INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

Syllabus for the courses of Monsoon 2022 Semester

Ver.2-(23-07-2022)

Sl. No.	Course Code	Course Name	Faculty
1	CS3.402	Advanced Computer Networks	Ankit Gangwal
2	CS5.502	Advanced Graphics, AR & VR	Avinash Sharma, Narayanan P J
3	CS7.501	Advanced NLP	Manish Srivastava
4	CS3.304	Advanced Operating Systems	Manish Srivastava
5	CE1.604	Advanced Structural Design	Sunitha Palissery
6	CS4.502	Advances in Data Mining	Vikram Pudi
7	CS1.301	Algorithm Analysis & Design	Suryajith Chillara
8	EC2.401	Analog IC Design	Abhishek Srivastava
9	HS0.303	Applied Ethics	Ashwin Jayanti
10	CS1.302	Automata Theory	Shantanav Chakraborty
11	HS0.203	Basics of Ethics	Ashwin Jayanti
12	CS9.421	Behavioral Research & Experimental Design	Vinoo A R
13	EC1.301	Bio Instrumentation & Devices-2	Anshu Sarje
14	SC3.202	Bioinformatics	Nita Parekh
15	SC3.321	Biomolecular Structure Interaction and Dynamics	Gopalakrishna B
16	PD2.422	Business Finance	Mayank Mathur
17	PD2.321	Business Fundamentals-1	Himanshu Warudkar
18	PD2.421	Business Fundamentals-2	Himanshu Warudkar
19	CE9.600	CASE Seminar-2 Credits	Pradeep Kumar Ramancharla,Sunitha Palissery
20	SC2.305	Chemical Kinetics and Reaction Dynamics	Prabhakar Bhimalapuram,Prabhakar Bhimalapuram
21	CL3.202	Computational Linguistics II: Comp Semantics and Discourse parsing	Radhika Mamidi
22	CS0.301	Computer Problem Solving	Lini Teresa Thomas
23	HS1.301	Critical Viewing and Reading	Sushmita Banerji
24	CS4.405	Data Analytics I	Krishna Reddy Polepalli
25	CS4.301	Data and Applications	Ponnurangam Kumaraguru
26	SC4.412	Data Driven Drug Discovery	Deva Priyakumar
27	CS1.304	Data Structures & Algorithms for Problem Solving	Vineet Gandhi
28	CS4.401	Data Systems	Kamalakar Karlapalem
29	CS7.601	Deep Learning- Theory and Practices	Naresh Manwani
30	CS9.429	Design for Social Innovation	Ramesh Loganathan

31	EC2.407	Design for Testability	Usha Gogineni
32	PD1.502	Design of Wearable Systems	Raghu Babu Reddy Y
33	PD1.401	Design Thinking - Idea to Evaluate	Raman Saxena
34	PD1.301	Design Thinking - Research to Define	Raman Saxena
35	CS7.404	Digital Image Processing	Santosh Ravi Kiran
36	CS3.401	Distributed Systems	Kishore Kothapalli
37	CS3.403	Distributing Trust & Blockchains	Sujit P Gujar
38	CE1.607	Earthquake Resistant Design of Masonry Structures	P Pravin Kumar Venkat Rao
39	EC3.202a	Embedded Systems Workshop	Sachin Chaudhari,Abhishek Srivastava
40	EC3.202	Embedded Systems Workshop	Zia Abbas,Aftab M. Hussain
41	CS1.407	Entropy and Information	Indranil Chakrabarty
42	HS4.301	Environment & Politics in India	Radhika Krishnan
43	CS9.428	Environmental Science & Technology	Ramachandra Prasad Pillutla
44	CS7.504	Fairness, Privacy and Ethics in AI	Sujit P Gujar
45	CE4.501	Finite Element Method	Venkateswarlu Mandadi
46	CS9.438	Game Design and Engineering	Kavita Vemuri
47	HS8.201	Gender and Society	Sushmita Banerji
48	PD1.501	Human Computer Interaction	Raman Saxena
49	CE5.502	Hydrological modelling and Software Development	Rehana Shaik
50	CS4.406	Information Retrieval and Extraction	Vasudeva Varma Kalidindi
51	EC5.410	Information Theory	Lalitha Vadlamani,Arti Yardi
52	CS9.426	Intro to Cognitive Science	Vishnu Sreekumar
53	CS9.427	Intro to Neural and Cognitive Modeling	Bapiraju Surampudi
54	HS2.202	Intro to Psychology	Priyanka Srivastava
55	SC3.101	Introduction to Biology	Vinod Palakkad Krishnanunni
56	HS3.201	Introduction to History	Aniket Alam
57	HS1.204	Introduction to Literature	Nazia Akhtar
58	CS9.423	Introduction to Neuroeconomics	Kavita Vemuri
59	HS4.201	Introduction to Politics	Aniket Alam
60	SC1.421	Introduction to Quantum Field Theory	Diganta Das
61	HS2.201	Introduction to Sociology	Radhika Krishnan
62	SC1.320	Introduction to Stochastic Processes	Bhaswar Ghosh
63	CE9.609	IoT Workshop	Nagamanikandan Govindan,Sachin Chaudhari
64	CE1.605	IS Codes on Design and structural Safety Assessment	Pradeep Kumar Ramancharla
65	CL2.203	Language and Society	Dipti Mishra Sharma
66	CS9.439	Learning and Memory	Bhaktee Dongaonkar
67	SC3.316	Mathematical Models in Biology	Abhishek Deshpande
68	MA6.301	MCS 1-Probability and Statistics	Pawan Kumar
69	MA6.302	MCS 2-Linear Algebra	Girish Varma

70	CS7.503	Mobile Robotics	K Madhava Krishna
71	EC5.411	Modern Coding Theory	Prasad Krishnan
72	CS1.405	Modern Complexity Theory	Srinathan Kannan
73	CS7.507	Multi Agent Systems	Praveen Paruchuri,Meghna Lowalekar
74	MA4.405	Multivariate Analysis	Venkateswarlu Mandadi
75	SC1.310	Open Quantum Systems and Quantum Thermodynamics	Samyadeb Bhattacharya
76	CS3.301	Operating Systems and Networks	Krishna Reddy Polepalli
77	PD2.423	Organizational Operations	Mayank Mathur
78	CS1.402	Principles of Programming Languages	Venkatesh Choppella
79	EC2.409	Principles of Semiconductor Devices	Anshu Sarje
80	MA6.102	Probability and Random Processes	Praful Mankar
81	MA6.101	Probability and Statistics	Pawan Kumar,Tejas Bodas
82	PD1.411	Product Design Workshop	Veera Prakash Yalla
83	PD2.401	Product Management 101	Ramesh Loganathan
84	SC1.203	Quantum Mechanics	Subhadip Mitra
85	MA4.101	Real Analysis	Samyadeb Bhattacharya
86	CS3.502	Real-Time Embedded Systems	Deepak Gangadharan
87	CS8.501	Research in Information Security	Ashok Kumar Das
88	EC4.401	Robotics: Dynamics and Control	Spandan Roy,Nagamanikandan Govindan
89	SC4.110	Science Lab I	Tapan Kumar Sau,Prabhakar Bhimalapuram
90	EC5.406	Signal Detection and Estimation Theory	Santosh Nannuru
91	EC5.201	Signal Processing	Chiranjeevi Yarra,Jayanthi Sivaswamy
92	CS9.425	Social Science Perspective on HCI	Nimmi Rangaswamy
93	CS6.302	Software Systems Development	Charu Sharma
94	CS4.408	Spatial Informatics	Rajan Krishnan Sundara
95	SC2.304	Spectroscopy	Krishnan Marimuthu
96	EC5.412	Speech Analysis and Linguistics	Chiranjeevi Yarra
97	EC5.408	Speech Signal Processing	Anil Kumar Vuppala
98	CS7.403	Statistical Methods in AI	Anoop Namboodiri
99	CE1.501	Structural Dynamics	Sunitha Palissery
100	CE1.502	Structural Engineering Design Studio	Pradeep Kumar Ramancharla
101	CE1.509	Structural Wind Engineering	Rehana Shaik
102	SC3.203	Systems Biology	Vinod Palakkad Krishnanunni
103	EC5.202	Systems Thinking	Spandan Roy,Vinod Palakkad Krishnanunni
104	CS9.424	Technology Product Entrepreneurship	Ramesh Loganathan,Veera Prakash Yalla
105	PD2.431	Technology Product Entrepreneurship 1	Ramesh Loganathan
106	PD2.432	Technology Product Entrepreneurship 2	Ramesh Loganathan

