REFERENCE BOOKS:

Hartley, R., & Zisserman, A. (2003). Multiple view geometry in computer vision. Cambridge

university press.

Thrun, S., Burgard, W., & Fox, D. (2005). Probabilistic robotics. MIT press.

***PROJECT:** 3 projects

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	40%
Quiz	-	5%
Open Book Exam/ 30 Min Quiz	-	25%

OUTCOME: The student is expected to be aware of stat e of the art mobile robotic algorithms and should feel comfortable reading and assimilating state of the art research papers in areas covered in the course/class.

REMARKS:

CS1.405 Modern Complexity Theory 3-1-0-4

Faculty: Girish Varma + Nitin Saurabh
Note: Please use course code for previously existing course
TYPE-WHEN :
PRE-REQUISITE: Discrete Maths, Algorithms
OBJECTIVE : To understand different models of computation and their limits. To be able to classify computational problems according to their difficulty.

COURSE TOPICS:
(please list the order in which they will be covered)

1. Intro and Proofs: Structure of Proofs, Logical Quantifiers, Countable & Uncountable Infinities, Cantor's Theorem, Some basic algorithms (eg. Karatsuba's Multiplication, Euclid's GCD) and proof of correctness and complexity. Axiomatic Definitions and Impossibility Results.

2. Circuits: Representations of Numbers and Objects in Binary, Prefix free Encodings, Circuit Computation Model, Encoding Circuits in Binary, Counting Circuits and Size Hierarchy Theorems. Proof of all function can be computed by Circuits. Universality of NAND.

3. Turing Machines: Non-Uniform vs Uniform Computation. TM Definition and Examples, Robustness of TM models, Universal TMs, Halting Problem and Computability. Turing Completeness and Church-Turing Hypothesis, Time, and Space Hierarchy for TMs.

4. NP Hardness: Decision vs Search Problems, Definitions of P, NP, CoNP in terms of Proof Verification, Reductions, NP Hardness, NP Completeness. Cook-Levin Theorem.

5. Randomized Computation: Recall Tail Bounds (Markov, Chebyshev, Chernoff), Definitions of RP, CoRP, BPP, Amplification Lemma, PIT, Schwartz Zippel Lemma and Applications. Adelman's Theorem. Average Case Model & Yao's Min-Max Principle.

6. Computational Learning Theory: Sample Complexity and PAC Learning Model, Lowerbounds in Sample Complexity, Agnostic Learning, Hardness of Learning.

7. Quantum Computation: Qubits, Unitary Operations, Quantum Measurements, Entangled states, Quantum Circuits, BQP Complexity Class, Simon's Algorithm, Shor's Factoring.

Some other possible topics:

• Communication Complexity

• Complexity of Counting

• Computational Game Theory

• Interactive Computation

• Probabilistically Checkable Proofs

PREFERRED TEXT BOOKS:

Introduction to the Theory of Computation by Michael Sipser

Introduction to Theoretical Computer Science by Boaz Barak.
https://introtcs.org/public/index.html

***REFERENCE BOOKS:**

Computational Complexity: A Modern Approach by Boaz Barak, Sanjeev Arora

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Project	-	20%
Quiz	-	30%
Open Book Exam/ 30 Min Quiz	-	30%

OUTCOME:

REMARKS:

SC2.315 Molecular symmetry and quantum mechanics 3-1-0-4

FACULTY NAME: Harjinder Singh
TYPE-WHEN: Science/Open Elective; Monsoon 2020-21
PRE-REQUISITE: Elementary linear algebra (vectors, matrices)
OBJECTIVE: Imparting knowledge of application of group theory in molecular physics
COURSE TOPICS: (1L: 90 mins)

1. Symmetry of objects, point groups, calculus of symmetry, reduced and irreducible representations, Great and Little orthogonality theorems (6L)
2. Group Theory and Quantum Mechanics, LCAO-SALC approach in MO theory, applications. (7L)
3. Special topics: Applications to Ligand field theory, Pericyclic reactions, Normal mode analysis of vibrational motion, etc. (9L)
4. Continuous (Lie) groups and applications (2L)

PREFERRED TEXTBOOKS:

1. F A Cotton, Chemical Applications of Group Theory, Wiley.
2. M. Tinkham, Group Theory and Quantum Mechanics, Dover.

*REFERENCE BOOKS: (1) 10 copies; (2) 4 copies

Course Assessment Plan (Monsoon 2021)

Assignments	-	25%
Quiz	-	30%
Open Book Exam/ 30 Min Quiz	-	45%

SC1.310 Open Quantum Systems and Quantum Thermodynamics 3-1-0-4

FACULTY NAME : Samyadeb Bhattacharya, CSTAR.
Note: Please use course code for previously existing course
TYPE-WHEN : Monsoon
PRE-REQUISITE : 1. Basic Linear algebra 2. Basic introduction to Quantum Mechanics
OBJECTIVE : Preparing a student in basic quantum information science tools and exposure to current research trends.

COURSE TOPICS :
(please list the order in which they will be covered)

1. Introduction to Quantum mechanics and linear algebra
2. Quantum states, density matrices and Von Neumann algebra.
3. Quantum Dynamics: from unitary operations to completely positive trace preserving maps.
4. Operator sum representation and introduction to basic quantum channels.
5. Quantum dynamical equations: from Schrödinger equation to quantum master equations.
6. Entropy production and laws of thermodynamics.
7. Application: Introduction to quantum heat engines.

PREFERRED TEXT BOOKS:1.John Preskill lecture notes, 2. Theory of open quantum systems by H P Breuer & F Petruccione.

***REFERENCE BOOKS:** Lecture notes in open quantum systems by Alicki & Lendi
***PROJECT:** Construction of basic quantum heat engines and other devices.

OUTCOME: Preliminary exposure of the students to research in quantum devices and thermodynamics.

Course Assessment Plan (Monsoon 2021)

Assignments	-	10%
Project	-	30%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	40%

REMARKS: As quantum information science is currently one of the most growing research areas in the world, a primary course on one of the aspects of such research trends can be very handful to students of an institution having serious impetus on current research.

CS1.402 Principles of Programming Languages 3-1-0-4

Faculty Name: Amey Karkare

TYPE-WHEN: Monsson-2021

PRE-REQUISITE : Programming in any programming language.

OBJECTIVE: This course is an introduction to the principles behind the design and interpretation of programming languages. Understanding the abstraction mechanisms in the language and their implementation is key to successfully using the language, i.e., doing programming and understand the behavior of the program. One way is to understand that programs are translated (compiled) into another, lower-level language, which is executed by hardware. Another way to think of programs and programming languages is that they are mathematical objects. Programming languages draw their foundations from mathematical logic, universal algebra and the theory of computation.

In this course, we take an interesting approach. We build a series of *interpreters*, each a virtual machine for a mini language with specific features. This approach draws from the denotational and the operational formalisms but couches them in the notation of a programming language, viz., **Scheme**. The bulk of the course will therefore be driven by studying and constructing *definitional interpreters* in Scheme. Using this approach we study standard features of procedural languages like abstract syntax, lexical scoping, stack architectures, parameter passing, environments and store, and also more advanced features like computational effects, continuations, exceptions, and imperative form transformation.

