Elective Courses Syllabus – Monsoon 2020

Ver.1-(27-07-2020)

Code	Course Name	Credits	Faculty
M20Temp14	Advanced Graphics, AR & VR	3-1-0-4	Avinash Sharma + PJ Narayanan
SCI541	Advanced Biomolecular Architecture **(50)**	3-1-0-4	Deva Priyakumar
CSE435	Advanced Computer Networks	3-1-0-4	Sujit Gujar + Shatrunjay Rawat (50)
M20Temp13	Advances in Data Systems	3-1-0-4	Krishna Reddy P
M20Temp17	Advanced NLP	3-1-0-4	Manish Shrivastava (50)
CES623	Advanced Structural Design	3-1-0-4	Sunitha P
ECE468	Analog IC Design	3-1-0-4	Abhishek Srivastava + Zia Abbas
M20Temp15	Behavioral Methods & Experimental Design	3-1-0-4	Vinoo Alluri + Bapi Raju S
SCI643	Biomolecular Structure Interaction & Dynamics **(20)** **Prerequisites: ABA, GSC or equivalent**	3-1-0-4	B.Gopalakrishnan
ECE467	CMOS Radio Frequency Integrated Circuit Design	3-1-0-4	Syed Azeemuddin
CSE503	Concurrent Data Structures	3-1-0-4	Govindarajulu R
HSS448	Critical Viewing and Reading	3-1-0-4	Sushmita Banerjee
CSE447	Data Analytics I	3-1-0-4	Vikram Pudi
M20Temp18	Data Systems	3-1-0-4	Kamal Karlapalem (100)
ECE469	Design for Testability	3-1-0-4	Ganesh V. Bhutekar, Renia Inc.
CSE478	Digital Image Processing	3-1-0-4	Ravi Kiran S
CSE431	Distributed Systems	3-1-0-4	Kishore Kothapalli (100)
CSE512	Distributing Trust and Block Chains	3-1-0-4	Sujit Gujar
IMA411	Entropy and Information	3-1-0-4	Indranil Chakrabarthy
CSE596	Environmental Science & Technology	3-1-0-4	RC Prasad
CEA621	Finite Element Methods	3-1-0-4	Venkateshwarlu M
IMA301	Functional Analysis	3-1-0-4	Lakshmi Burra
CSE464	Game Design and Engineering **(60)**	3-1-0-4	Kavita Vemuri
HSS339	Gender and Society	3-1-0-4	Sushmita Banerjee
CEW613	Hydrological modelling and Software Development	3-1-0-4	Shaik Rehana
CEB411	Illumination Engineering	3-1-0-4	Vishal Garg
CSE474	Information Retrieval & Extraction	3-1-0-4	Vasudeva Varma
CSE485	Intro to Cognitive Science	3-1-0-4	Priyanka Srivastava (50)
HSS351a	Intro to Psychology	3-1-0-4	Priyanka Srivastava
HSS343a	Introduction to History	3-1-0-4	Ashwin Jayanti

CSE486	Introduction to Neural and Cognitive Modeling	3-1-0-4	Bapi Raju S
HSS316	Introduction to Philosophy	3-1-0-4	Don Wallace D'Cruz
HSS345a	Introduction to Shakespeare	3-1-0-4	Aruna Chaluvadi
HSS368	Introduction to Sociology	3-1-0-4	Radhika Krishnan
CES644	IS Codes on Design and Structural Safety Assessment	3-1-0-4	Pradeep Kumar R
CSE483	Mobile Robotics	3-1-0-4	Madhava Krishna
M20Temp11	Modern Complexity Theory	3-1-0-4	Girish Varma (50)
M20Temp8	Molecular symmetry and quantum mechanics	3-1-0-4	Harjinder Singh
M20Temp16	Open Quantum Systems and Quantum Thermodynamics	3-1-0-4	Samyadeb Bhattacharya
M20Temp9	Plastic Theory of Structures	3-1-0-4	Venkateshwarlu M
CSE418	Principles of Information Security	3-1-0-4	Srinathan Kannan (100)
CSE415	Principles of Programming Languages	3-1-0-4	Venkatesh Ch (50)
ECE462	Principles of Semiconductor Devices	3-1-0-4	Anshu Sarje
ECE535	Radar Systems	3-1-0-4	K R Sarma
M20Temp12	Real-Time Systems	3-1-0-4	Deepak Gangadhran (50)
CSE540	Research in Information Security	3-0-1-4	Ashok Kumar Das
M20Temp10	Robotics: Dynamics and Control	3-1-0-4	Spandan Roy + Abhishek Sarkar
SCI347	Selected topics in Instrumental Analysis	3-1-0-4	Tapan Kumar Sau
CSE451	Social Science Perspective on HCI	3-1-0-4	Nimmi Rangaswamy
CSE591	Spatial Informatics	3-1-0-4	Rajan KS
ECE448	Speech Signal Processing	3-1-0-4	Anil Kumar V
CSE471	Statistical Methods in AI	3-1-0-4	Jawahar CV
CES635	Structural Wind Engineering	3-1-0-4	Shaik Rehana
CEG445	Technology Product Entrepreneurship **(50)**	3-1-0-4	Ramesh Logangathan + Prakash Yalla
HSS444	Theories and Practices of Nationalism	3-1-0-4	Aniket Alam
CSE484	Topics in Applied Optimization	3-1-0-4	Pawan Kumar
CSE975	Topics in Machine Learning **Prerequisite: Statistical Methods in AI**	3-1-0-4	Naresh Manwani
HSS338	Understanding Raga: Semi Classical Forms of Indian Music	3-1-0-4	Saroja TK
ECE438	Wireless Communications	3-1-0-4	Ubaidulla

Advanced Graphics, AR & VR **3-1-0-4**

Faculty Name: Avinash Sharma + PJ Narayanan

Course Description Format

TITLE: Advance Graphics, Geometry Processing & AR/VR Technologies

Course
Note: Please use course code for previously existing course

TYPE-WHEN: Area Elective (for UG 7th semester and PG 3rd semester*) Monsoon 2020
PRE-REQUISITE: DIP and Computer Vision

OBJECTIVE: The course is designed to introduce advance ideas in Computer Graphics, Geometry Processing and building of AR/VR Technology. The objective of this course is to familiarize the audience with the theoretical as well as practical aspects of Computer Graphics and AR/VR Technology.