107	HS3.303	Theories and Practices of Nationalism	Aniket Alam
108	CE0.501	Theory of Elasticity	P Pravin Kumar Venkat Rao
109	HS0.201	Thinking and Knowing in the Human Sciences-1	Sushmita Banerji,Ashwin Jayanti
110	HS0.202	Thinking and Knowing in the Human Sciences-2	Nazia Akhtar,Radhika Krishnan
111	MA8.401	Topics in Applied Optimization	Pawan Kumar
112	SC2.401	Topics in Nanosciences	Tapan Kumar Sau
113	CS6.501	Topics in Software Engineering	Raghu Babu Reddy Y
114	CL5.401	Topics in SSMT	Anil Kumar Vuppala,Rajeev Sangal,Dipti Mishra Sharma,Chiranjeevi Yarra
115	HS1.205	Understanding Raga: Semi Classical Forms of Indian	Saroja T K
116	CS9.501	User Research Methods	Priyanka Srivastava
117	OC3.101	Value Education-1	Radhika Mamidi
118	EC2.201	VLSI Design	Zia Abbas
119	EC5.407	Wireless Communications	Praful Mankar

Syllabus for Courses listed above in red color is not available now.

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

Faculty Name: Ankit Gangwal

1. Prerequisite Course / Knowledge:

Basic principles of computer networks and algorithms.

2. Course Outcomes (COs)

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

CO-1 Demonstrate a familiarity with concepts of network management, standards, and protocols

CO-2 Discuss variousprivacy-enhancing techniques used in modern computer networks

CO-3 Apply the knowledge of distance-vector (RIP and IGRP) and link-state (OSPF and IS-IS) routing protocols to find routing paths for a variety of networks

CO-4 Analyse wireless LAN technologies including IEEE 802.11

CO-5 Design efficient routing protocols for advanced computer networks (e.g., SDN and ICN)

CO-6 Develop a framework for building a large-scale enterprise network

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	1	2	3	2	1	1	1	1	2	3	3	2	3	1	2
CO 2	3	2	3	3	3	2	1	2	1	3	2	3	2	2	2	1
CO 3	2	2	3	3	1	1	2	1	1	1	2	2	1	2	1	1
CO 4	2	2	3	3	2	2	3	1	2	1	2	2	2	2	3	2
CO 5	2	3	2	2	2	1	2	2	1	3	3	2	3	2	2	1
CO 6	3	3	3	3	2	2	2	3	2	2	2	2	2	2	2	1

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1: Modeling and measurement: Network traffic modeling, network measurement, simulation issues, network coding techniques

Unit 2: Flow and congestion control, TCP variants, TCP modeling, active queue management

Unit 3: Routing: Router design, scheduling, QoS, integrated and differentiated services

Unit 4: Wireless networks: Mobility supports, MAC, multicast

Unit 5: Overlay networks and Emerging applications: SDN, ICN, P2P, CDN, Web caching, cross-layer optimizations, VoIP, SIP, video over P2P

Reference Books:

1. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, 5th edition, Elsevier, 2012
2. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 6th edition, Pearson Education, 2013
3. Jean Walrand and Pravin Varaiya, High-Performance Communication Networks, 2nd edition, Elsevier, 2000
4. Research papers

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

Lectures by integrating ICT into classroom teaching; tutorials involving problem solving; being a systems course, it requires hands-on working as well as critical thinking and active learning by the students to solve practical problems; and finally, project-based learning by implementing semester-long project(s) to solve real-world issues.

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

If any changes in the assessment method, faculty will announce in the first class.

Assignments	20 marks
One at home project	30 marks
Mid Semester Examination	20 marks
End Semester Examination	30 marks

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

Faculty Name : Manish Shrivastava

TYPE-WHEN : Monsoon 2021

OBJECTIVE : To get the students acquainted with the state-of-the-art for NLP by focusing on the advances in the field and their impact on a few applications.

COURSE TOPICS :

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

PREFERRED TEXTBOOKS:

None. Mostly research papers.

***REFERENCE BOOKS:**

Statistical Machine Translation by Philip Koehn

Deep Learning by Ian Goodfellow

***PROJECT:**

Titles to be decided based on recent research publicationsGRADING PLAN:

If any changes in the Grading plan, faculty will announce in the first class.

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

OUTCOME:

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

CS3.304 Advanced Operating Systems 3-0-1-4

Faculty Name: Manish Shrivastava

Objective: Computer is a tool which consists of machine part and operating part. The operating part provides services to users and applications so that the underlying machine canbe used in an efficient and convenient manner. The objective of this course is to understand the operating system (operating part) of a computer machine. In this course we study the general principles of operating system design by focusing on a general-purpose, multi-user, uni-processor systems.

This course will primarily study general purpose, time-shared operating systems. The purpose of this course is to introduce some of the fundamental concepts in the design of a time-shared operating system. These include:

- Process Management, inter-process communication, synchronization, Concurrency
- CPU scheduling
- Memory management and virtual memory

The course would aim to be hands-on, relying on detailed experimentation to gain better understanding of fundamental principles of operating systems by exploring the Linux
kernel. One of the goals of this course is to expose students to Linux OS (a.k.a. Linux Kernel) internals to provide an up-close view of its design and features. For some of the concepts, recent research works proposing extensions/optimizations will also be covered.

Course objectives:

1. Understanding the principles of design of operating systems
2. Look at four major OS Components in depth: System Call, Memory Management,CPU Scheduling and Concurrency
3. Understanding the design and functioning of Linux kernel components
4. Experiencing the kernel by passive/active observation
5. Extending the Linux kernel for deeper understanding
6. Exploring current research trends in OS, Linux being the reference OS

Course Topics:

History of Operating Systems, Processes and OS Abstractions, OS APIs, Interrupts and system calls, Introduction to the Linux Kernel, Compiling the kernel, Module programming, Writing your own system calls, Overview of kernel startup and initialization, Kernel Debugging Techniques, Interrupts - PICs, APICs, exceptions (traps) and hard interrupts, IDTs, Address Spaces and Loading, Virtual Memory, Memory allocators, Overview of memory spaces: logical segmentation, linear virtual, actual physical, Detecting BIOS- provided physical RAM map, paging, buddy system, setting up page directories (global, upper, middle), tables and PTEs, (N)UMA, nodes, zone, memory types, Setting up buddy system, Allocating contiguous pages from buddy system, Setting up slabs for small memoryobjects, CPU Scheduling, Threads, Process - structures, organization, initialization, Concurrent Programming, Locking, Deadlocks, Structures: thread union, thread info, stack, task, and thread struct, Creating kernel threads, using kthread, Kernel process scheduling, Scheduling processes with red-black tree, process switching, Context switches, Switching to suspended process, Linux File Systems and Disk Scheduling.