COURSE TOPICS:

(Please list the order in which they will be covered)
The role of Programming languages, Syntactic structure – grammars. Imperative Programming. Values, types and expressions. Semantic methods. Inductive datatypes and recursive programming, Functional programming – list manipulation, high order functions and currying. Data abstraction and Abstract Data Types. Arithmetic and Algebraic interpreters. Block structure and lexical environments. Scope and binding.

Procedures and closures. Recursion. Implementing recursion. Dynamic scope. Stores. Computational effects. Explicit and implicit references. Implementing mutation. Expressible and denotable values. Parameter passing – Call by Value, Call by Reference, Call by Name. Lazy evaluation. Introduction to Lambda Calculus.

Tail recursion. Iterative systems. Continuation-passing style (CPS). Converting to CPS. Continuation-passing interpreters. Trampolining. Debugging - Single Stepping and breakpoints. Making control context explicit, Imperative form. Modeling exceptions and threads.

Other Programming Paradigms like logic and object-oriented programming. Comparative study of languages.

PREFERRED TEXTBOOKS:
Essentials of Programming Languages (EoPL) by Friedman and Wand. Prentice Hall India.

***REFERENCE BOOKS:**

Programming Languages –Concepts and Constructs by Ravi Sethi

Simply Scheme: Introducing Computer Science by Brian Harvey and Matthew Wright.

***PROJECT:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**20**
Mid Sem-2 Exam	**20**
End Sem Exam	**30**
Assignments	**30**
Project	
Term Paper	
OtherEvaluation_____	

OUTCOME:

PoPL is useful because it encourages the student to think about software artefacts as virtual machines, with a well-defined interface (a programming language) and an internal structure consisting of symbolic structures operating according to well-defined rules. With a background in the Principles of Programming Languages, one starts thinking about the quality of a software artefact by relating it to the properties of the virtual machine that is implicitly defined underneath it.

More concretely, a student graduating from a PoPL course should be able to perform each of the following sample tasks:

- Identify and understand the abstract syntax aof any programming language like C or Java
- Design small, domain specific languages from scratch and implement them either as interpreters or embeddings in another language.
- Analyse and critique the design of programming languages like C, C++ orPython.
- Specify the structure of a software application like a spreadsheet or a word processor in terms of its interface as a language of user operations and its internal structure as a virtual machine.

REMARKS:

EC5.509 Radar Systems 3-1-0-4

Faculty Name: K R Sarma

COURSE CONTENT

- Introduction to Radar, History of Radar, Measurement of range and velocity, Unambiguous range, Range resolution, Velocity resolution and their dependence on radar signal Description of radar system and its subsystems
- Radar range equation and its dependence on systems parameters,
- Radar Signal Design, Need for large Time Bandwidth product, Uncertainty principle. Woodward's Ambiguity function of radar signal, its properties and importance Some optimum radar signals – pulse train, chirp PN sequence, Barker, Frank, their ambiguity functions
- Target characterization Radar cross-section, computation of RCS, Measurement of RCS, Radar Target Models – fluctuating targets – slowly fluctuating targets , delay and Doppler spread targets, Swirling Models
- Noise and Clutter, their characterization as random processes.
- Radar detection and estimation Theory- Simple binary detection optimum receiver Matched filter, Probability of detection and false alarm. Neyman Pearson criterion. Coherent detection vs non-coherent detection. Optimum non-coherent detector-I0 detector Multiple observations- coherent and non-coherent integration
- PD and PF for Swelling Models for coherent and Non-coherent integration
- Optimum receiver for delay and Doppler estimation- matched filter
- Range Doppler signal processing

- Target position estimation, beam scanning, Monopulse,
- Target tracking: Moving target indicator, αβ trackers Kalman filter
- Phased Array Radar description and bean formation and steering techniques
- Synthetic Array Radar – Principle of SAR. Azimuth resolution inside looking SAR. Signal processing of SAR, Radar imaging. Other variants of SAR- polarimetric SAR, Interferometric SAR
- Radar System Components- Antennas – characterization, types of antennas used in radar, array antennas and aperture antennas and reflector antennas Phased arrays and electronic beam forming and scanning, multimode radar
- Low noise receivers-low noise amplifiers; mixers- resistive and parametric Manley Rowe Relationships, Noise in mixers
- Microwave High Power sources for Radar: Klystron Magnetron and TWT principles of their operation
- Diverse applications of Radar techniques-

PREREQUISITE: Signals and Systems, Stochastic Processes, Electromagnetic Theory and Applications

TEXT BOOKS:

1. Mark A.Richards: Principles of Modern Radar V 1 Scietech Publishing 2010 *International Edition available*
2. Mark A Richards: Radar Signal Processing Mc Graw Hill Second Edn 2014 *International Edition available*

***REFERENCE BOOKS**

1. Skolnik - Introduction to Radar Systems 3e IE (McGraw, 1981)
2. Mahafza: Radar System Analysis and Design Chapman & Hall 2e
3. Peebles: Radar Priciples Wiley Interscience
4. Levanov, Mozeson: Radar Signals IEEE- John Wiley
5. Van Trees: Detection Estimation and Modulation Vol I , III John Wiley

Many more excellent books are written by peers in the radar field like the 28 volume series of Radiation Laboratories, Reintje and Coate, Nathanson, Barton, Hovanessian, Eli Brockner, Kock, DiFranco and Rubin, Rihaczek, Kahrilas, Pillai

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Term Paper	-	20%
Any other	-	20%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	20%

REMARKS: Sonar, Weather Radar**,** AWACS, MIMO Radar, Over-the-Horizon Radar, Radar Astronomy, Remote sensing, SECURITY, Medical, GPR will be addressed through term papers.

CS3.502 Real-Time Systems 3-1-0-4

Faculty Name: Deepak Gangadhran
Note: Please use course code for previously existing course
TYPE-WHEN : Monsoon term
PRE-REQUISITE : Computer Systems Organization, Basic Operating Systems, Algorithms and Complexity Analysis (desirable but not necessary)

OBJECTIVE :
Learning Outcomes-

1) Understanding Real-Time System concepts
2) Insight into the various models of real-time tasks in a system.
3) In depth understanding of the various Real-Time Scheduling and Schedulability Analysis Techniques (both unicore and multicore)
4) Handling shared resources
5) Ability to implement real-time tasks and scheduling algorithms
6) Ability to use Real-Time Operating Systems (will have exercises with one RTOS)

COURSE TOPICS :
(please list the order in which they will be covered)
Real-Time Systems – Introduction and Concepts, Modeling Real-Time Systems

Commonly used approaches to Real-Time Scheduling – Clock Driven approach, Weighted Round Robin approach, Priority Driven Approach, Dynamic vs Static Systems, Offline vs Online Scheduling, Preemptive vs Non-Preemptive

Clock Driven Scheduling – Scheduling Aperiodic and Sporadic Jobs, Schedulability test

Priority Driven Scheduling – Static Priority: Rate Monotonic and Deadline Monotonic Algorithms, Dynamic Priority: EDF Algorithm, Schedulability tests

Scheduling Aperiodic and Sporadic jobs in Priority Driven Systems – Deferrable Server, Sporadic Server, Constant Utilization Server, Total Bandwidth Server and Weighted Fair Queuing Server

Multiprocessor Scheduling

Resources and Resource Access Control

PREFERRED TEXT BOOKS:

1) Jane W S Liu, Real-Time Systems, Pearson Education
2) Giorgio C Buttazo, Hard Real-Time Computing Systems: Predictable Scheduling Algorithms and Applications, 3rd edition, Springer

***REFERENCE BOOKS:**
C.M. Krishna & Kang G. Shin , Real Time Systems, McGraw Hill

***PROJECT:**

Each student will have to complete a course project. The project can fall into any of the following two categories
i) defining a research problem in the real-time systems area, implementing the solution and demonstrating results
ii) implementing a solution proposed in a research paper and perform comprehensive analysis demonstrating the advantages/issues with the proposed solution.
Students may work in groups of 2, based on the total number of students registered for the course and the amount of work that is proposed.