COURSE TOPICS:

1. **Computer Graphics Module (5-6 lecture)**

   - Revision to basics of Computer Graphics (Plan to cover primarily using tutorials/flipped classroom sessions): Primitives, Geometric Transformations, Hierarchical Modeling and Viewing Transforms, Clipping Points and Lines, Polygon Filling, Visibility, intro to WebGL.
   - Advance Concepts in Computer Graphics: View Frustum Culling, Depth Buffering, Lighting Shading & Shadows Mapping, Texture Mapping, BRDF, raytracing.

2. **Geometry Processing Module (6-8 lectures)**

   - Representations of 3D Objects: Point Clouds, Implicit Surfaces & Meshes.
   - Point Cloud Registration (ICP).
   - Mesh Reconstruction from Points, Poisson Surface Reconstruction.
   - Polygonization of Implicit Surfaces.
   - Mesh Simplification, Laplacian Smoothing.
   - Introduction to Differential Geometry of Curves and Surfaces.

3. **AR/VR Module (10-12 lectures)**

   - Introduction to Augmented Reality and Virtual Reality.
   - Hardware, Software Interfaces.
   - Light, Optics (Properties of light and lenses).
   - Human Vision System (Depth & Motion perception).
   - Revision of Camera Models & Multi-view Geometry Concepts.
   - Generating 360 degree PhotoSphere / Photogrammetry.
   - 6 DoF Optical Tracking: Outside-in Tracking and Inside-out Tracking.
   - Navigation in Virtual Reality World.

- Rendering Virtual Objects in Augmented Reality.
- Interaction with Virtual Objects in Augmented Reality.

4. **Invited expert talks (1-2 Lectures)**

PREFERRED TEXT BOOKS:

1. Computer Graphics with OpenGL by Hearn and Baker

2. Multiview Geometry in Computer Vision by Hartley & Zisserman.

3. Augmented Reality (1/e), Deiter Schmalstieg and Tobias Hollerer, Addison Wesley.

4. Virtual Reality, Stevan LaValle, Cambridge University Press (Free Online Version)

Other reference content:

- NPTEL short course on VR by Prof. LaValle (video lectures).
- NPTEL course lectures on Computer Graphics (video lectures).

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Quiz 1	**5%**
Mid Sem Exam	**15%**
End Sem Exam	**25%**
Assignments	**30%**
Course Project	**25%**

OUTCOME: By the end of the course, it is expected that students will have very good understanding of existing AR/VR technologies including geometric processing and computer graphics fundamentals, and they should be able to implement such systems on mobile platforms.

***Selected UG 5th semester, PG 1st semester students will be allowed to register (based upon advisor's recommendation and research project alignment).**

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SCI541 Advanced Bio-Molecular Architecture 3-1-0-4

FACULTYNAME : Abhijit Mitra

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 TEXT BOOKS: Text books: 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

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CSE435 Advanced Computer Networks 3-1-0-4

Faculty Name: Sujit Gujar + Shatrunjay Rawat
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 Routing 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

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M20Temp13 **Advances in Data Systems** **3-1-0-4**

Faculty: Krishna Reddy P

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 expected to 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).

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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)

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Advanced NLP 3-1-0-4

Faculty Name: Manish Shrivastava

CES623 Advanced Structural Design 3-1-0-4

Faculty Name: Sunitha P

Type-when: Monsoon 2019

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.

Grading

Assignments	20 %
Term Project	15%
Quiz 1	7.5 %
Quiz 2	7.5 %
Mid-sem	15 %
End-sem	35 %

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.

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ECE468 Analog IC Design 3-1-0-4

FACULTY NAME: Abhishek Srivastava + Zia Abbas
TYPE-WHEN : Monsoon 2020

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, cascode, 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

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem Exam (1)	20%
Quiz (2)	10%
End Sem Exam	30%
Assignments (4)	20%
Project (2)	20%

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Behavioral Methods & Experimental Design 3-1-0-4

Faculty Name: Vinoo Alluri + Bapi Raju S

When: Monsoon 2020

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.

EVALUATION CRITERIA:
Assignments and Quizzes: 30%
Class Participation: 10%
Project: 40%
Exams: 20%

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SCI643 Biomolecular Structure Interactions and Dynamics 3-0-1-4

Faculty Name: B.Gopalakrishnan

Type When: Monsoon-2020

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. Text Book:

1. Bio-Chemistry - Lehninger
2. Bio-Chemistry ı Stryer
3. Biochemistry ı Voet, Voet and

Pratt Syllabus and topic wise

Coverage: Lectures Topics

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 mechanisms ı 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, SwissMod.

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 structures 4. Learning to use and understanding the principles of molecular modeling, docking and molecular dynamics simulations for inferring structures, functions and interactions from sequences ı 5. 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.

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ECE467 CMOS Radio Frequency Integrated Circuit Design 3-1-0-4

Faculty Name: Syed Azeemuddin

Type when: Monsoon - 2020Pre-Requisite:
Pre-requisites: Electronic Circuits and Design, Analog signal design, some basics of EMT

Course Description: Introduction to RF and wireless technology, Basic concepts in RF Design, Passive RFIC components, Review of MOS device Physics, RLC networks, Transmission lines concept, Smith Chart and S-parameters, Bandwidth estimation techniques, biasing circuits, Noise, high-frequency amplifier design techniques, CMOS low noise amplifiers (LNA), An overview of wireless transceiver architectures (If time permits).

Text Book:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge University Press, 2004, ISBN 0521835399.

2. Behzad Razavi, RF Microelectronics, Prentice-Hall 1998, ISBN 0-13-

887571-5. Projects (if any):

1. CMOS low noise amplifier.

Grading:

1. Course Grading Home Work - 10 %

2. Mid-term Exam - 20%

3. Laboratory Assignments - 10%

4. Final Exam - 30%

5. Final project - 30%

Remarks: Home works are due in the class on the assigned due date. Makeup exam will be given only under special circumstances.

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CSE503 Concurrent Data Structures 3-1-0-4

Faculty Name: Govindarajulu R

TYPE-WHEN: Monsoon 2020

PRE-REQUISITE:

OBJECTIVE: The objective of this course is to provide an overview of the challenges involved in designing concurrent data structures and a summary of relevant work for some important data structure classes. A few popular data structures that illustrate key design issues are chosen for implementation in the laboratory sessions.