Preferred Textbooks:

1. Thomas Anderson and Michael Dahlin; ***Operating Systems: Principles and Practice,2nd Edition;*** Recursive books (August 21, 2014),; ISBN: 0985673524
2. Daniel P. Bovet & Marco Cesati; ***Understanding the Linux Kernel (3rdedition);*** O'Reilly & Associates, November 2005. ISBN: 0596005652

***Reference Books:**

1. Remzi Arpaci-Dusseau and Andrea Arpaci-Dusseau; ***Operating Systems: Three EasyPieces;*** Arpaci-Dusseau Books; August, 2018 (Version 1.00)
2. Jonathan Corbet; Alessandro Rubini; Greg Kroah-Hartman; ***Linux Device Drivers (3rd edition);*** O'Reilly & Associates, February 2005.; ISBN-13: 978-0-596-00590-0
3. Robert Love; ***Linux Kernel Development*** **(3nd Edition);** Addison-WesleyProfessional, 2010.; ISBN: 0672329468
4. Ellen Siever, Stephen Figgins, Robert Love, and Arnold Robbins; ***Linux in a Nutshell, 6th Edition;*** O'Reilly & Associates, September 2009.; ISBN: 978-0-596-15448-6

***Project:**

Project topics will be assigned during the first few weeks of the course constituting50% of the course weightage.

Course Assessment Plan (Monsoon 2020)

If any changes in the assessment method, faculty will announce in the first class.

Assignments	-	18%
Project	-	40%
Term Paper	-	10%
Viva	-	20%
Quiz	-	12%

CS1.301 Algorithm Analysis & Design 3-1-0-4

Faculty Name : Suryajith Chilara
Pre-Requisite : Discrete Mathematics and Data Structures. Objective: To teach the basics of algorithm design and analysis.

Course Topics:
(A) Thinking towards a solution (algorithm design): This objective is usually achieved by studying several exemplary techniques like: (a) Divide and Conquer. (b) Greedy Paradigm. (c) Dynamic Programming. (d) Linear Programming. (e) Backtracking. (f) Branch-andBound etc.
(B) Analyzing the efficacy (correctness) and efficiency (feasibility) of purported solutions: This objective is usually achieved through several relevant examples like: (a) Solving recurrence relations. (b) Proving the correctness of a few number-theoretic algorithms. (c) Matroid theory (for greedy algorithms). (d) Proofs of correctness (usually via induction) for several optimization algorithms. (e) Basic results in probability theory (for randomized algorithms).

(C) Insightfully appreciating the inherent complexity of a given problem: This objective is usually achieved by proving lower bound results and studying basic complexity classes like: (a) The Class P. (b) The Class NP. (c) The Class NPC. (d) The Class BPP. (e) The Class BQP.
(D) Understanding the limits of computing: This objective is usually achieved by studying: (a) Godel's incompleteness theorem. (b) Church-Turing hypothesis. (c) Proving Undecidability via diagonalization/reduction. (d) Quantum Computing.

Preferred Textbooks:
(1). Cormen, Leiserson, Rivest, Stein. Introduction to Algorithms (3rd Ed), Prentice Hall of India.
(2). Sipser Michael. Introduction to Theory of Computation, 2/e, Cengage Learning. Outcome: The students would learn how (a) to think about solving computation problems, (b) to prove the correctness and goodness of their solutions, (c) to continually attempt at improving on their approach and (d) to recognize if and when an optimal solution is designed.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	10%
Project	-	30%
Term Paper	-	20%
Any other	-	40%

HS0.303 Applied Ethics 3-1-0-4

Faculty Name **:** Ashwin Jayanthi/Guesh Faculty
TYPE-WHEN **:**CHD core, Monsoon 2021
FACULTY NAME **:** Don Dcruz
PRE-REQUISITE **:** Thinking and Knowing in the Human Sciences – I, Classical Text Reading - I

OBJECTIVE: This course aims to acquaint students with the philosophical aspects of ethical evaluation. The aim is not to teach what is and is not ethically good but to empower students with the intellectual skills necessary to make that decision for themselves when faced with ethical dilemmas or when engaging in ethical debates. The course is divided into two parts. The first part is on moral theory where basic concepts of ethics are covered and fundamental issues about ethical normativity are discussed. This helps students to uncover the principles of ethical reasoning that that could be made use of in thinking rationally about ethical matters, both in personal and professional life. The second part of the course, which focusses on applications of the topics covered in the first part, is done seminar-style with students discussing papers related to their term paper topic as well as their final presentation.

COURSE TOPICS:

Module I: Ethical argumentation
Module II: Normativity
Topic 1: Moral skepticism
Topic 2: Goodness and Value
Module III: Normative ethical theories
Topic 3: Consequentialism
Topic 4: Non-consequentialism
Topic 5: Virtue
Module IV: Ethical responsibility
Topic 7: Attribution conditions
Module V: Applications

REFERENCES

Shafer-Landau, R. 2019. *Living Ethics: An Introduction with Readings*. Oxford University Press.

Shafer-Landau, R. 2013. *Ethical Theory: An Anthology* 2nd Edition. Wiley-Blackwell.

Cahn, S. M. (ed). 2020. *Exploring Ethics: An Introductory Anthology* 5th Edition. Oxford University Press.

Singer, P. 1986. *Applied Ethics.* Oxford University Press.

Cohen, A. et al. 2005. *Contemporary Debates in Applied Ethics.* Wiley-Blackwell.

If any changes in the Grading plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Participation	10
Assignments	40
Essay	10
Essay presentation	10
Term paper	20
Term paper presentation	10

OUTCOME: (1) Understand the elements of ethical argumentation (2)Cultivate the ability to think independently about normative and meta-ethical issues. (3) Perform philosophical analysis of ethical issues by dissecting complex ethical arguments, questioning assumptions, clarifying distinctions and bringing out the nuances involved in ethical dilemmas.(4) Develop analytical skills needed to argue cogently in ethical contexts by presenting views clearly, assessing competing positions systematically, anticipating possible objections to a reasoned conclusion and composing valid responses to those objections.

REMARKS: Students are expected to do the assigned readings, which usually does not take more than 2 to 3 hours, before the lecture so as to engage effectively in class discussions. To do well in the written assignments, students must think on what they have read what they have understood, dissect arguments, and demonstrate inferences clearly in writing. Explain why you think what you think in a rational manner without committing fallacies. This must be done in an organized fashion by clarifying terms, and defining any, if necessary, based on how it is used. Maintain a non-erratic flow when writing and make use of simple examples wherever possible.

CS1.302 Automata Theory 3-1-0-2

Faculty Name : ShantanavChakraborthy
Type and When : **UG core-Monsoon-2021.**
Prerequisites : **Discrete Maths**
Objective:
The objective of this course is to gain an understanding of the fundamental ideas behind automata and formal languages, the essential mathematical results in this area, and develop a facility with proving some of these results.

Syllabus and topics

• Basic review of discrete mathematics, Structural (tree) induction, Finite Automata, Nondeterminism, Regular Expressions, Equivalence and Minimization, Nonregular languages and

the Pumping Lemma.
• Context-free languages, Ambiguity, Chomsky Normal Form, CYK algorithm for recognizing CFLs, Pumping Lemma for CFLs, Pushdown Automata, Equivalence between CFLs and PDAs.

Textbook and ReferencesTextbook
The text for this course is Michael Sipser's Introduction to the Theory of Computation, Third Edition. A few copies of the book (and its previous editions) will be made available on reserve in the library.
The syllabus of the course will follow the first few chapters of Sipser's textbook.

Reference Books

1. Introduction to Automata Theory, Languages and Computation. 3rd Edition. Hopcroft, Motwani and Ullman. Pearson.

If any changes in the Grading plan, faculty will announce in the first class.

Grading (tentative)

Event	Percentage
Quiz	20
Mid	30
Final	50

Readings, HomeWorks and Tutorials

Reading assignments will be assigned for each class. Written homework's will be assigned, but not graded. Students are encouraged to do the homework and attend tutorials where problems will be solved.

Outcome:
In addition, the course will help the student develop an ability to use automata and formal languages as models for representing various simple and abstract aspects of computers and languages that they manipulate (e.g., finite automata models of hardware, regular expression patterns in programming, etc.)