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Project	-	30%
Any other	-	20%
Quiz	-	10%
Open Book Exam/ 30 Min Quiz	-	20%

OUTCOME:
Students will be able to design and develop real-time systems. They will also be able to analyze various scheduling approaches and their associated complexities. Finally, the students will have sufficient expertise implementing a scheduler in a RTOS.

REMARKS:

CS8.501 Research in Information Security 3-0-1-4

Faculty Name: Ashok Kumar Das
Type When: Monsoon 2021

PRE-REQUISITE: programming languages (C/C++, Python), operating systems, compilers, introduction to security.

OBJECTIVE: This course is intended to introduce students the exciting world of information security research. The main focus of this course would be on non-cryptographic security research i.e. topics related to software vulnerabilities, malware, intrusion detection/prevention systems. The renowned Cryptographer Dr. Bruce Schneier once said that "security is a chain and is as strong as its weakest link. Cryptography is already a string l ink, problem lies somewhere else- in networks and software …."

Following the aforementioned suggestion, the course is designed to introduce software security issues and state-of-the-art in techniques to address those issues. At the end of the course, the students should:

1. understand the various issues in software security.

2. understand the techniques that are applied in order to address security issues.

3. understand the majority of the attacks that hamper the security of the networks, e.g. bug exploitation (aka hacking);

4. learn basics of malware analysis and defensive techniques.

5. learn basics of program analysis (static and dynamic program analysis) that are applied to analyze software for vulnerability detection.

6. get familiar with the state -of-the-art in security research to lay foundation for their advance research.

COURSE TOPICS:

Syllabus

* Elliptic-Curve Cryptography (ECC)
* Key management in hierarchical access control
* Lightweight Security Protocols for Wearable Devices
* Security protocols for Implantable Medical Devices
* Key management in wireless sensor networks
* User authentication in wireless sensor networks
* User access control in wireless sensor networks
* Access control in wireless sensor networks and wireless body area sensor networks
* Proxy signature
* Password-based remote user authentication and key agreement using smart cards
* Biometric-based remote user authentication and key agreement using smart cards
* Security in vehicular ad hoc networks
* Security in smart grid
* Security in cloud computing
* Intrusion detection in wireless network security

PREFERRED TEXTBOOKS:

The course is mainly based on research articles and notes given by the instructor.

***REFERENCE BOOKS:**

= Any compiler book for dataflow analysis

= Assembly book for x86

= Practical malware analysis, by Sikorski and Honig

***PROJECT**: Student can choose some topic that can be extended to major project for the master's degree or advance research. However, if student choose to work on the project during the course, they can do. So, this is optional.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	30%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	20%

OUTCOME: The students will be well aware of state-of-the-art in non-cryptographic security issues and their proposed solutions. The student will also get to know about the opportunities that exist in the research space. Some of the topics are very practical from i ndustry point of view, especially when it comes to proactive approach to security i.e. security during development process.

REMARKS: The course is highly flexible in its contents and approach. Based on the student's participation and interest, the course may progress in a particular direction.

EC4.401 Robotics: Dynamics and Control 3-1-0-4

Faculty Name: Nagamanikandan Govindan + Spandan Roy
Note: Please use course code for previously existing course

TYPE-WHEN:
PRE-REQUISITE : Basic mechanics (+2 Physics), Linear Algebra
OBJECTIVE :

1. To develop the student's knowledge in various robot structures and their workspace.
2. To develop student's skills in performing spatial transformations associated with rigid body motions.
3. To develop student's skills in perform kinematics analysis of robot systems.
4. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
5. To provide the student with some knowledge and analysis skills associated with trajectory planning.
6. To provide the student with some knowledge and skills associated with robot control.
7. To provide the student with some knowledge associated with quadrator.

COURSE TOPICS:

1) Rotation & Translation Kinematics

2) Homogeneous Transformation, Forward and Inverse Kinematics
3) Jacobian
4) Dynamics
5) Inverse Dynamics Control for Robots
6) Lyapunov Stability Theory
7) Robust Control Design for Robots
8) Quadrotor dynamics
9) Linear control system design
10) Controller design for Quadrotor

PREFERRED TEXTBOOKS:

1) Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, **Robot Modeling and Control,** John Wiley & Sons.
2) Lorenzo Sciavicco and Bruno Siciliano, **Modelling and control of robot manipulators**, Springer Science & Business Media, 2012.
3) **Applied Nonlinear Control** by Slotine and Lee
4) **Quad Rotorcraft Control** by LRG Carrillo, AED Lopez, R Lozano and C Pegard.
5) **Modern Control Engineering** by K Ogata.

***REFERENCE BOOKS:**

1) Reza N. Jazar, **Theory of applied robotics: kinematics, dynamics, and control**, Springer Science & Business Media, 2010.

***PROJECT:**

Course Assessment Plan (Monsoon 2021)

Assignments	-	25%
Project	-	25%
Quiz	-	30%
Open Book Exam/ 30 Min Quiz	-	20%

OUTCOME:

1. Students will demonstrate an ability to apply spatial transformation to obtain forward kinematics & inverse kinematics equation of robot manipulators.
2. Students will demonstrate an ability to obtain the Jacobian matrix and use it to identify singularities.
3. Students will demonstrate an ability to generate joint trajectory for motion planning.
4. Students will demonstrate knowledge of robot controllers.
5. Student will demonstrate knowledge of Quadrotor mechanics and control.

REMARKS:

EC5.406 Signal Detection and Estimation Theory 3-1-0-4

TYPE-WHEN **:** Monsoon

FACULTY NAME : Praful Mankar
PRE-REQUISITE **:** Probability Theory and Random Processes
OBJECTIVE **:**

COURSE TOPICS :
(Please list the order in which they will be covered)
Estimation Theory:

1. Estimation Performance: Unbiased estimator, Minimum-variance unbiased (MUV) estimator.
2. Cramer-Rao lower bound (CRLB): Fisher information and its properties, CRLB for white gaussian noise (WGN), vector parameters and parameter transformation.
3. General MUV estimator: Neyman-Fisher factorization, Sufficient and complete test statistics, MUV estimation using test statistics, Rao-Blackwell-Lehmann-Scheffe (RBLS) theorem for finding MUV estimator.
4. Best linear unbiased estimation (BLUE): BLUE for WGN and non-WGN, Gauss-Markov theorem, Example: Source localization.
5. Maximum likelihood estimation (MLE): Properties of MLE, MLE for vector parameter, Gaussian and non-Guassian noise, Numerical methods of MLE - Newton Raphson and Expectation maximization (EM) methods.
6. Linear least square estimation (LSE): LSE approach and its geometrical interpretation, Constraint linear LSE.
7. Bayesian Estimation and maximum aposteriori probability (MAP) estimation.