COURSE TOPICS:

1. Concurrent Objects - Concurrency and Correctness; Quiescent Consistency, Sequential Consistency; Linearizability
2. Spin Locks and Contention - Test-and-Set Locks; Exponential Backoff; Queuelocks
3. Monitors and Blocking Synchronization - Monitor Locks and Conditions; Readers – Writers Locks Semaphores
4. Linked Lists: The Role of Locking - List-based Sets; Course-grained Synchronization, Fine-grained Synchronization, Optimistic Synchronization
5. Concurrent Queues - A Bounded Partial Queue; An unbounded Total Queue; An unbounded Lock-Free Queue
6. Concurrent Stacks - Unbounded Lock-free Stack; Elimination; The Elimination Backoff Stack
7. Counting, Sorting and Distributed Coordination - Shared Counting; Software Combining; and Counting Networks
8. Transactional Memory - Transactions and Atomicity; Software Transactional Memory; Hardware Transactional Memory The proliferation of commercial shared-memory multiprocessor machines has brought about significant changes in the art of concurrent programming. The advent of Multicore architectures has produced a renaissance in the study of highly concurrent architectures. Shared-memory multiprocessors are systems that concurrently execute multiple threads of computation which communicate and synchronize through data structures in shared memory. The efficiency of these data structures is crucial to performance, yet designing effective data structures for multiprocessor machines is an art currently mastered by a few. By most accounts, concurrent data structures are far more difficult to design than sequential once because threads executing concurrently may interleave their steps in many

ways, each with a different and potentially unexpected outcome. Furthermore, new challenges arise in designing scalable concurrent data structures that continue to perform well as machines that execute more and more concurrent threads become available.

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

Maurice Herlihy and Nir Shavit, "The Art of Multiprocessor Programming", Morgan Kaufmann Publication, 2008.

***PROJECT:**

Recent research Papers will be discussed. There are laboratory sessions dealing with the practice of concurrent programming in Java. The number of students that can register for this course is 20.

GRADING (Tentative):

Laboratory Assignments: 20%, Exams: 40%, Project: 40%

OUTCOME:

REMARKS:

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HSS448 Critical Viewing and Reading 3-1-0-4

Faculty Name: Sushmita Banerjee

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 Ramphele 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 PostColonial 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 %) Mid Semester Exam 20% Quiz 10% Assignment 1 20% Assignment 2 20% Final Exam 30%

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 recommended films, and attend film screenings when required.

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CSE447 Data Analytics I 3-1-0-4

Faculty Name: Vikram Pudi

TYPE-WHEN : CS Elective.
PRE-REQUISITE : Data and Applications
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 TEXT BOOKS:

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 their choice.

1. CSV file to the data warehouse
2. Attribute-oriented induction
3. Frequent patterns
4. Classification
5. Clustering
6. Any other data mining exercise of their choice.

GRADING PLAN:

Type of Evaluation	Weightage (in %)	Total Weightage
Quiz-1	At least 3% At most 15%	20% to 60%
Quiz-2	At least 3% At most 15%	
Mid Sem Exam	At least 10% At most 55%	
End Sem Exam	At least 10% at most 55%	
Assignments	0% to 10%	
Project/any other evaluation	At least 40%	40% to 60%

OUTCOME:

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

REMARKS:

A cool first database course.

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CSE441 Data Systems 3-1-0-4

Faculty Name: Kamal Karlapalem

TITLE : Data Systems
Course Code : CSE441
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.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**ADBI**
Mid Sem-2 Exam	**ADBI**
End Sem Exam	**ADBI**
Assignments	**ADBI**
Project	**At least 40%**
Term Paper	**N/A**
Other Evaluation _____	

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.

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ECE469 Design for Testability 3-1-0-4

Faculty Name: Ganesh V. Bhutekar, Renia Inc.

TYPE-WHEN : Monsoon 2019

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 Testabili ty”,Laung-Terng Wang, Cheng-Wen Wu, XiaoqingWen

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:**

GRADING: 2 Mid Sem Exams 2 x 20 40 2 Surprise Tests 10 Final Examination 50 ---------

Total Marks 100 --------- A > 80 B 70 _ 79 C 60 _ 69 D 50 _ 59 E < 50

OUTCOME:

REMARKS:

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CSE478 Digital Image Processing 3-1-0-4

Faculty Name: Ravi Kiran S
TYPE-WHEN: Monsoon 2020
FACULTY NAME: S. Ravi Kiran

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 ofdigital 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**

GRADING:

Type of Evaluation	Weightage (in %)
Quiz-1	5
Quiz-2	5
Mid Sem Exam	10
Assignments	25
End Sem Exam	25
Lab Exam	
Project/any other evaluation	30

45% theory (10% for quizzes, 10% for mid semester exam, 25% for end semester exam) 55% practice (25% for assignments, 30% for final project)

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

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CSE431 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 Alogorithm Maekawa‘s Algorithm Deadlock detection in Distributed Systems: Models of deadlocks, Knapp‘s classification of distributed deadlock detection algorithms. Mitchell and Merrit‘s algorithm for single resource model Consensus and agreement algorithm: Problem definition. Agreement in a failure -free system (synchronous or asynchronous). Agreement in (messagepassing) synchronous system with failures. Agreement in asynchronous message passing systems with failures.

The syllabus includes the following topics:

- RPC, Google protobufs
- Logical clocks, vector clocks, generalized clocks
- Totally ordered multicase
- Mutual exclusion, leader election algorithms
- Deadlock detection/prevention algorithms
- Consensus algorithm, Paxos (possibly Raft)
- Consistency, eventual consistency, monotonic reads, read your writes, etc
- Failure modes, types of failures
- Distributed transactions, 2 phase commit, 3 phase commit
- CAP theorem
- Apache HDFS, MapReduce
- Google BigTable
- Amazon Dynamo DB
- Kafka

Grading:

Quiz 1 and Quiz 2 at 10% each

Mid exam is at 25%
End exam is at 35%
Homeworks at 20%

Reference Books

1) Ajay D. Kshemkalyani and Mukesh Singhal, ―Distributed Computing Principles, Algorithms and

System‖, Cambridge University Press 2008.

2) Sukumar Ghosh, ―Distributed Systems – An Algorithmic Approach‖, Chapman & Hall

ICRC, 2007.

3) M. L. Liu, ―Distributed Computing Principles and Applications‖, Pearson, 2004.

4) George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, ―Distributed Systems Concepts

and Design‖, Fifth Edition, Pearson 2011.

Mukesh Singhal and Niranjan G. Shivaratri, ―Advanced Concepts in Operating Systems‖, TMH, 1994, 2010

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CSE512 Distributing Trust and Block Chains 3-1-0-4

Faculty Name: Sujit Gujar

TYPE-WHEN : Monsoon 2020

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 21st century. There are people who believe it is a gold where as 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.