HS0.203 Basics of Ethics 3-1-0-2

Faculty Name : Ashwin Jayanti
TYPE-WHEN : Humanities core, Monsoon 2022
PRE-REQUISITE : None

OBJECTIVE: This is an introductory level course that attempts to acquaint you with the philosophical aspects of ethical evaluation. The aim is not to teach what is and is not ethically good but to empower you with the skills necessary to make that decision for yourself when you encounter actual ethical problems or engage in ethical debates. Our journey would be guided by fundamental questions about ethics to uncover the principles of ethical reasoning that that could be made use of in thinking rationally about ethical matters, both in personal and professional life.

COURSE TOPICS:

Module I: Introduction
Topic 1: Ethics and critical reasoning, argument analysis
Module II: Normativity
Topic 2: Moral skepticism
Topic 3: Goodness and Value
Module III: Normative ethical theories
Topic 4: Consequentialism
Topic 5: Non-consequentialism
Topic 6: Virtue
Module IV: Ethical responsibility
Topic 7: engineering ethics, control condition, and moral luck

PREFERRED TEXTBOOK
Shafer-Landau, R. 2019. *Living Ethics: An Introduction with Readings*. Oxford University Press.

REFERENCE BOOKS
Shafer-Landau, R. 2013. *Ethical Theory: An Anthology* 2nd Edition. Wiley-Blackwell.
Vaughn, L. 2019. *Doing Ethics: Moral Reasoning, Theory and Contemporary Issues* 5th Edition. W W Norton and Co.
Cahn, S. M. (ed). 2020. *Exploring Ethics: An Introductory Anthology* 5th Edition. Oxford University Press.
Stich, S. and Donaldson. T. 2019. *Philosophy: Asking Questions, Seeking Answers.* Oxford University Press.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Participation	10
Assignments (1000 words)	80 (4x20)
Essay (750 words)	10

OUTCOME: (1) Understand the elements of ethical argumentation (2)Cultivate the ability to think independently about normative and meta-ethical issues. (3) Get a feel of doing philosophical analysis by dissecting complex ethical arguments, questioning assumptions, clarifying distinctions, and bringing out the nuances involved in ethical dilemmas.(4) Develop analytical skills needed to argue cogently in ethical contexts by presenting views clearly, assessing competing positions systematically, anticipating possible objections to a reasoned conclusion and composing valid responses to those objections.

REMARKS: Students are expected to do the assigned readings, which usually does not take more than 2 to 3 hours, before the lecture so as to engage effectively in class discussions. To do well in this course, students must think on what they have read what they have not understood, dissect arguments, and demonstrate inferences clearly in writing.

SC3.202 Bioinformatics 3-1-0-2

Faculty Name **:** Nita Parekh

Core Course **:** CND-3 (Half Course)

Course Plan:
Lectures: 13
Tutorials: Biological Resources & Web-based tools
Mid-term Exams: 1
Quiz Exam: 1
Lab/Project Exam: 1
Final Exam: 1
Weekly Assignments
Project – Implementing DP for global and local alignments, UPGMA for phylogeny tree construction

Objective:
The objective of the course is to familiarize the students with available web-based bioinformatics resources (databases and tools), how to use them for analysis and extract information from them. The various analyses that can be performed on genomic sequences, *viz*., kmer search, pairwise and multiple sequence alignments, sequence-based database search, phylogenetic reconstruction and gene prediction will be covered in the course.

Week-wise Plan:

Week 1

I Introduction (2 Lectures)

- Overview – Bioinformatics, Gene and Genome structure
- Gene Technology – Restriction Endonucleases, Cloning vectors
- DNA sequencing – PCR, cDNA and Whole Genome sequencing, NGS and third generation sequencing technologies

Week 2

II BioDatabases (1 Lectures)

- Major Bioinformatics Resources – NCBI, EBI, PubMed
- Primary Nucleotide and Proteins Databases - GenBank, UniProt, PDB
- Genome Browsers – Ensembl, UCSC

Week 2-4

III Sequence Alignment (5 Lectures)

Pairwise Alignment –

- Types of pairwise alignments – Global, Local and Overlap alignments
- Dot Plots, dynamic programming (DP) algorithm
- Scoring matrices for nucleotides and proteins and gap penalties
- Sequence-based Database Search algorithms – BLAST, FASTA

Multiple Alignment

- Algorithms for Global and Local MSA – DP, Progressive based (ClustalX), Iterative methods, motif search-based methods

Week 5

IV Modeling Molecular Evolution – Phylogeny (3 Lectures)

- Markov models of base substitution
- Computing Phylogenetic Distances
- Phylogenetic Tree Construction Methods
- PHYLIP

Week 6

V Gene Prediction (2 Lectures)

- Gene Prediction approaches - Open Reading Frames, Homology search, Content-based methods, Markov models

References:

1. *Bioinformatics Sequence and Genome Analysis*, David W. Mount, Cold SpringHarbor Laboratory Press, 2001.
2. *Biological Sequence Analysis, Probabilistic Models of Proteins and Nucleic Acids*, Richard Durbin, Sean R. Eddy, Anders Kroghs and G. Mitchison, Cambridge University Press 1998.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Quiz	-	20%
Open BookExam/ 30 Min Quiz	-	40%

SC2.305 Chemical Kinetics and Reaction Dynamics (H2) 3-1-0-2

Faculty Name: Prabhakar Bhimalapuram

TYPE-WHEN: Monsoon 2021

PRE-REQUISITE: ability to solve ordinary differential equations and elementary linear algebra (vectors, matrices)

OBJECTIVE: Imparting basic knowledge of Rate processes in molecular physics and chemistry – phenomenological modeling (kinetics) and understanding at a molecular level (in terms of electronic and other internal modes of motion)

COURSE TOPICS: (1L: 90 mins)

1. a) Empirical chemical kinetics: Experimental techniques; The rates of reactions; Integrated rate laws; Reactions approaching equilibrium; The temperature dependence of reaction rates; Accounting for the rate laws; Elementary reactions; Consecutive elementary reactions; Impact on biochemistry: The kinetics of the helix-coil transition in polypeptides; Unimolecular reactions (2L)

b) Chain reactions; The rate laws of chain reactions; Explosions; Polymerization kinetics; Stepwise polymerization; Chain polymerization; Homogeneous catalysis; Features of homogeneous catalysis; Enzymes (2L)

c) Photochemistry, Kinetics of photophysical and photochemical processes; Impact on: The chemistry of stratospheric ozone; Applications: Impact on environmental sciences,biochemistry, and other areas.

2. Molecular Reaction Dynamics: Reactive encounters; Collision theory; Diffusion-controlled reactions; The material balance equation; (2L)

Transition state theory; The Eyring equation; Thermodynamic aspects; The dynamics of molecular

collisions; Reactive collisions; Potential energy surfaces; Some results from experiments and calculations; (2L)

The investigation of reaction dynamics with ultrafast laser techniques; Electron transfer in homogeneous systems; The rates of electron transfer processes; Theory of electron transfer processes; Experimental results; Impact on biochemistry: Electron transfer in and between proteins (2L)

3. Special topics (oscillating reactions, etc.): 1L

PREFERRED TEXTBOOKS:

1) Physical Chemistry, by P. W. Atkins.
2) Physical Chemistry by Berry, Rice and Ross
3) Chemical Kinetics by Keith Laidler

***REFERENCE BOOKS**:

(1) 10 copies; (2) 4 copies; (3) 4 copies

If any changes in the Grading plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz	25%
Final Exam	50%
Assignments	25%

CL3.202 **Computational Linguistics II: Comp Semantics and Discourse parsing** **3-1-0-4**

Faculty Name **:** Radhika Mamidi
TYPE-WHEN **:**Monsoon-2021.
PRE-REQUISITE **:** CL-1 or NLP-1

OBJECTIVE **:**

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

COURSE TOPICS

1. SEMANTICS: Meaning Representation

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

Building resources: Dictionaries, Ontologies, WordNets, VerbNets, VerbFrames

Formal Semantics: Formal representation of natural language - semantic features, semantic

primitives. Variability and unambiguous representation. First order logic; Variables and quantifiers, Lambda notation. Inference. Event, state and time representation. Predicate logic. Proposition. Inference. Notation for representing a proposition.