Detection Theory:

8. Hypothesis testing, Neyman-Pearson (NP) theorem, Likelihood ratio test (LRT), Receiver operating characteristic (ROC), Minimum probability of error, Bayes Risk, Minimum Bayes risk detector, MAP detector.
9. Detection of deterministic signals: Matched filter for WGN and non-WGN, Binary and M-array signal detection using matched filter.
10. Detection of random signals: Estimator correlator, Linear model, Examples- energy detector and Rayleigh fading.
11. Detector of deterministic signals with unknown parameters: Composite hypothesis testing, Generalized LRT (GLRT), Bayesian approach, Rao test, Wald test.

PREFERRED TEXT BOOKS:

1. **Steven M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory,* Vol. 1.**
2. **Steven M. Kay, *Fundamentals of Statistical Signal Processing: Detection Theory,* Vol. 2.**

***REFERENCE BOOKS: Same as the preferred text books**

***PROJECT: Nil**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	**40**

Assignments	**20**
Term paper	**15**
Project	
Surprise class quizzes	**25**
Other Evaluation _____	

OUTCOME:

REMARKS:

SC2.310 Selected topics in Instrumental Analysis 3-1-0-4

Faculty Name **:** Tapan Kumar Sau
TYPE-WHEN **: Domain Elective** for CNS Dual/Ph.D. and **General Elective** for all B. Tech. students
PRE-REQUISITE **:** None
OBJECTIVE **:**To study the principles and real-world applications of selected modern instrumental analysis techniques.

COURSE TOPICS :

1. **INTRODUCTION:** Chemical Measurements and Instrumental Analysis.
2. **ELEMENTAL ANALYSIS:** Atomic Absorption Spectroscopy; Energy Dispersive X-Ray Spectroscopy.
3. **SPECTROSCOPIC CHEMICAL SPECIATION:** UV-Visible Absorption and Emission; Infrared (IR); Raman Scattering; Nuclear Magnetic Resonance (NMR); Mass Spectrometry.
4. **SEPARATION TECHNIQUES:**Gas Chromatography; High Performance Liquid Chromatography (HPLC); Capillary Electrophoresis.
5. **ELECTROANALYTICAL ANALYSIS:** Cyclic Voltammetry (CV).
6. **THERMAL ANALYSIS:** Thermogravimetry (TG); Differential Scanning Calorimetry (DSC).
7. **SURFACE ANALYSIS:** BET Surface Area Analysis; X-ray Photoelectron Spectroscopy (XPS) or Electron Spectroscopy for Chemical Analysis (ESCA); Atomic Force Microscopy (AFM); Scanning Electron Microscopy (SEM).

PREFERRED TEXTBOOKS:

1. Sivasankar, B, "Instrumental Methods of Analysis", Oxford University Press, 2012.
2. R.S. Khandpur"Handbook of Analytical instruments", Tata Mc Graw-Hill, 2nd Edition, 2006.
3. Principles of Instrumental Analysis, Skoog, Holler, Nieman, Thomson Brooks-Cole Publications, 6thEdition.

***REFERENCE BOOKS:**

1. Instrumental Methods of Analysis, Willard, Merritt, Dean, Settle, CBS Publishers & Distributors, New Delhi, 7th edition.
2. Introduction to Instrumental Analysis, Robert D. Braun, McGraw-Hill Book Company.
3. Instrumental Methods of Chemical Analysis, Galen W. Ewing, McGraw-Hill Book Company, Fifth edition

***PROJECT:** None

Course Assessment Plan (Monsoon 2021)

Assignments	-	50%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	30%

OUTCOME: Students after finishing this course are expected to develop a better understanding of the principles of various modern instrumental analyses, real world applications, scope, and the limitations of these analyses and an enhanced appreciation for analytical techniques.

REMARKS: (1) **Max. Number of Students = 60**
(2) All CNSD students who opt for it will get it.

CS9.425 Social Science Perspective on HCI 3-1-0-4

Faculty Name : Nimmi Rangaswamy

TYPE-WHEN : Monsoon 2021

PRE-REQUISITE: U3 and above

OBJECTIVE :

To introduce Human-Computer Interaction as an inter -disciplinary domain of study to students of Engineering and the Social Sciences

To bring a social perspective and the importance of lived contexts in the framing and understanding of man-machine interaction

To get a grasp of the theoretical and applied frameworks supporting the dom ain of HCI

Importantly, to introduce the idea of cross -fertilisation of academic domains, especially computer sciences and humanities to originate Human -Computer Interaction as a fertile research and academic science

COURSE TOPICS/OUTLINE/CONTENT

Overview of Course

Quote: "A sushi restaurant puts sensors on its plates to assess, in real time, what's being eaten so it can adjust its food offerings" [Goodman, The Atomic Age of Data, 2015]" End Quote.

Radically different ways of interacting with computationa lly based systems are possible, ranging from the visual [surfaces, input devices] to the invisible [sensor technologies, back end processors] and importantly social [which means non -technological] affectations triggering diverse ways of interfacing with technology. Human-Computer Interaction [HCI] is a vision for a world of interconnected devices, that have acquired smartness due to computing power. As computational technologies continue to 'disappear' and merge with the physical world, becoming increasingly tangible, embedded and embodied in a range of environments, architectures and artifacts, new research agendas and design approaches are called for [Nansen et al, 2014].

This course is an introduction to the field of Human -Computer interaction research with a focus on 'human' and how the HCI domain interfaces with the social sciences. The course begins with a selection of seminal work that establish the HCI domain: interactive systems/techniques, design and user interfaces. We will then move on to topi cs including social and context aware computing, design research and evaluation methods.

The course will also present a perspective based on the importance and role of objects in social relations. We situate this work in relation to a conceptual understand ing of objects and social relations, suggest effective methodological and theoretical tools to study of a more object -centered sociality and suggest design opportunities to make better products.

The course will center on the processes and challenges of ideating, designing and evaluating technologies as products, their usability and immersion into the social contexts of users. We will study contextual design as a field that emerged in response to the challenges of designing for context and usability. Another important strand in this course will dwell on the sociological aspects of HCI and explore the 'mediation' of technology use by a range of contextual situations: socio-cultural obligations, habits, values, infrastructure, material objects and not in the least family, kinship and human bonds. Some examples of the above are:

Understanding social interactions with a webcam as an important new development in communication interfaces and its widespread adoption in the real world supporting family relationships, business work flows and social networking.

A deep look at social networking as everyday HCI - Facebook; Twitter; Messaging applications.

Another example will be looking at technologies driven by data science, like mobile marketing analytics, and their consequences for society.