COURSE TOPICS :

(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 it is 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, ZeroCash etc.
(viii) Differential Privacy: Concepts and important results

PREFERRED TEXT BOOKS:

Bitcoin and Cryptocurrency Technologies, Narayanan, Bonneau, Felten, Miller, Goldfeder, Clark, Princeton University Press 2016

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

***PROJECT:GRADING PLAN:**

Type of Evaluation	Weightage (in %)
Mid Sem Exam	**20**
End Sem Exam	**30**
Home Works/Quizzes	**10**

Programming/Reading Assignments	**30**
Scribes	**5**
Course Participation	**5**

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 chain technology.

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.

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IMA411 Entropy and Information 3-1-0-4

Faculty Name: Indranil Chakrabarthy

PRE-REQUISITE : Basic Probability Theory

OBJECTIVE : To give an exhaustive overview of the Mathematical Framework on Information Theory

COURSE TOPICS :

1. **ENTROPY CONCEPT IN PROBABILITY THEORY:** Entropy of Finite Schemes, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Chain Rules, The Uniqueness Theorem, Jensen's Inequality and its consequences, Log Sum Inequality and its applications, Data Processing Inequalities, Sufficient Statistics, Fano's Inequality.

2. **PROBABILITY MEASURE AND ASYMPTOTIC EQUIPARTION PROPERTY:** Probablity as a measure, Law of Large Number, Assymptotic Equipartition Theorem (AEP), Data Compression, Typical Sets, Gambling and Data Compression.

3. **ENTROPY RATES OF A STOCHASTIC PROCESS:** Entropy of Markov Chains, Entropy Rate, Entropy Rate of a random walk on a weighted graph, Hidden Markov Models, Fundamental Theorems.

4. **DATA COMPRESSION:** Kraft Innequality, Optimal Codes, Bound on the optimal code length, Kraft inequality for Uniquely Decodable Codes, Huffman Codes, Optimality of Huffman code

5. **CHANNEL CAPACITY:** Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Joint Typical Sequence, Channel Coding theorem, Zero Error Codes, Fano's Inequality and Converse of Channel Coding Theorem, Feedback Capacity

6. **DIFFERENTIAL ENTROPY MAXIMUM ENTROPY AND SPECTRAL ESTIMATION:** Definition, AEP for Continous Random Variable, Relation of Differential Entropy to Discrete Entropy, Joint and Conditional Entropy, Relative Entropy and Mutual Information, Maximum Entropy distributions, Anamolous Maximum Entropy Problem, Spectrum Estimation.

PREFERRED TEXT BOOKS: Elements of Information Theory, Thomas. M. Cover, Joy. A. Thomas; Wiley Series in Telecommunication.

***REFERENCE BOOKS: (I will update it later)**

***PROJECT:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizz 1 and 2	**10% each**
Mid Sem Exam	**15%**
End Sem Exam	**30%**
Assignments	**15%**
Project	**20%**

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CSE596 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 relatedwith 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 TEXT BOOKS:

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.

GRADING PLAN:

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

Project	**25**

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

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CEA621 Finite Element Methods 3-1-0-4

Faculty Name: Venkateshwarlu M

TYPE-WHEN: Monsoon Semester

PRE-REQUISITE: Calculus and Linear Algebra

OBJECTIVE: Solution of differential equations by Finite Element Method and its application to heat conduction and elasticity problems..

COURSE TOPICS: Introduction - Strong and Weak forms for one dimensional heat conduction and elasticity problems – Finite Element Formulation for one dimensional problems, shape functions, Finite Element Equations, Examples, numerical Integration – Mathematical Preliminaries, Green's theorem, Divergence theorem – Scalar Field Problems, Strong and weak forms for two dimensional heat conduction, Three Node Triangular Elements, four node rectangular elements, iso -parametric elements, four node quadrilateral element, numerical integration, higher order elements – Multi dimensional elasticity, strain tensor, stress tensor, constitutive law, coordinate transformations, strong form , weak form, finite element formulation, iso -parametric finite elements - Structural Mechanics, beams, Euler-Bernoulli beam theory, strong and weak forms, finite element formulation, coordinate transformations , Timoshenko beam theory, plane truss, plane frame.

PREFERRED TEXT BOOKS: Finite Element Method by Kwon
***REFERENCE BOOKS:** Finite Element Method by S.S.Rao, Finite Element method by JN Reddy

***PROJECT:**

GRADING:

40 marks: Assignments (8)

30 marks: Mid-Semester Exams (2)

30 marks:End-Semester Exams (1)

OUTCOME: Student will get a basic understanding of the use of Finite Element Method in heat conduction and elasticity problems and will enable him to pursue its other applications.

REMARKS:

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IMA301 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 TEXT BOOKS: **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**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**20**
Quiz-2	**20**
	Best of two /average
Assignments	**20**
Project	**30**
Term Paper	
End Exam	**30**

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

REMARKS:

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CSE464 Game Design and Engineering 3-1-0-4

Faculty Name: Kavita Vemuri

TYPE-WHEN: Monsoon 2020
FACULTY NAME: Kavita Vemuri
PRE-REQUISITE: None

OBJECTIVE:The course introduces aspects fundamental to game design, genres, technology analysis and development for market. The course gives equal emphasis to digital, board and physical games.

COURSE TOPICS: This course is designed to introduce the critical aspects of games design and development. Students will go through a structured process involving theory and practical classes to understand game development. Equal emphasis is given to non-virtual or digital games including board games, electronic games like rhythm mat and/or games that require physical devices. The main goal is to get create patentable ideas. The theory classes will cover aspects like theme, narrative, technology (single player versus multiplayer, managing data, rendering etc.,), game play, player experience, material analysis in the case of physical games, marketing and animation. In game play, basics like game engine (digital) and game logic models

will also covered. Experts from industry will cover animation and certain topics in marketing. In the lab class, the teams will huddle to conceptualize the idea, structure the game design documents, present their ideas and finalize technology issues. The secondary or even primary goal in some cases is to use of CAD/CAM like tools to come up with schematics of any physical implement required for the game and actually solder, cut, fabricate and paint ….

Syllabus (theory classes)

1. What is a game?
- Games Overview - A Theory of Fun; History of Games.
- History of Computer Games

2. What are the elements of a game?
In this part, we cover the elements of a game, with emphasis on the four major ones. Case studies of games in which one or more of these elements have made the game will be analysed.
- Mechanics: rules & procedures of the game.
- Story: events that bind the game together.
- Aesthetics: game's look, feel and sounds.
- Technology: high-technology to materials (paper, sensors, wood etc.,)

3. Principles of Game Design:
-Layers of Game Design
- Design Issues
- Preproduction and Documentation
- Design Trade Offs
- Poor Design
End of this part, the Game Design Document is prepared.