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

Semantic Role labelling

Resources: Dependency Treebanks, Propbanks, Framenet.

2. Computational Discourse Analysis

2.1 Discourse Cohesion

Studying Structure of text and coherence, Discourse connectives and relations

Rhetorical Structure theory

Coreference Chains, anaphora resolution, entity linking.

Sentiment Analysis. Humour Analysis.

3. Computational Pragmatics:

Language Understanding; Meaning beyond textual context; speaker's intention andhearer's inference; inference - bridging inferences, causal and spatial inferences, elaborative and restrictive inferences.

Dialogue Systems, dialogue acts.

Resources: Discourse Treebank, Coreference chains, dialogue data.

PREFERRED TEXTBOOKS

Daniel Jurafsky& James H. Martin (2000); Speech and Language Processing, Pearson Education/Prentice Hall.

James R. Hurford& Brendan Heasley (1983). SEMANTICS - a course book. Cambridge University Press.

Judith Greene (1986). Language Understanding - a cognitive approach. Open University Press.

REFERENCE BOOKS:

Lyons, John. (1977). Semantics. Cambridge University Press.

Levinson, Stephen C. (1983). Pragmatics. Cambridge University Press.

Leech, Geoffrey. (1983). Principles of Pragmatics. Longman.

Brown, G and Yule, G. (1983). Discourse Analysis. Cambridge University Press. Cutting, Joan (2002). Pragmatics and Discourse: A resource book for students. Allen, James (1994). Natural Language Understanding. Pearson.

PROJECT

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

SEMINAR

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

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN

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

OUTCOME

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

CS0.301 ComputerProblemSolving 3-1-0-4

Type-When :Monsoon 2021

FacultyName: Lini Thomas

Pre-requisite: Understand how to solve problems (computational, mathematical) using step by step procedures, write C programs to implement these procedures and test them.

Fundamentals – computer programming vis-a-vis problem solving Control

Structures

Searching and Sorting Functions

and Recursions Pointers

Structures and Linked lists Classes

Assignments will cover concepts as well as applications

Textbooks

C Programming Language – Kernigham& Ritchie

How to solve it by Computer – R G Dromey

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	50%
Project	-	20%
Any other	-	20%
Quiz	-	10%

HS1.301 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 Post-Colonial South Asia: A Reader, Vol. II. Eds. Tai Young Tan and Gyanesh Kudaisya*. London: Routledge, 2008.

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

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

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

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

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

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

REMARKS: Students are expected to read up to 30 pages a week, watch any video lectures made available, and view films and read literature when required. This class shall deal with material students might disagree with. All informed disagreements, opinions, and discussions are encouraged. It shall however be the instructor's right to shut down any disrespectful behavior.

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

Faculty NAME: P. Krishna Reddy
TYPE-WHEN: Fifth semester and onwards

1. **Prerequisite Course / Knowledge:**

(i) Data and Applications, *or equivalent courses that cover Data modelling, normalization, SQL*
(ii) First courses on programming, data-structures and algorithms
(iii) Basics of Python language, to be able to use relevant libraries and toolkits for data analytics

2.Course Outcomes (COs)

Objective: In a computerized and networked society, vast amount of data is being collected every day in multiple domains. We are drowning in data, but starving for knowledge or actionable insights. Datamining or data analytics constitute a collection of concepts and algorithms, which are being developed to answer "how" questions by

extracting interesting and useful knowledge of from large data. Data analytics based platforms are being operated in multiple domains to extract valuable and actionable insights from the data to improve the business performance. The objective of this first level course is to learn the important concepts and algorithms related to data mining functionalities such as summarization, pattern mining, classification, clustering and outlier analysis.

The Course Outcomes (COs) are as follows:

- After completing the course successfully, the students are able to
  - CO-1. describe the concepts of data summarization, data warehousing, pattern mining, classification and clustering approaches
  - CO-2. perform the task of data summarization, pattern mining, classification and clustering based on the requirement.
  - CO-3. prescribe a single or a combination of data summarization, pattern mining, classification and clustering approaches for the problem scenario of a business/organization.
  - CO-4. construct the improved data analytics methods for existing services.
  - CO-5. formulate new data mining problems for creating new services and design the corresponding solutions

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

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

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping.

4. Detailed Syllabus

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

Unit 1: Introduction, data summarization through characterization, discrimination and datawarehousing techniques (9 hours)

Unit 2: Concepts and algorithms for mining patterns and associations (9 hours) Unit 3: Concepts and algorithms related to classification and regression (9 hours)Unit 4: Concepts and algorithms for clustering the data (9 hours)

Unit 5: Outlier analysis and future trends. (3 hours)

- Five mini projects related to the above syllabus will be done by students in the laboratory

Reference Books and materials:

1. Book: Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Thirdedition, 2012, Elseiver Inc.
2. Book: Pang-Nong Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining,2006, Pearson Education.
3. Research Papers: About 25 research papers from the proceeding of the conferences and journals related to data summarization, data warehousing, pattern mining, classification,clustering, outlier detection.

5. Teaching-Learning Strategies in brief

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing 5 mini-projectsin laboratory by the students

If any changes in the assessment method, faculty will announce in the first class.

6. Assessment methods and weightages in brief

Two Class Room tests: 10 marks; Mid Semester Examination in theory: 20 marks , End Semester Examination in Theory: 40 marks, Assessment of 5 mini projects in Laboratory:30 marks

****

CS4.301 Data and Applications (H2) 3-1-0-2

Faculty Name: Ponnurangam Kumaraguru
TYPE-WHEN: Institute Core for CSE, Offered in 3rdsemester.
OBJECTIVE: Theory and practice of core database design and building complex applications accessing relational database

COURSE TOPICS:
Data, Database, Database System
Data Models, Conceptual Data Modeling, ER Models
Relational Data Model, Relational Algebra, Tuple Relational Calculus SQL, Constraints, Triggers, Database Connectivity, Applications Normalization, Relational Database Design

PREFERRED TEXTBOOKS:
Fundamentals of Database Systems, Elmasri and Navathe, 7th Edition, Person, 2017 Database System Concept, Silberschatz, Korth, Sudarshan, 2010
Database Management System, Ramakrishnan, Gehrke, McGraw Hill, 2014

***PROJECT:**
Compulsory Components:

A group project to take the domain and design a database, populate a relational database, and build an application.
A lab exam on SQL skills

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	20%
Project	-	45%
Any other	-	35%
Quiz	-	25%
Open Book Exam/ 30 Min Quiz	-	40%

OUTCOME:
A very good understanding of core concepts and practice of databases, database design, and application development with back-end relational databases.

REMARKS:
A cool first database course.

CS1.304 Data Structures & Algorithms for Problem Solving 3-0-2-6

Faculty Name: Vineet Gandhi

Type-when : Monsoon 2020

Course Overview: To improve practical skills and gain experience in problem solving inCS (programming, data structures, etc.).