A third example will be studying real world application of big data to social situations: real time traffic; real world geographic navigation; geo -location based services [food delivery; friendship; dating]; Consumer-centric health care services [monitoring parameters; precision medicine; Health care platforms]

A close look at the impacts of peer to peer sharing platforms [Uber, AirBnB]

This class has no pre-requisite requirements and open to students from any background. Students are expected to do all of the readings. Students will be evaluated with a quiz or a test and a presentation that will gauge student ability in engaging with and comprehending the course readings and class room discussions. The class test and the presentat ion will be based on the class lectures and readings assigned for the course

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

Norman, D. A. (1990). *The design of everyday things*. New York: Doubleday. Miller, D and Sinanan,

J, *Webcam*, Polity Press, 2014

Sterling, B. *The Epic Struggle Of The Internet Of Things* , Moscow: Strelka Press, 2014.

Rogers, Y. *HCI Theory: Classical, Modern, and Contemporary* . [San Rafael, Calif.], Morgan & Claypool, 2012

Blomberg, J., Burrell, M., and Guest, G. *An Ethnographic Approach to Design*, Human-Computer Interaction Handbook, L. Erlbaum Associates Inc. Hillsdale, NJ, USA,2003

***REFERENCE ARTICLES:**

Bell, G., Blythe, M., and Sengers, P. 2005. Making by Making Strange: Defamiliarization and the Design of Domestic Technology. *ACM Trans. Computer-Human Interaction*, 12(2), 149-173.

Dourish, P. 2006. Implications for Design. *Proc. ACM Conf. Human Factors in Computing Systems CHI 2006* (Montreal, Canada), 541-550.

O'Brien, J., Rodden, T., Rouncefield, M., and Hughes, J. 1999. At Home with the Technology: An Ethnographic Study of a Set -Top Box Trial. ACM Trans. Computer-Human Interaction, 6(3), 282-308.

Kelson, J.A.S. (1982). The process approach to understanding human motor behavior: An introduction. In J.A.S. Kelso (Ed.), Human Motor Behavior: An Introduction, 3-19, Hillsdale, N.J.:

Lawrence Erlbaum Associates.

Bell, G., Blythe, M., Gaver, B., Sengers, P., and Wright, P. Designing culturally situated technologies for the home. *Ext. Abstracts CHI 2003.* ACM Press (2003), 1062-1063.

***PROJECT:**

Course Assessment Plan (Monsoon 2021)

Assignments	-	10%
Project	-	50%
Quiz	-	40%

OUTCOME:

Students will be able to identify and apply a sociological lens to a human-computer interaction context. This will mean applying informed ways to draw boundaries to an HCI context, use the right theoretical tools of study and processing appropriate data to conduct an independent academic study of selective HCI situations in the real world

REMARKS:

CS4.408 Spatial Informatics 3-1-0-4

Faculty Name: Rajan KS

TYPE-WHEN: Open Elective

PRE-REQUISITE : Open to UG-3, UG-4, DD/MS, and PhDstudents

OBJECTIVE :

Spatially explicit information like a map (e.g. Google Maps) informs us not just the geographical location but also the relationship between the objects in it. While mapping models focus on the Spatial (and Temporal) data collection, storage and management (Spatial DBMS) with map generation as one of the key elements; the recent advances in technology have expanded the horizon to include Spatio-temporal Analytics, 3D GIS, Ontology and GML,etc.

This course gives an introduction to the concepts of GIS, the science and algorithms behind it and how this technology can benefit many disciplines, including navigation, transportation and traffic planning, Urban planning, hydrology, environmental management, disaster response, etc.

COURSE TOPICS: Course Structure (each of approximately 1–2-week duration):

1. What is Geographical Information Systems (GIS)?
2. Fundamental concepts of Space
3. Geospatial data and its Digital representation – Vectors and Rasters
4. GIS Data collection, Editing and Data formats
5. Data structures for Spatial data and Spatial data management (Geospatial

database)

6. Spatial Data Query and Analysis – Spatial Analysis, Network Analysis
7. Data compatibility - Projections and Georeferencing
8. Spatial reasoning and uncertainty
9. Web-GIS, GML and Map services
10. Geospatial applications in few areas like in Hydrology (Water flows and floods); Ecology and Environment; Land use and Land cover; Urban planning and Transportation; etc.
11. Topics in Spatial Informatics
    1. 3DGIS
    2. Open-Source Initiatives in GIS/RS

A few lectures, may be given by Invited Speakers in related areas during the course to provide the students a wider understanding of its relevance and application.
In addition, there will be a hands-on (lab tutorials) introduction to one or two GIS software and tools at relevant times during the course.

PREFERRED TEXTBOOKS:

1. Geographical information systems and science by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W.Rhind
2. Introduction To Geographic Information Systems by Kang-Tsung Chang
3. GIS–A computing perspective by Micheal Wor boys and Matt Duckham
4. Concepts and techniques of geographic information systems by C P Lo and Albert K W Yeung

Course Assessment Plan (Monsoon 2021)

Assignments	-	10%
Project	-	20%
Any other	-	30%
Quiz	-	20%
Open Book Exam/ 30 MinQuiz	-	20%

OUTCOME: Students will learn the basic concepts of Geospatial data representation, cartography, visualization, data manipulation and how to extract meaningful information from it. In addition, they will be exposed to the application potential of this fast-developing domain cutting across disciplinary interests.

EC5.408 Speech Signal Processing 3-1-0-4

Faculty Name: Chiranjeevi Yarra + Anil Kumar Vuppala
Type-when: Monsoon-2021

Pre-Requisite:(PG, research and BTech students from 3rd year on wards will be permitted) Signal and systems Digital signal processing.

COURSETOPICS: Background and need for speech processing, Speech production mechanism, Nature of speech signal, Basics of digital signal processing, Equivalentre presentations of signal andsystems, Speech signal processing methods, Linear prediction analysis, Basics of speech recognition.

PREFERREDTEXTBOOKS: 1.L.R.Rabinerand B.HJuang, Fundamentals of speech recognition, PearsonLPE(1993).2.L.R.RabinerandR.W.Schafer,Digitalprocessingofspeechsignals, Pearson LPE(1993).

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	20%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	30%

CS7.403 Statistical Methods in AI 3-1-0-4

Faculty: Anoop Namboodiri
TYPE-WHEN: Monsoon -2021
COURSETOPICS:

. Introduction, Feature Representation
. Nearest Neighbor Classification
. Random Variables, Probability Densities, Multivariate Densities
. Bayesian Decision Theory
. Naive Bayes Classifier
. Maximum Likelihood Estimation (MLE)
. Linear Discriminant Functions
. Perceptron Learning
. Minimum Squared Error Procedures
. Logistic Regression
. Neural Networks, Backpropagation, Training Methods
. Principal Component Analysis and Eigen Faces
. Linear Discriminant Analysis and Fischer Faces
. Max-Margin Classification (SVM), SVM variants, Kernelization
. Data Clustering, K means (EM) and variants, Hierarchical Clustering
. Decision Trees
. Graphical Models, Bayesian Belief Networks
. Combining Classifiers, Boosting

REFERENCE BOOKS:
*Pattern Classification by Duda, Hart & Stork
* Machine Learning – A probabilistic Perspective by Kevin Murphy (free eBook available online),

* Neural Networks-A Comprehensive Foundation by Simon Haykin

Pre-requisite: Basics of Linear Algebra, Calculus, Probability Theory and Statistics. Programming in Matlab and C/C++.