3. Who is the player?
- Game Genre and player
- Cutting through the noise from player (likes, dislikes...)

4. What is player's experience?
- measuring player's experience
- Cognitive behavior measurement techniques

Understanding and measuring player's experiences during game play is an important test for optimal game designs. Player's experiences are recorded by many techniques. This part will analyze each of the technique and the value addition of each. Some experimental work will be required using tools like simple EEG, ECG/GSR and eye tracking.

5. How to design game mechanics?
- Decision-making, types of decisions
- Flow theory.
- Special dynamics: feedback loops, emergence and intentionality

6. What's game interface?
- User Interface design.
- Differences between digital and non-digital UI.
- User Interface iteration

7. How to create a game script/story?
- Linear & Nonlinear storytelling

8. Building a game with technologies
-Analysis of game engines (Unity, XNA)
- AI versus HI in game development.
- Computer graphics & animation
- Physics engine –collision detection

9. Testing a game.
- Solo testing.
- Critical analysis
- Designer testing.
- Player testing

10. Marketing the game

11. Ethics, Culture, Violence in Games and Responsibilities

PREFERRED TEXT BOOKS:

1. The Art of Game Design, Jesse Schell, 2008. 2. Challenges for Game Designers, Brenda Brathwaite

***REFERENCE BOOKS:**

1. Characteristics of Games, Elias, Garfield, and Gutschera, 2012, MIT Press
2. Game Design and Development: Introduction to the Game Industry. Moore, Mi chael. Reference papers on serious games, board games, swarm/biological behavior, cognition and games etc.,

***PROJECT:**

Each team of 3 will conceptualize, design, prototype and test 2 unique games. Number of Project: 2

P1: Design and prototype a board game that explains a concept. This can be trading, friendship, education, jobs, global trade, social media etc., think on the lines of games like monopoly, go, chess etc., Use readily available material to make the prototype. Game play, rules and player demographics will make up your report.

P2: Design and develop/engineer a game virtual or live -action game that can be used for physical therapy. Virtual game – for carpal tunnel syndrome (look up the web for this occupational hazard). Liveaction game: which can help people exercise their lower back (a major issue with people who sit for long hours)? Materials for the virtual game can include Kinnect or joy sticks. Interfaces need be assembled. For the live-action, raw materials which are readily available need to be used and also fabrication like injection molding should be avoided. Sensors can be used, if electronic games are selected.

GRADING:

Game ideas (15%), Mid-term (25%), Assignments (15%), projects (50%).

OUTCOME:

At least couple of design patents. Selected games ideas to the annual Game Developer Conference, transfer/license and most importantly connecting theory to practice/real product **REMARKS:**
The course requires a lot lab type of work. Considering that animation experts and animators are not available, some creativity is encouraged to create avatars, characters for the digital games and layouts for the physical games. Half of the class hours will be in a lab room or work space. This space will be kept open throughout the semester for students to work at any time.

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HSS339 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: <u>Core concepts and terms</u>

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 TEXT BOOKS:

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 in India, 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 gender discourse. 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 screenings when required.

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CEW613 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 aboutwater 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.

COURSE TOPICS **:**

- **Introduction:**fundamentals of fluid mechanics and open channel flows; hydrology, rainfall and runoff processes andhydro-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**: Open source public domain software based on Microsoft Windows environment: US Environmental Protection Agency'sEPANET, Qual2k, SWMM;MatlabTools: Air2stream; Windows based decision support system: WEAP
- **Development and Application of Software**:Real-world applications at various scales for waterresources management

PREFERRED TEXT BOOKS:

- 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., New York.
- Haan T. C., *Statistical Methods in Hydrology*, East West Publishers, 1998.
- SK Som and G Biswas, Introduction to Fluid Mechanics and Fluid Machines

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.

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CEB411 Illumination Engineering 3-1-0-4

Faculty Name: Vishal Garg

flipped classroom pedagogy and this is the NPTEL course. Students may refer: https://nptel.ac.in/courses/108/105/108105060/

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CSE474 Information Retrieval & Extraction 3-1-0-4

Faculty Name: Vasudeva Varma

TYPE-WHEN: Monsoon-2020

PRE-REQUISITE:

OBJECTIVE:

COURSE TOPICS: Search, Information Retrieval, Information Extraction - An Introduction (Function of an IR system, Kinds of IR systems, Components of an IR system, Problems in designing an IR system., The nature of unstructured and semi-structured text).

Role of Language Processing in Search, IR and IE, Role of Machine Learning in Search, IR and IE, Modeling documents for IR purpose - Vector model, term weighing, Similarity measures, text collections and issues, Text processing and Indexing Techniques (Preliminary stages of text analysis and document processing, tokenization, stemming, lemmatization, stop words, phrases), Data Structures for IR and IE, distributed and Parallel IR (Advanced Indexing, query expansion, Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes, Index compression, Web Based Search, Page Ranking, LSI, Evaluation of IR and IE Systems, Ontologies and Categorization, Named Entity Recognition, Personalization, Question Answering, Summarization Cross Lingual Information Retrieval, Other applications and Conclusions,

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS**: 1. Modern Information Retrieval, by R. Baeza-Yates and B. Ribeiro-Neto. 2. Information

Retrieval: Algorithms and Heuristics by D. Grossman and O. Frieder

***PROJECT:** There are no home assignments. This is a project Intensive course. Groups will have project deliverables every alternate week. Project Deliverable: Finalize the project, Preliminary study and requirements Specification document, Architecture and D

GRADING:

Type of Evaluation	Weightage (in %)
Quiz-1	0
Quiz-2	0
Mid Sem Exam	10
Assignments	15
End Sem Exam	15
Lab Exam	0
Project/any other evaluation	60

OUTCOME:

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CSE485 Intro to Cognitive Science 3-1-0-4

Faculty Name: 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 TEXT BOOKS: (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 Science, 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.

GRADING (indicative only): Mid-term Exams (2): 30% Final Exam: 40% Project: 20% Quizzes, Assignments, Class Attendance and Participation: 10%

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 behaviour.