Sample Topics for Each Class

1. Motivation + "Hello, Your Name Capitalized!"
2. Prime Numbers, Max k numbers from an array
3. Memory allocation, Files, Matrix multiplication
4. Reading and writing to files; ascii/binary formats; little/big-endian formats
5. Recursion - Factorial, Fibonacci, Optimized fibonacci
6. Binary, Fibonacci, Arithmetic Progression search
7. Hashing + STL Vectors
8. Hashing - Implementation
9. Pointer Intricacies
10. Sequential sort, Bubble sort, Insertion sort
11. Merge sort, Quick sort, Radix sort

12. Linked Lists
13. More on linked lists -- doubly linked, etc.
14. Array of structs; Sparse arrays and triangular arrays; Multiple Set Intersections
15. Stacks (prefix/postfix expression evaluation) and
Queues(Insertion/Deletion/Applications/Theory)
16. Queues (Mention networks of queues; similarity to network flow; discrete
probabilityDistributions
crash-course: bernoulli, binomial, poisson -- application of poisson to queues; implementing
probability distributions using rand())
17. Trees, traversals, array representation
18. Binary search trees
19. Balancing binary search trees, Family trees, Skip-lists
20. Prefix/Suffix trees (Sets of sequences)
21. Suffix trees as Hashtrees, Finding all subsets of a set in a hashtree
22. Graphs, Representation, Paths, Reachability, Connectedness, Applications
23. Kruskals, Prims and Dijkistra's Algorithms, Travelling salesman problem
24. Problem solving as Search (Breadth-first, Uniform cost, etc.), Greedy Search, A* Search

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2020)

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

MA5.101 Discrete Structures 3-1-0-4

Faculty Name **:** Ashok Kumar Das + Venkatesh Choppella
TYPE-WHEN **:** UG-Core-Monsoon-2021

COURSE TOPICS:

Logic, Propositional Equivalences, Predicates and Quantifiers Sets, Proof Techniques, Mathematical Induction, Contradiction, Counting Techniques, Pigeonhole Principle.Set Theory, Relation, Composition of Relation, Matrix Representation, Equivalence Relation, Partial order relation (Posets), Hasse diagram, Topological Sorting, Lattice, Functions, Permutation FunctionsDefinition and examples of simple graphs, Isomorphism, Connectedness, Adjacency, Subgraph, Matrix Representation. Eulerian and Hamiltonian graphs, Trees, Bipartite Graph, Simple Graph, Hall's Marriage Theorem.Groups, Subgroups, Cosets, Lagrange's Theorem, Permutation Groups, Isomorphism, Ring, FieldMultinomial coefficients,

Recurrence Relations, Generating functions, Combinations with repetitions, Linear algebraic equations with unit coefficients. Principles of inclusion, exclusion.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**5**
Quiz-2	**10**
Mid Sem Exam	**30**
End Sem Exam	**40**
Assignments	**15**
Term Paper	
OtherEvaluation	

EC3.202a Embedded Systems Workshop 1-0-3-3

Faculty Name : Sachin Chaudhari and Abhishek Srivastava
TYPE-WHEN : Monsoon 2021
PRE-REQUISITE : Introduction to IoT

OBJECTIVE: This is a hands-on course on embedded systems based on learning by doing method. Students must choose a real-life problem in the society such as air quality monitoring, water quality and quantity, energy management, etc. They should design, develop and deploy a basic proof of concept prototype. The main emphasis in this course is on considerations of practical issues that come in the field while deploying. The project in this course is team activity, which will also develop interpersonal skills.

COURSE TOPICS:
1. Sensing/Actuators and Interfacing
a. Sensor/Actuator selection (using data sheets)
b. Physics of sensors and actuators related to projects
c. Interfacing: Serial interfaces, Analog out, SPI, UART, I2C, "propriety" such as DHT22
2. Controller, Embedded Systems and Peripherals -
a. Platform selection – ATMEL328, ESP32, STM8 Architecture; timers, interrupts, AVR, SAMR architectures
b. Embedded Systems: power management, interrupts, memory managements, leaks, OTA firmware update, reliability, onboard debugging
c. Peripherals: RTC, ADC channels, resolution, onboard memory, power, external/internal watchdog
3. Communications, Networking and IoT Architecture
a.DifferentIoTcommunication protocols: Comparison of Zigbee/WiFi/BLE/4G/5G/eSim/LoRaWAN
b. Data Protocols: MQTT/HTTPS/CoAP
4. Data Storage and Computation
a. Cloud storage and computing
b. Data retrieval optimization
c. IoT standards for interoperability: Implementation using oneM2M
5. PCB and Enclosure Design
6. Data privacy and security
7. Dashboard and Visualization
a. Software/Approaches: UI/UX and Time Series Data Visualization; Front-end and back-end technologies
8. Documentation

a. User document and developer's documentation
b. Best practices for writing the two documents
c. Referring style manual. For example, Microsoft/Chicago manual of style

PREFERRED TEXT BOOKS:

- P. Lea, Internet of Things for Architects, Packt, 2018
- D. Norris, The Internet of Things, McGraw Hill, 2015
- A. Kurniawan, Internet of Things Projects with ESP32, Packt, 2019

***REFERENCE BOOKS:**

- O. Hersent, D. Boswarthick, O. Elloumi, The Internet of Things, Wiley, 2016
- A. Bahga and V. Madisetti, Internet of Things, University Press, 2016
- Raj Kamal, Internet of Things, McGraw Hill, 2018

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:
Type of Evaluation Weightage (in %)
Quizzes 10
EndSem 30
Project 60

OUTCOME:
After completion of this course, a student will be able to
· Evaluate different solutions for a real-life application and choose the solution, which is practical in given conditions.
· Design, develop and deploy a proof-of-concept solution
· Test, debug, and redesign the solution based on field experiences

---

EC3.202 Embedded Systems Workshop 1-0-3-3

Faculty Name **:** Aftab Hussain + Zia Abbas
TYPE-WHEN : Monsoon 2021
PRE-REQUISITE : Introduction to IoT

OBJECTIVE: This is a hands-on course on embedded systems based on learning by doing method. Students must choose a real-life problem in the society such as air quality monitoring, water quality and quantity, energy management, etc. They should design, develop and deploy a basic proof of concept prototype. The main emphasis in this course is on considerations of practical issues that come in the field while deploying. The project in this course is team activity, which will also develop interpersonal skills.

COURSE TOPICS:
1. Sensing/Actuators and Interfacing
a. Sensor/Actuator selection (using data sheets)
b. Physics of sensors and actuators related to projects
c. Interfacing: Serial interfaces, Analog out, SPI, UART, I2C, "propriety" such as DHT22
2. Controller, Embedded Systems and Peripherals -
a. Platform selection – ATMEL328, ESP32, STM8 Architecture; timers, interrupts, AVR, SAMR architectures
b. Embedded Systems: power management, interrupts, memory managements, leaks, OTA firmware

update, reliability, onboard debugging
c. Peripherals: RTC, ADC channels, resolution, onboard memory, power, external/internal watchdog
3. Communications, Networking and IoT Architecture
a.DifferentIoTcommunication protocols: Comparison of Zigbee/WiFi/BLE/4G/5G/eSim/LoRaWAN
b. Data Protocols: MQTT/HTTPS/CoAP
4. Data Storage and Computation
a. Cloud storage and computing
b. Data retrieval optimization
c. IoT standards for interoperability: Implementation using oneM2M
5. PCB and Enclosure Design
6. Data privacy and security
7. Dashboard and Visualization
a. Software/Approaches: UI/UX and Time Series Data Visualization; Front-end and back-end technologies
8. Documentation
a. User document and developer's documentation
b. Best practices for writing the two documents
c. Referring style manual. For example, Microsoft/Chicago manual of style

PREFERRED TEXT BOOKS:
- P. Lea, Internet of Things for Architects, Packt, 2018
- D. Norris, The Internet of Things, McGraw Hill, 2015
- A. Kurniawan, Internet of Things Projects with ESP32, Packt, 2019

*REFERENCE BOOKS:
- O. Hersent, D. Boswarthick, O. Elloumi, The Internet of Things, Wiley, 2016
- A. Bahga and V. Madisetti, Internet of Things, University Press, 2016
- Raj Kamal, Internet of Things, McGraw Hill, 2018