GRADING Scheme:

***** Assignments3:20%(1Mini-project+2Assignments)
***** Homeworks:30% (2-4 problems given after each lecture; Top 80% counted)
***** Two Mid Sems :30%
***** Final Exam:20%

OUTCOME:
This course will enable students to understand pattern recognition techniques namely, classification and clustering in detail including both the oretical and practical aspects.

CE1.509 Structural Wind Engineering 3-1-0-4

Faculty Name **:** Shaik Rehana
TYPE-WHEN **:** CASE Elective -Monsoon
PRE-REQUISITE **: Nil**

OBJECTIVE: To develop a detailed understanding about wind engineering, various principles involved in the design of wind loads, wind induced responses on structures, application on solving wind induced problems on structures

COURSE TOPICS :

- Wind climate, nature and types of high winds and storms
- Wind damages, damage index, wind impact on structures
- Estimation of design wind speed and pressure distribution
- Estimation of wind loads on buildings, factors affecting wind load
- Prediction of design wind speed and structural safety
- Estimation of extreme wind speeds
- Atmospheric boundary layer and wind turbulence: mean wind speed profiles, wind spectra, topographic multipliers
- Structural interaction with aerodynamic forces, pressure, lift, drag and moment effects on structures
- Wind loads, codes and standards

PREFERRED TEXTBOOKS:

Y. Tamura A. Kareem (2013), Advanced Structural Wind Engineering, ISBN 978-4-431-54336- 7 ISBN 978-4-431-54337-4 (eBook), DOI 10.1007/978-4-431-54337-4, Springer Tokyo Heidelberg New York Dordrecht London.

John D. Holmes (2003), Wind Loading of Structures, ISBN 0-419-24610-X, ISBN 0-203-30164- 1 Master e-book ISBN.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem and Quiz	**30**
End Sem Exam	**30**
Assignments	**15**
Project	**25**

OUTCOME:

Integrating wind induced responses in the design of various structures such as tunnels, tall buildings etc.

CS9.424 Technology Product Entrepreneurship 3-1-0-4

Faculty Name: Ramesh Logangathan + Prakash Yalla
Technology Product Entrepreneurship- Tools & Techniques

Description:

This course introduces the fundamentals of technology product entrepreneurship. In a workshop format, you will learn the process of building a technology enterprise. Starting from a technology idea, mapping the idea to a high-potential commercial opportunity, defining/designing/validating the product, figuring out the market avenues & how to sell the product, and planning/managing rapid growth. Class will apply the learning on their tech product ideas and create a venturable product & plan; in a workshop mode thru extensive hands on assignments concurrent with course modules.

Aim: The aim of this course is to introduce students to the process to take technology from research labs towards the market as a end product. As a venturable business.

Key Takeaways:

Pedagogy Format

- Classroom sessions, guest lectures (from serial tech entrepreneurs/investors) and case study discussions in class
- Assignments applied on tech product ideas from the class

Prerequisites:

- A technology product idea that has come out of an internship, research work or honors work in one of IIIT-H research centers

- Students register for class as teams (2 -4 students) with a tech product idea
- Basic knowledge of cloud computing and mobile appls is preferred

Outline (Tentative):

Sl No	Topics	Week
1	Introduction • Technology Product innovation. • Successful products cases review	1
2	Creativity & Innovation • Stretch the idea. Idea Hexagon framework applied	
3	Frameworks & Models • Product & Market first • Vision first (Vision/Strategy/Execution) • Large opportunity (Big untapped market/ Much better product/ Much better team) • Lean Startup models • Crossing the chasm"	2
4	Customer Discovery/Opportunity mapping • LEAN Startup methodology • Business Model canvass Tool	2
5	Design Thinking _ Design thinking process: understand, observe, define, ideate, prototype, test	2
6	Customer Development • Models: through trial and error, hiring and firing, successful startups all invent a new, parallel process to product development for sales, marketing and business development • Market & Competitive Positioning	2
7	Sales & Market Strategy • Go to Market avenues, and projections • GTM Planning	1
8	Business Plans • Creating, developing and evaluating the Technology	

	Product's "concept of a business"	
	• innovation? Is it a business or a product or both? Sizing the market? The technology, market and competitive risks?	
	Competitive proposition	2
9	Technical Architecture considerat ions	
	_ Leveraging Mobile and Cloud	1
10	Corporate Technology Innovation	1
	_ Applying research technology in corporate environments	
11	Tech Product Pitch/Plan presentations	
	_ What makes a good product pitch and demo	1
12	Final Demo and presentations	1
TOTAL		**17 classes**

Evaluation (tentative)

4quizzes(20%),4labs(20%),TechProductBizplan(20%),Demo&Presentation(10%),Final Exam (30%)

Assignments:

Students will apply the learning on your tech product idea and create a venturable product and plan; in a workshop mode thru extensive hands on assignments concurrent with course modules. Submissions eachweek.

• Introduction:Assignment: Create startup website; Vision; Basic Positioning statement;

• Creativity & Innovation: Assignment: Based on team's tech idea considered, list 3 product possibilities, applying Idea hexagon framework.

• Frameworks & Models: Assignment: Assess opportunity for the ideas. And pick the "venturable business."

• Customer Discovery/Opportunity mapping: Assignment: Apply Lean Startup Methodology, and Validate customer interest, need & … ; Assignment: First cut of Musiness Model Canvass filled in

• Design Thinking: Assignment: Rapidly create and refine the product functionalit y for the teams product using design thinking process

• Customer Development: Assignment: Competitive Positioning; Assignment: Update Product functionality capturing the competitive proposition

• Sales & Market Strategy: Assignment: Evolve the GTM plans

• Business Plans: Assignment: Completed, defensible, business model canvass; Assignment: Product roadmap- market & technical, GTM plans, revenue projections

• Technical Architecture considerations: Assignment: Study 2 similar solutions in market and compare/contrast tech architecture used by your product

• Corporate Technology Innovation : TBD

• Tech Product Pitch/Plan presentations

References

Required Readings:

1. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company
2. by Steve Blank and Bob Dorf Reference papers
3. Technology Entrepreneurship: Overview, Definition, and Distinctive Aspects
4. http://timreview.ca/sites/default/files/article_PDF/Bailetti_TIMReview_February2012.pdf
5. Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity
6. http://amr.aom.org/content/25/2/312.abstract
7. Harvard: Why Lean Startup Changes everything
8. http://host.uniroma3.it/facolta/economia/db/materiali/insegnamenti/611_8959.pdf
9. The Power of Integrality: Linkages between Product Architecture, Innovation, and Industry Structure
10. http://www.sciencedirect.com/science/article/pii/S0048733308001091

Suggested Reading:

1. High Tech Start Up, Revised and Updated: The Complete Handbook For Creating Successful New High Tech Companies by John L. Nesheim
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries

Additional Reference

1. The Art of the Start by Guy Kawasaki
2. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber
3. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen
4. Running Lean: Iterate From Plan A to a Plan That Works by Ash Maurya
5. Positioning: The Battle for Your Mind by Al Ries and Jack Trout

6. Venture Deals by Brad Feld and Jason Mendelson
7. Lean Analytics by Alistair Croll and Benjamin Yoskovitz
8. Crossing the Chasm by Geoffrey A. Moore

CE0.501 Theory of Elasticity & Plasticity 3-1-0-4

TYPE-WHEN: Monsoon Semester

FACULTY NAME: Dr. P. Pravin Kumar Venkat Rao

PRE-REQUISITE: Solid Mechanics

OBJECTIVE: In this course the concept of elasticity and plasticity, an important property of solids will be discussed in a comprehensive way. Idealization of physical system, representing the idealized system through mathematical equation and finally finding solution of those equations are the key features that constitute the structure of this course. In this course emphasis will be given on both theory and applications.