REMARKS:

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HSS351a Intro to Psychology 3-1-0-4

Faculty Name: Priyanka Srivastava

Type when: Monsoon 2020

Pre-requisite: NoneCourse 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 theMind
3. Evolutionary Psychology
4. Human Development
5. Sensation, Perception, Attention, andAwareness

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 of two 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 co nduct 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 / c ontradictory findings

Grading:

1. Assignments: 20%
   a. Brief Write up (10%)
   b. Class presentations (5%)
   c. Peer review (5%)
2. Quizzes 10%
3. Mid-Term II –20%
4. Final Term –20%
5. Project – 30%
   a. Project ideas (10%)
   b. Conducting study (10%)
   c. Final report and presentation (10%)

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/f3763236185c4c41ac182ad823e70b64/5e64 28fae8ed446ba4ca1f07f80bc9c1/)

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HSS343a Introduction to History 3-1-0-4

Faculty Name: Ashwin Jayanti

TYPE-WHEN: Humanities Elective, Monsoon 2020

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.

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

***REFERENCEBOOKS:** 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 historicalmethods.

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.

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CSE486 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 TEXT BOOKS:

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, OUP Oxford.
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)
GRADING:
Mid-term Exam(s) (1): 30%
Final Exam: 35%
Quiz / Assignment / Project: 30%
Other: 5%

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:

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HSS316 Introduction to Philosophy 3-1-0-4

Faculty Name: Don Wallace D'Cruz
Type-When: This is based on EdX
course: https://www.edx.org/course/introduction-philosophy-god-knowledge-mitx-24-00x

Students have to register at the above link to download study material for a self-study and attend a group discussion session once a week for 1.5 hrs. Evaluations will be done by the course instructor and **not** EdX.
Monsoon 2020

Pre Requisite: none

Objective: This course will look at some perennial philosophical problems: Is there a God? What is knowledge, and how do we get it? What is the place of our consciousness in the physical world? As this course is meant to develop self-learning, it is not lecture-based. This

course will be carried out by having discussions and writing assignments as well as term paper. This will help to develop the critical reasoning and argumentative skills more generally.

Course topics and related readings

Part 1: God

Week 01

Meeting 1: Introduction (For God: The Ontological

Argument) Meeting 2: Assessing Arguments

Week 02

Meeting 3: For God: We See

Design Meeting 4: Against God:

The Problem of Evil **Week 03**

Meeting 5: For God: Pascal's

Wager ***Part 2: Knowledge and***

Justified Belief **Week 04**

Meeting 6: What is

Knowledge? Meeting 7:

SkepticismAbout Knowledge

Week 05

Meeting 8: SkepticismAbout Justified Belief, Part 1: The Old Problem

of Induction Meeting 9: SkepticismAbout Justified Belief, Part 2: The

New Problem of Induction ***Part 3: Mind and Consciousness***

Week 06

Meeting 10: How Things

Feel Meeting 11:

Science Strikes Back

Week 07

Meeting 12: Thinking Machines

Part 4: Free Will

Week 08

Meeting 13: Free Will and Determinism Meeting 14: Freedom Without Alternatives

Week 09

Meeting 15: A Compatibalist Theory of Free Will

Part 5: Personal Identity

Week 10

Meeting 16: The Psychological Criterion of Personal Identity Over Time I Meeting 17: The Psychological Criterion of Personal Identity Over Time II **Grading:**

Assignments = 20%

Discussion group participation = 30% Term paper 20%

Final exam = 30%

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HSS345a Introduction to Shakespeare 3-1-0-4

Faculty Name: Aruna Chaluvadi

TYPE-WHEN : Monsoon 2020

PRE-REQUISITE : 3rd and 4th year students
OBJECTIVE : To introduce Shakespeare through critical readings from his Plays and Sonnets

COURSE TOPICS :

Reading with Explanation : Romeo and Juliet
: King Lear
: Henry IV

General Introduction (Movies) : Othello, Hamlet, Macbeth, Julius Caesar, The Merchant of Venice, The Taming of the Shrew

Sonnets: Explanation and Recitation
PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

***PROJECT:**

GRADING

PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**20%**
Mid Sem-2 Exam	**20%**
End Sem Exam	**40%**
Assignment : Characters and Contexts in Shakespeare (Presentation)	**10%**
Surprize Quiz	**10%**

OUTCOME: Introduction to Shakespeare; Students would be able to read and appreciate Shakespeare on their own.

REMARKS

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HSS368 Introduction to Sociology 3-1-0-4

Faculty Name: Radhika Krishnan

TYPE-WHEN : Monsoon 2020

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:

(2) Sociological concepts
(3) Sociological methods
(4) Study of social institutions in India
(5) 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.

GRADING PLAN:

Type of Evaluation	**Weightage**
Quiz-1	0%
Quiz-2	0%

Mid Sem Exam	25%
Assignments	35% (4-5 assignments, based on readings)
End Sem Exam	40%
Lab Exam	0%
Project/any other evaluation	0%

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.

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CES644 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 **:**

1. 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 Structu ral 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

GRADING:

- 50 marks: Assignments (6) + Project (2)
- 20 marks: Mid-Semester Exams (1)
- 30 marks: End-Semester Exam (1)

OUTCOME:

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

REMARKS: None

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CSE483 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, op timization 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

GRADING:

Mid Sem II - (20%)

End Sem - 20%

3 Projects - 20% Each

OUTCOME: The student is expected to be aware of state 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:

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Modern Complexity Theory 3-1-0-4

Faculty: Girish Varma

Note: Please use course code for previously existing course

TYPE-WHEN :
FACULTY NAME :

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

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	10
Mid SemExam	20
Quiz-2	10
End Sem Exam	35
Assignments	25
Project	None
Term Paper	None
Other Evaluation _____	None

OUTCOME:

REMARKS:

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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 TEXT BOOKS:

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

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	**30**
Final Exam	**45**
Assignments	**25**

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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.

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Mid Sem-1 Exam	**10%**
Mid Sem-2 Exam	**25%**

End Sem Exam	**35%**
Assignments	**5%**
Project	**25%**
Term Paper	
Other Evaluation _____	

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

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.