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:
Type of Evaluation Weightage (in %)
Quizzes 10
EndSem 30
Project 60

OUTCOME:
After completion of this course, a student will be able to
· Evaluate different solutions for a real-life application and choose the solution, which is practical in given conditions.
· Design, develop and deploy a proof-of-concept solution
· Test, debug, and redesign the solution based on field experiences

---

SC3.101 Introduction to Biology 3-1-0-4

Faculty Name: Vinod PK
OBJECTIVE: To understand the molecular logic of life and connect it to topics in computational and systems biology

COURSE TOPICS:

o Time and length scales in biology
o Cellular foundations: Cell organelles, Membranes and cellular compartments, Tree of life
o Chemical foundations: Biomolecules, Structure and function
o Physical foundations: Bioenergetics, Catalysis, Enzymes, Photosynthesis, Respiration
o How cells obtain energy from the food - metabolism
o Genetic foundations: DNA, Chromosomes, and Genomes
o Evolutionary foundations, Systematics
o Basic concepts of gene, Mendelian principles, Mutations
o DNA Replication, Repair, and Recombination - an overview
o How Cells Read the Genome: From DNA to Protein
o Control of Gene expression
o Analysing and manipulating DNA – an overview
o Cell Signalling, Cell division and death
o Cells in their social context- Differentiations, multicellular organisms, tissues/organs
o Disease and defense mechanisms, Infectious disease (one case study)
o Systems thinking in Biology
o Big data in Biology
o Computers in Biology – an overview

PREFERRED TEXTBOOKS:

1. Fundamentals of Biochemistry by Voet, Voet& Pratt
2. Lehninger Principles of Biochemistry by David Nelson, Michael Cox
3. Molecular biology of the cell, Sixth Edition by Alberts B., et al

OUTCOME:

After successfully completing the course, students are expected to have a basic understanding of the biological concepts required to tackle problems in computational biology, bioinformatics, and systems biology.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Any other	-	10%
Quiz	-	30%
Open BookExam/ 30 Min Quiz	-	30%

CL1.101 Introduction to Linguistics-1 3-1-0-4

Faculty Name: Aditi Mukherjee

Type When: Monsoon 2021

PRE-REQUISITE: XX

OBJECTIVE: Toprovideabird'seye viewoftheareaoflinguisticstothestudents,sothatthey have a nunderstandingofwhatthe domain of linguistics is andwhywoulditberelevantfor

computationallinguistics

COURSE TOPICS:

1. **Whatislanguage?**DifferencebetweenhumanlanguageandAnimallanguages.***(3hrs.[2])***
Naturallanguage,FormallanguageandArtificiallanguage,Characteristicfeaturesofhuman language,whatweknowaboutlanguage.

2. **StudyofHumanlanguage–thefieldofLinguistics*****(Total30hrs.[20])***
Looking at language from synchronic and diachronic points of view

Areas of Study

Fromstructuralperspective(25.5 hrs.[17])

a) Syntagmaticandparadigmaticaspectsoflanguagestructure,Levelsofstructuralanalysis:Phonetics: Placeandmannerofarticulationofspeechsounds,IPA.**(4.5hrs.[3])**

b) Phonology:Phone,phoneme,allophone;Distinctivefeatures;Phonologicalrules;Syllable. **(6 hrs. [4])**

Morphology:Unitsofword'sinternalstructure,wordformationprocesses,inflectionaland derivationalmorphology,compoundwordsandhowtheyareformed. **(7.5 hrs.[5])**
Syntax: Types of sentences, Sentence structures, Phrase structure grammar. **(7.5 hrs. [5])**

c) **Fromevolutionperspective:**HistoricalLinguistics **(1.5hrs. [1])**

d) **Fromusageperspective:**Sociolinguistics **(1.5hrs. [1])**

e) **From Psychological perspective:** Mechanisms of language acquisition, knowing more than onelanguage **(1.5hrs. [1])**

IndianGrammaticalTradition: Acommunicationmodelforlanguagestudy.Paniniangrammaticalmodel. ***(6 hrs.[4])***

WritingSystems: Representinglanguagethroughgraphiccharacters. ***(1.5hrs.[1])***

If any changes in the assessment method, faculty will announce in the first class.

GRADING:

Assignments: 15%,
Mid Sem: 30%,
End Sem: 35% and
Project: 20%

PROJECT:

Thestudentswillworkonahands-onprojectonlanguageanalysis.Intheprojectthey areexpectedtoworkwithrealtimedataandunderstanditsnature.

PREFERRED TEXTBOOK:

Language:Nature,PsychologyandGrammaticalAspectsbyVictoriaFromkin,RobertRodman andNinaHyams,CenageLearning(IndianEdition)

REFERENCE BOOKS:

1. **Linguistics**byJeanAitchison,5thedition.London:HodderHeadline,TeachYourselfBooks, 1999.ISBN:0-340-73733-6.Retitledandreprintedwithcorrectionsas:***Linguistics:An Introduction***.2ndedition.London:HodderHeadline,1999.ISBN:0-340-75792-2).

2. **IntroductiontoLanguageby**Fromkin,V.A.andRodman,R.,1997.HarcourtBrace.6thedition

OUTCOME:

Thestudentwillgetageneralpictureofvariousaspectsoflanguage.Thestudentwillalsoget familiarwithsomebasicconceptsoflinguisticsandthemethodstocarryoutlanguageanalysis.

CL2.203 Language and Society 3-1-0-4

Faculty Name : Dipti Mishra Sharma
TYPE-WHEN : Monsoon 2021
PRE-REQUISITE : Introduction to Linguistics (suggested)

OBJECTIVE : The students will be introduced to the social aspects of language. The focus will be on exploring how language and society are intricately related: the politics of language in society, language and power, consequences of language contact, language variation with focus on users and the use, language and social media, cross-cultural communication in changing times.

COURSE TOPICS :

1. Language Variation: Language, Dialects and Varieties. Speech Communities. Regional and social dialects. Approaches to study variation systematically in the social context. Sociolinguistics and sociology of language.

2. Social stratification of language. Inherent variability. Sociolinguistic variables: indicator, marker, stereotype. Style shifting. Hypercorrection. Language variation and language change. Social motivation for sound change.

3. Language Contact: Bilingualism/Multilingualism, borrowing, code mixing/switching, pidginization and creolization, convergence, language maintenance/shift, language acquisition in a multilingual setting. Diglossia with or without bilingualism.

4. Sociolinguistic devices for effective communication. Communicative competence. Politeness strategies. Pronouns of power and solidarity.

5. Critical Sociolinguistics. Language and power; Language and social attitudes; Language and gender

6. Language planning: codification and elaboration. Language standardization.

7. Socio-pragmatics issues: Cross-Cultural communication; Politeness and Face Management in different communities

8. Social media language: Language use and Language analysis; Online identity; Social Networks; Online communities; Computer-mediated Communication; flaming, trolling, social norms, emoji, shared spaces; Social media language data analysis

PREFERRED TEXTBOOKS:

Trudgill, Peter (2000). Sociolinguistics: An Introduction to language and society (4th edition). UK: Pearson.

Wardhaugh, R., & Fuller, J. M. (2015). An Introduction to Sociolinguistics (7th edition). UK: Blackwell.

Holmes, Janet (2008). An Introduction to Sociolinguistics (3rd edition). UK: Pearson.

REFERENCE BOOKS:

Mesthrie, Rajand, Joan Swann, Andrea Deumert, and William L. Leap (2000) Introducing Sociolinguistics. Edinburgh University Press.

Romaine, Suzanne (2001) Language in Society. Oxford University Press. Second edition. Brown, P., Levinson, S.C., 1987[1978]. Politeness: Some Universals in Language Use.

Cambridge University Press, Cambridge, UK.