COURSE TOPICS:

Mathematical preliminaries introduction to tensor, Concept of stresses and strains, Stress and strain transformation at a point in an elastic body, Rigid body translation and rotation of an element in space, Generalized Hook's law, Principal stresses and strains, Two dimensional problems in elasticity: Plain stress, Plain strain and Axisymmetric problems, Boundary conditions, Formulation of boundary value problems in equilibrium and compatibility, Stress functions, Three dimensional problems in elasticity: Differential equation of equilibrium in 3D, Condition of compatibility determination of displacement, Principle of superposition, Uniqueness theorem, Torsion of bar, Membrane analogy, Theory of failures.

Introduction to plasticity: Criterion of yielding strain hardening rules of plastic flow different stress strain relation, Total strain theory, Theorem of limit analysis, Elasto-plastic bending and torsion of bars.

REFERENCE BOOKS:

9. Ugural, A. C., & Fenster, S. K. (2003). Advanced strength and applied elasticity. Pearson education.
10. Timoshenko, S. P., & Goodier, J. N. (1971). Theory of Elasticity, McGraw-Hill, New York, 1970. Fok-Ching Chong received the BS degree from the Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan, in.
11. Shames, I. H. (1964). Mechanics of deformable solids.
12. Srinath, L. S. (2003). Advanced mechanics of solids. Tata McGraw-Hill.
13. Chakrabarty, J. (2012). Theory of plasticity. Butterworth-Heinemann.
14. Timoshenko, S. (1953). History of strength of materials: with a brief account of the history of theory of elasticity and theory of structures. Courier Corporation.
15. Boresi, A. P., Chong, K., & Lee, J. D. (2010). Elasticity in engineering mechanics. John Wiley & Sons.
16. Popov, E. P., & Balan, T. A. (1968). Mechanics of solids. Mexico City, Mexico: Pearson Education, 2000) (in Spanish).

17. NPTEL Lecture Notes: IIT, Madras.
18. Hill, R. (1998). The mathematical theory of plasticity (Vol. 11). Oxford university press. 11. Lubliner, J. (2008). Plasticity theory. Courier Corporation.
19. Wong, M.B. "Plastic Analysis and Design of Steel Structures", Elsevier Publications, 2009.

GRADING PLAN:

Class Quiz - 50%
Assignments - 35%
Attendance – 15%

OUTCOME: At the completion of this course, the student shall acquire knowledge and ability to define state of stress and strains, equilibrium and compatibility. They will be able to derive the governing equations and their solutions for application to problems in plane stress state, plane strain state, torsion and bending.

CS6.501 Topics in software Engineering 3-1-0-4

Faculty Name **:** Raghu Reddy + Vasudeva Varma + Pankaj Jalote.

Offered **: Monsoon 2021**

PRE-REQUISITE **:** Knowledge of AI and Learning techniques and familiarity with Software Engineering; or Knowledge of Software Engineering and familiarity with AI/ML; or consent of the instructor.

Course Description:

Modern methods of engineering software generate a lot of data – almost all artifacts produced in a software project are machine processable, projects capture a lot of data in various repositories like source code control, bug tracking, etc., programmers' activities log is available, companies have project database with data on past projects, proposals submitted, etc.

Over the last decade AI techniques have really matured, and AI models are being applied in SE much more – e.g. for automation, monitoring project health, providing assistance to engineers or managers, providing guidance for decisions, etc. Besides using AI for the activities helping projects or engineers, AI techniques can also be used by companies which execute hundreds of projects, to benefit from better monitoring and control of their portfolio of projects, better utilization and planning of resources, better risk management, etc. The use of AI in SE is an emerging area with a lot of promise and activity.

The goal of this course is to introduce various research challenges and state of the art in applying AI for SE issues. Topics will be discussed in conjunction with various seminal papers related to that topic. Lectures on various topics will be given by the instructor and some invited experts.

The course is being offered by multiple institutes parallelly. As a result, faculty from multiple institutes will be teaching the course and students from multiple institutes will be attending the course.

COURSE OUTCOMES:

- Familiarity about how AI is being used for addressing different problems in SE
- In-depth understanding of use of AI techniques in one particular SE issue
- Understanding of how to apply AI techniques for a different domain (SE in this case)
- Improved ability to review research literature and understand the state of the art in some area
- Improved ability to do independent research

COURSE TOPICS:

The course will discuss the state of the art in various aspects of ML for SE. Some of the SE areas/topics where ML is used are listed here. A subset of these will be selected for discussion in the class – based on the interest of students:

- equirements engineering
- Performance (software or system) tuning or prediction
- Defect prediction and detection
- Automatic bug repair / system/software repair
- Making testing more effective
- Code refactoring
- Assisting code review and code analysis
- Effective developer/designer assistance (through recommendations, …)
- Project management (various aspects like estimation, risk management, …)
- Improving the monitoring of health of a project
- NLP/Information Retrieval in Software Engineering
- Applying ML for bug triaging
- Analyzing logs and user comments (for bug detection, issues, etc.)

***REFERENCE BOOKS/Papers:**

- The Art and Science of Analyzing Software Data. Eds: Christian Bird, Tim Menzies, Thomas Zimmerman
- Seminal papers published in this area

GRADING PLAN (subject to modification):

Peer Evaluation and Class participation: 20%
Presentation on the topic: 20%
State of art Report on the chosen topic: 20%
Research in the chosen topic - R&D problem formulation and some work: 20%
Final Exam: 20%

REMARKS:

MA8.401 Topics in Applied Optimization 3-1-0-4

Faculty Name: Pawan Kumar
TYPE-WHEN: Monsoon
PRE-REQUISITE: Linear Algebra, Calculus, Statistics, and any one of the programming languages: C/C++/Python/Matlab/Octave to write codes for assignment problems. Basic knowledge of machine learning (linear regression, logistic regression,

SVMs, NN) is desirable, but not necessary.

OBJECTIVE : To learn selected advance optimization techniques, and to apply them to solve selected problems stemming from data sciences, and scientific computing.