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Plastic Theory of Structures 3-1-0-4

Faculty Name: Venkateshwarlu M

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CSE418 Principles of Information Security 3-1-0-4

Faculty Name: Srinathan Kannan

TYPE-WHEN : Monsoon 2020
PRE-REQUISITE : Algorithms
OBJECTIVE:
To discuss on the fundamentals of the state-of-the-art information security protocols

COURSE TOPICS:

Classical cryptography and their cryptanalysis, perfect secrecy, Shannon's theorem, pseudorandom generators, stream ciphers, CPA-secure encryption, pseudorandom permutations, practical block ciphers (3-DES, AES), modes of operation, MACs, Hash functions, CCA-secure encryption, Diffie-Hellman key exchange, Public key cryptosystems (RSA, El Gamal, Paillier, Rabin, Goldwasser-Micali), PKCSv1.5, digital signatures, DSS, digital certificates and

PKI,
basic cryptographic protocols, oblivious transfer, secret sharing, Byzantine agreement, secure multiparty computation, interactive proof systems, cryptography in noisy channels and quantum cryptography.
TEXTBOOK:
Y. Lindell and J. Katz. Introduction to Modern Cryptography. MIT press.
REFERENCE BOOKS:
(a) Oded Goldreich. Foundations of Modern cryptography: Parts I and II. Cambridge Press. 2001.
(b) A. Menezes, P.C. van Oorschot and S.A. Vanstone. Handbook of Applied Cryptography, CRC Press, 1996.
GRADING :
Mid-sem exams: [40\% GRADE]
End-sem exam: [40\% GRADE]
Term-paper/Assignments: [20\% GRADE]
OUTCOME:
The course will be useful for students who plan to do research/product development/analysis in areas related to secure computing in their career.

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CSE415 Principles of Programming Languages 3-1-0-4

Faculty Name: Venkatesh Ch

TYPE-WHEN **:** Monsson-2020

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.ImperativeProgramming. 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. Arithmatic and Algrbricinterpreters. 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 TEXT BOOKS:
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++ or Python.
- 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:

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ECE462 Principles of Semiconductor Devices 3-1-0-4

Faculty Name: Anshu Sarje

Type-When: Elective Course – Monsoon 2020

Pre-requisite: Electronic Circuits

Course Overview: The course details the physics of various semiconductor devices and relates it to their electrical characteristics. Popular devices like PN-junction diodes, MOS Capacitors, various MOSFETs and BJTs are discussed in detail along with their circuit simulation models. An overview of advanced Integrated Circuit Technology is provided at the end of the course.

Course Topics

• Fundamentals of semiconductors: Band structure, Electron-hole statistics, Intrinsic and Extrinsic semiconductors, Band diagrams, Carrier transport Mechanisms, generation- recombination, optical absorption and emission, basics of circuit models and parameter extraction.

• P-N junctions: Physics of P-N junction, Diode electrical characteristics, charge storage and transient behavior, Circuit model, Junction break down, Zener diode, Schottky diodes, photo diode, Solar cell, tunnel diode, LED and laser diode.

• Bipolar Junction transistors: Transistor physics, Circuit models for BJT, Frequency response and switching of BJTs, Non-ideal effects, Hetero-junction Bipolar transistors, power BJTs.

• Metal Oxide Semiconductor capacitor: MOS capacitor – structure and regions of operation, electrical characteristics, interface states, flat-band condition, small-signal capacitances.

• Metal Oxide Semiconductor Field Effect Transistor: Regions of operation, Body effect, threshold voltage, popular MOSFET SPICE models, Scaling laws, Short geometry effects, Integrated circuit technology.

• Advanced Integrated Circuit Technology: Principles and technology of advanced devices for future IC technology- Devices like UTBSOI, FinFETS, HEMTs, Tunnel FETS will be introduced.

Referred Text books:

• "Fundamentals of modern VLSI device," by Y Taur & TH Ning, Cambridge UniversityPress.

• "Semiconductor Devices: Physics and Technology," by Simon M. Sze, Ming-Kwei Lee, Wiley, 2012.

• "Solid State Electronic Devices," by Ben Streetman, Sanjay Banerjee.

Reference books:

• "Semiconductor Device Fundamentals," by R.F. Pierret, Addison-Wesley, 1996.

• "Semiconductor Devices, An Introduction," by Jasprit Singh, McGraw-Hill.
• Current literature from journal and conference proceedings.

Course Objectives

The course aims in providing the essential link between the devices and their circuits. From this course, student will appreciate how the physics of the device gets related to its electrical properties, which in- turn determines the circuit applications.

Remarks

Final projects of the course will use the existing Circuit simulator from Cadence.

Grading Policy

1. Home Works - 15%
2. Mid-term 1 Exam - 20%
3. Mid-term 2 Exam - 20%
4. Final project - 10%
5. Class Participation and Quizzes – 5%
6. Final Exam – 30%

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ECE535 Radar Systems 3-1-0-4

Faculty Name: K R Sarma

TYPE-WHEN : Elective, Monsoon 2020
PRE-REQUISITE : Signals and Systems, Communication Theory
OBJECTIVE :
COURSE TOPICS :
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 Tme Bandwidth product,Uncertainity 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, Swerling Models Noise and Clutter , their characterization as random processes. Radar detection and estimation Theory- Simple binary detection optimum receiver Matched filter, Probability of detection andf false alarm. Neymen Pearson criterion. Coherent detection vs non-coherent detection. Optimum non-coherent detector-I0 detector Multiple observationscoherent and non-coherent integration PD and PF for Sweling Models for coherent and Non-coherent integration
Optimum receiver for delay and Doppler estimation- matched filter Range Doppler signal processing 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 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 in side looking SAR. Signal processing of SAR, Radar imaging . Other variants of SAR- polarimetric SAR, Interferometric SAR Diverse applications of Radar techniques

PREFERRED TEXT BOOKS:

1. Mark A.Richards: Principles of Modern Radar V 1 Scietech Publishing 2010
2. Mark A Richards: Radar Signal Processing Mc Graw Hill
(Both the books are available in International Editions)

***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, Barton, Hovanessian, Eli Brockner,Kock,DiFranco and Rubin, Rihaczek, Kahrilas

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Mid Sem-1 Exam	20
Mid Sem-2 Exam	20
End Sem Exam	30
Assignments	10
Term Paper	20

OUTCOME: Good overview of the state of the art in Radar technology

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

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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.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**10**
Mid Sem-2 Exam	**10**
End Sem Exam	**25**
Assignments	**15**
Project	**25**
Term Paper	
Other Evaluation – Research Paper Presentation	**15**

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:

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CSE540 Research in Information Security 3-0-1-4

Faculty Name: Ashok Kumar Das

Type When: Monsoon 2020

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

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* 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 TEXT BOOKS:

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 degree or advance research. However, if student choose to work on the project during the course, they can do. So, this is optional.

Grading Policy

Type of Evaluation	Weightage (in %)
Quiz-1	5%
Quiz-2	5%
Mid Sem Exam	25%
Assignments	--
End Sem Exam	35%
Lab Exam	--
Project/any other evaluation	30%

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.

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Robotics: Dynamics and Control 3-1-0-4

Faculty Name: Spandan Roy + Abhishek Sarkar

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:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	20
Mid Sem-2 Exam	
End Sem Exam	30
Assignments	25
Project	

	25
Term Paper	
Other Evaluation _____	

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:

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SCI347 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

GRADING PLAN:
For the year 2020: Quizzes: 20% + Assignments: 50% + Final Assignment/Quiz: 30%

Type of Evaluation	Weightage (in %)
Quiz-1	10
Mid SemExam	20
Quiz-2	10
End Sem Exam	40
Assignments	20
Project	None
Term Paper	None
Other Evaluation _____	None

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.**

**********CS

E451 Social Science Perspective on HCI 3-1-0-4

Faculty Name: Nimmi Rangaswamy

TYPE-WHEN : Monsoon 2020

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 :**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz	**20**
Class presentation of project	**30**
Assignments	**20**
Project reports	**30**
Other Evaluation	**NA**

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:

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CSE591 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 PhD students

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. 3D GIS
    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 TEXT BOOKS:

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 Worboys and Matt Duckham
4. Concepts and techniques of geographic information systems by C P Lo and Albert K W Yeung

GRADING:

Details of Assignments/Projects will be announced during the course.

Type of Evaluation	Weightage (in %)
Quiz-1	10
Quiz-2	10
Mid Sem Exam	20
Assignments	10
End Sem Exam	30
Lab Exam	Part of Assignments
Project/any other evaluation	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.

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ECE448 Speech Signal Processing 3-1-0-4

Faculty Name: Anil Kumar V

Type-when: Monsoon-2020

Pre-Requisite: (PG, research and BTech students from 3rd year onwards will be permitted) Signal and

systems Digital signal processing.

COURSE TOPICS: Background and need for speech processing, Speech production mechanism, Nature of speech signal, Basics of digital signal processing, Equivalent representations of signal and systems, Speech signal processing methods, Linear prediction analysis, Basics of speech recognition.

PREFERRED TEXT BOOKS: 1. L.R.Rabiner and B.H Juang, Fundamentals of speech recognition, Pearson LPE (1993). 2. L.R.Rabiner and R.W.Schafer, Digital processing of speech signals, Pearson LPE (1993).

GRADING:

Quiz-1: 10%

Quiz-2: 10%

Mid Sem Exam: 20%

Assignments: 10%

End Sem Exam: 40%

Project/any other evaluation: 10%

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CSE471 Statistical Methods in AI 3-1-0-4

Faculty: Jawahar CV

TYPE-WHEN : Monsoon - 2020

Lectures : Mondays, Thursdays; 3:30pm -5:00pm

COURSE TOPICS :

. 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, Kernalization

. Data Clustering, Kmeans (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:
***** Assignments 3: 20% (1 Mini-project + 2 Assignments)
***** Homeworks: 30% (2-4 problems given after each lecture; Top 80% counted)
***** Two MidSems : 30%
***** Final Exam : 20%

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

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CES635 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 onstructures, 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 TEXT BOOKS:

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.

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CEG445 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 mo de 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)

4 quizzes (20%), 4 labs (20%), Tech Product Biz plan (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 each week.

• 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

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HSS444 Theories and Pratices of Nationalism 3-1-0-4

Faculty Name: Aniket Alam

TYPE-WHEN :

PRE-REQUISITE :

OBJECTIVE: This course intends to introduce students to the manner in which nationalism has been conceptualised by nationalists in India and also to the academic theories of nation-states and nationalism. It will provide a perspective to understand the dynamics and complexities of nationalism in our world today and appreciate its salience.

COURSE TOPICS : (1) Academic theories of Nationalism

a) Imagined Communities
b) Industrialised Societies
c) Colonial and Post-Colonial

(2) Brief history of the nation-state in the world

a) Latin America
b) Europe
c) Japan, China, Arab

(3) Nationalism in India
a) Cultural Nationalism
b) Anti-Colonial Nationalism

(4) Theories of Nationalism in India
a) Gandhi
b) Bankim
c) Nehru
d) Tagore
e) Savarkar, Golwalkar

PREFERRED TEXT BOOKS:

Ernest Gellner: *Nations and Nationalisms*.
Benedict Anderson: *Imagined Communities*.
Partha Chatterjee: *Nationalist Thought and the Colonial W*
Javeed Alam: *India- Living With Modernity*
Sumit Sarkar: *Modern India*.
Bipan Chandra: *India's Struggle for Independence*.

***REFERENCE BOOKS:**

M.K. Gandhi: *Hind Swaraj*.
V. D. Savarkar: *Hindutva*.

Rabindranath Tagore: *Nationalism*.
M. S. Golwalkar: *We or Our Nationhood Defined*. Jawaharlal Nehru: *Discovery of India*.
Bankim Chandra Chattopadhyay: *Anandamath.*

Rabindranath Tagore: *Gora*.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**0**
Mid Sem-2 Exam	**20%**
End Sem Exam	**40%**
Class Assignments (TWO)	**10% (5 + 5)**
Term Paper (In Lieu of Mid Sem-1)	**20%**
Other Evaluation (Book Review)	**10%**

OUTCOME: The student will get an overview of the history of nationalism and will be introduced to how it has been theorized over the past century and more. S/he will also be able to trace nationalism's trajectories in India, recognize its main debates and understand

its historical role in constituting our present day conditions.

REMARKS: The course will be based on lectures and the students will be expected to read all the books given in the reading list.

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CSE484 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 applythem 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 TEXT BOOKS:
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.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**15**
Mid Sem-2 Exam	**15**
End Sem Exam	**30**
Assignments	**10**
Project	**20**
Term Paper	
Other Evaluation: Quizzes	**10**

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

REMARKS:

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CSE975 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.

GRADING PLAN:

Type of Evaluation Weightage (in %)

Quizzes (2) 7.5% + 7.5% = 15 %

Mid Sem Exam (1)

20% End Sem Exam

20% Assignments

25%

Project 15%

Scribing 5%

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HSS338 Understanding Raga: Semi Classical Forms of Indian Music 3-1-0-4

Faculty Name: Saroja TK

TYPE-WHEN : Open Elective- Monsoon 2020

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 different ragas.

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 TEXT BOOKS:

***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.

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ECE438 Wireless Communications 3-1-0-4

Faculty Name: Ubaidulla

TYPE-WHEN : Monsoon 2020

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, top ological 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)

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**25**
Mid Sem-2 Exam	**25**
End Sem Exam	**-**
Assignments/Quizzes	**20**
Project	**30**
Term Paper	**--**
Other Evaluation:	**---**

OUTCOME:REM

ARKS:

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Sd/ -

Dean (Academics)