COURSE TOPICS:

0. Review of Linear Algebra, Calculus, Probability and Statistics.
1. Concept of Convex Sets, Convex functions, Convex Optimization Problems, Duality.
2. Algorithms for Constrained and Unconstrained Minimization. Applications.
3. Algorithms for Interior Point Methods. Applications.
4. Algorithms for Stochastic Gradient Methods: 1^{st} order and 2^{nd} order methods. Preconditioning. Momentum based and Nestrov Accelerated Gradient Descent. Applications.
5. Algorithms for Non-smooth Optimization: Sub-gradient Methods; Primal-dual sub-gradient methods; Stochastic subgradient methods. Applications.
6. Variants of Conjugate Gradient Methods and Truncated Newton Methods. Applications.
7. Algorithms for Non-convex Minimization and Applications.

PREFERRED TEXTBOOKS:
1. ***Numerical Optimization***, J. Nocedal, S. J. Wright, Springer, 1999
2. ***Optimization Methods for Large Scale Machine Learning***, arXiv 2016
3. ***Optimization for Machine Learning***, Suvrit Sra et. al., MIT Press

***REFERENCE BOOKS:**

***PROJECT:** Projects will be primarily from the domains of Scientific Computing and Machine Learn ing. A student will be asked to read a paper, implement optimization algorithms mentioned in the paper, and present their work using overhead projectors.

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Project	-	30%
Quiz	-	30%
Open Book Exam/ 30 Min Quiz	-	20%

OUTCOME: After taking this course, student should be able to formulate a problem as optimization problem, select appropriate algorithm, and implement it efficiently.

REMARKS:

CS7.502 Topics in Machine Learning 3-1-0-4

Prerequisite: Statistical Methods in AI

Faculty Name: Naresh Manwani

TYPE-WHEN: Monsoon

PRE-REQUISITE: Good knowledge of linear algebra, probability theory. Proficiency in programming. Basic knowledge of machine learning.

OBJECTIVE: The objective of this course is to cover the fundamentals of reinforcement learning (RL). The focus will be on understanding both theoretical and practical aspects of RL approaches. There will be many programming assignments to cover various implementation issues.

COURSE TOPICS:

Introduction to reinforcement learning, Markov decision processes, dynamic programming, Monte Carlo methods, temporal-difference (TD) learning, SARSA, Q-learning, double Q-learning, n-step TD, eligibility traces Value-function Approximation methods, deep Q-learning Policy gradient methods, actor-critic methods, natural policy gradient, deterministic policy gradient (DPG), deep deterministic policy gradient (DDPG) Partially observed Markov decision processes (POMDP)

PREFERRED TEXT BOOKS:

Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, 2nd edition, MIT Press, 2016. Masashi Sugiyama, Statistical Reinforcement Learning: Modern Machine Learning Approaches, CRC Press. Some recent research papers in RL.

REFERENCE BOOKS:

Martin L. Putterman, Markov Decision Processes: Discrete Stochastic Dynamic Programming, John Wiley and Sons Publishers.

Course Assessment Plan (Monsoon 2021)

Assignments	-	40%
Any other	-	10%

Quiz	-	30%
Open Book Exam/ 30 Min Quiz	-	20%

HS1.205 Understanding Raga: Semi Classical Forms of Indian Music 3-1-0-4

Faculty Name: Saroja TK
TYPE-WHEN : Open Elective- Monsoon 2021

PRE-REQUISITE : Instructors
consent OBJECTIVE :

1. Conceptual study of raga by introducing around ten ragas in both North and South Indian music systems.
2. Practice of different Semi classical forms including some folk forms of Indian music
3. Understanding the importance of Semi classical genre in Indian music.
4. Role of music in bringing out the rich ideas and expr essions in the compositions. inter relationship of the musical and linguistic expressions.

5. Introducing different composers whose musical experiences and ideas resulted in the existing semi classical forms.

6. Experiencing the techniques of composing and learn to compose some simple songs.

COURSE TOPICS:
(please list the order in which they will be covered)
Lesson 1,2,3 : Introduction to ragas. Basic exercises in differentragas. Lesson 4,5:

Introduction of various semi classical forms of Indian music

Lesson 6, 7: Bhajans

Lesson 8, 9,10: Annamayya compositions

Lesson 11, 12, 13: Contribution of some Composers whose compositions are identified as separate genres in Indian music.

Lesson 14, 15: Ghazals

Lesson 16, 17: Techniques of composing

Lesson 18: Qawwali
Lesson 19, 20: Abhang and Purandara dasa compositions Lesson 21, 22: Contribution of some more

composers.

Lesson 23: Comparitive study of Semi classical forms and Folk forms of music.

Lesson 24: Study of the inter relationship of musical and lyrical expressions in bringing out the beauty of the compositions.

Lesson 25, 26: Practical exercises of all the concepts.

PREFERRED TEXTBOOKS:

***REFERENCE BOOKS:**

1. The Hindu Speaks on Music - compilation of 232 selective music articles by The Hindu.

2 . A Southern Music (The karnatic story) by T.M. Krishna

3. Videos and audios to demonstrate different concepts.

***PROJECT:** Practical oriented project

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**20**
Mid Sem-2 Exam	**20**
End Sem Exam	**----**
Assignments	**20**
Project	**40**
Term Paper	**-----**
Other Evaluation_____	**For all the exams Practicals 60% and Theory 40%**

OUTCOME:

1. Ability to recognize some ragas with their very characteristics.

2. Ability to identify, sing or play different semi classical compositions like Bhajan, Ghazal, Annamayya composition, Qawwali, Abhang etc
3. Understand the importance of raga in Indian music.

4. Know the importance and role of the composers in bringing out variety in music.

5. Basic attempt to compose simple songs.

6. Knowledge of different rhythmic structures that play a major role in the compositions.
7. Ability to sing or play compositions in atleast 10 ragas.

8. Videos and audios to demonstrate different concepts.

REMARKS: Students with minimum of vocal or instrumental experience are encouraged.

EC5.407 Wireless Communications 3-1-0-4

Faculty Name: Ubaidulla
TYPE-WHEN : Monsoon 2021
PRE-REQUISITE : Basics of random variables (Gaussian RVs, and random vectors and functions of Gaussians), Digital Communication (Comm. Theory 1)
OBJECTIVE : Learn fundamentals of wireless communications with focus on mobile technologies, and understand the current frontiers of research

COURSE TOPICS : (Note : More time will be spent on the fundamentals, and more complex topics (even those not listed) will be optionally taken up based on time available)

1. Wireless channel modelling (Single-input single output): Time and frequency coherence, fading
2. Probability of error vs SNR: exploiting channel diversity.
3. Cellular systems: Frequency reuse, GSM, CDMA.
4. Capacity considerations
5. Beamforming
6. MIMO Channel model, transmission schemes and receivers.
7. Multiuser MIMO.
8. 5G physical channel models, transmission techniques.
9. Interference channel, Interference alignment, topological interference alignment.

PREFERRED TEXT BOOKS: Fundamentals of Wireless Communication by David Tse and Pramod Vishwanath

***REFERENCE BOOKS**: Wireless Communications- Principles & Practice (Rappaport).
***PROJECT:** (List of topics will be mentioned later)

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Project	-	40%
Quiz	-	10%
Open Book Exam/ 30 Min Quiz	-	30%

Sd/ -
Dean (Academics)