Brown, R., Gilman, A., 1968[1960]. Pronouns of power and solidarity. In: Fishman, J. (Ed.), Readings in the Sociology of Language. Mouton, The Hague, Netherlands, pp. 252–276.

Related videos by experts will also be used.

GRADING CRITERIA

Two major factors that will be determine the grade are:

(i) Sincerity and Ethics followed in the virtual mode of teaching.

(ii)Commitment and perseverance reflected in learning.

Attendance, participation, and contribution to class by sharing interesting articles or videos is highly encouraged.

Assessment Scheme:

In-class Activities and Home-based Activities done individually, in pairs and in groups of 4. No exams.

1. [AUGUST last week] Group work: Each group of 4 will be assigned a task which includes data collection and analysis. Quantitative and Qualitative methodology to be followed. **[10%]**

2. [SEPTEMBER last week] Pair work Seminar presentation: Each pair of students [from the above group] will summarise and present 4 research papers – 2 papers each – related to the same task. Chapters from a book may be included as well, **[20%]**

3. [OCTOBER last week] Micro presentations: The students will choose a topic (from a list given), work on it with a sample data and lead a discussion over the topic with other students. **[10%]**

4. Research projects/papers: This will be assessed through the semester.

[By Mid-SEPTEMBER] Step 1: Students will explore some aspect of sociolinguistics, collect data, read relevant papers, and present their findings. **[10%]**

[By Mid-OCTOBER] Step 2: They will write a 1000 – 1500-word paper as the mid-term assignment discussing their findings by analyze the data collected. **[20%]**

[By Mid-NOVEMBER] Step 3: Final report submission and presentation. Students are expected to formally present their final research projects to the class. **[20%]**

5. We will have a CLASS BLOG. All contributions relevant to the course will be assessed on a weekly basis through the semester. [10%]

OUTCOME: Greater awareness of the social dynamics of language.

If any changes in the assessment method, faculty will announce in the first class.

<u>Course Assessment Plan (Monsoon 2021)</u>

Assignments	-	50%
Project	-	50%

ASSIGNMENTS: Group tasks [10], Micro-presentations [10], 2 Seminars [20], Blog contribution [10]; PROJECT: 50 [in 3 phases - 10+20+20]

HS8.101 **Making of Contemporary World** **3-1-0-4**

Faculty Name **:** Aniket Alam
TYPE-WHEN **:**CHDCore,Semester1
PRE-REQUISITE **:** Admission to Human Sciences Dual DegreeProgram

OBJECTIVE: Thiscoursewillinformthestudentabouttheworldinwhichtheylive.Rather thantakingachronologicalorder,itwilllookatafewlandmarkeventsandprocesseswhichmarkedand producedourworld.Itismeanttofillintheinformationgapwhichstudentswillhaveabouttheworld welivein,butalsogivethemasenseofhowdifferentdisciplinesandscholarslookattheworld,how thesameprocessesoftenplayoutindifferent"fields"andhowoneinfluencestheother.Theobjective istobothinformthestudentsaboutthecontemporaryworldandhowitcametobe,andtoappreciate thevariousstrands,thediversityofideasandpractices,whichconstituteit.Theobjectiveisalsoto teachthestudenthowtoanalysesocial,economic,political,andintellectualtrendsintheworldinwhich theywillworkandlive.Itwillbringthemup-to-speedtothemomentofdigitaltransformationstheyare livingthrough.

COURSE TOPICS: This course will be divided into six modules. These are

1. MapsandBooks:Howtheworldwas"discovered"and"known"bytheEuropeansoverthelastfive centuries.Howthiscreatedthenations,cultures,knowledges,andgeopoliticsofourcontemporary world.

2. Revolutions(American,French,Russian,Iranian):Lookattheseasembodyingimportantidea(l)sofour contemporaryworld,likepoliticalrepresentation,fundamentalrights,redistribution,andindigenism. Introducestudentstotheglobalsignificanceofeachandwhytheyremaincontemporary.

3. Wars(LiberationWarsofHaitiandVietnam;WorldWars):Thesewilllookatthetwomaintypesof modernwarfarewhichhavedefinedourworld,thewarsofliberationandthewarsofEuropeanlootandd division of theworld.

4. Energy(Muscle,Solar,Hydrocarbons,Nuclear):Theselectureswillfocusonhowchangesinenergy use have made the industrial revolution possible, the manner of urbanisation, travel and communications. How forms of energy use and debates about them remain s central to our contemporaryworld.

5. Representation(Novel,Films,Photography,social media):Theselectureswilllookathownewcultural formshavedevelopedtogiveexpressiontothemodernselfandhowtheseprovidethecontextinwhich we understandourselves.

6. Philosophical Foundations: This module will look at the emergence of ideas and practices of equality, liberty, fraternity, secularism, progress, etc in different parts of the world over the past five centuries. The first lecture will lay the broad outlines of the course, the topics to be covered and the context in which these are being taught. The last three lectures will bring the students up to the current digitally mediated world and leave them with ideas about what questions the humanities and social sciences is asking, and can ask of the contemporary times, and how.

PREFERRED TEXTBOOKS: Select chapters and themes from the following books will comprise the course textbook.

1. C. A. Bayly: *The Birth of the Modern World – 1780 –1914*
2. C. A. Baylu: *Remaking the Modern World: 1900 –2015*
3. Howard Zinn: *A People's History of theWorld*
4. Micheal Spence: *The Next Convergence: The Future of Economic Growth ina MultispeedWorld*

5. Jurgen Osterhammel: *The Transformation of the World: A Global History of the 19th Century*
6. Immanuel Wallerstein: *HistoricalCapitalism*
7. Amiya K. Bagchi: *The Political Economy ofUnderdevelopment*
8. Michael Williams: *Deforesting the Earth: From Prehistory to GlobalCrisis*
9. Max Weber: *The Protestant Ethic and the Spirit ofCapitalism*
10. Nathan Watchel: *The Vision of the Vanquished – The Spanish Conquest of Peru Through Indian Eyes,1530-1570*
11. Max Tegmark, *Life 3.0: Being Human in the Age of ArtificialIntelligence*.

***REFERENCEBOOKS:** Students will be given readings from various books and articles related to the topics being covered in class. A list of additional readings will also be given for term papers and for students who want to read more on a particular topic.

***PROJECT:**

Eachstudentwilltakeaspecifiedtopicfromwithinthecourseandstudyitingreatdetail. S/hewillbuildacrossdisciplinaryreportonthattopicandtryoutcomputationalmethodstoanalyseit. Theprojecttopicswillbegivenoutafterthefirst Quizandwillhavetobeworkedoninconsultation withthemaininstructor.Theprojectwillhavetobepresentedinclass.

If any changes in the assessment method, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	7.5%
Quiz-2	7.5%
Mid Sem Exam	15%
Assignments (four)	20%
End Sem Exam	30%
Lab Exam	0%
Project	20%

OUTCOME:

Thestudentwillcometoknowoftheimportantlandmarksofthecontemporaryworld,both eventsandprocesses.S/hewillbeabletoclearlyandcorrectlyidentifytheimportanttrendsthatmake thecontemporaryworldandalsoidentify themainacademictheorieswhichareusedtoanalyseit.The studentwillhaveanunderstandingofhowdifferentdisciplineshavelookedatsimilarsituationsandwill developanappreciationforthecross-disciplinarymethodofresearchandstudy. Thecoursewillhelpthe student develop a 'baseline' on which to understand the transformations wrought by informationtechnologyandstartappreciatingthepointsofchangeandcontinuity.

REMARKS:

Thecourseisdesignedinawaywhichrequiresactiveparticipationofthestudentsinclass discussions,assignments,andtheproject.Eachstudentwillbeencouragedtostudytwotopicscovered inthecourseinsomedepththroughextrareadingsandpresentations.

Thecoursewillhavedifferentfacultymembersofthe CentreforHumanSciencescomingandteaching specific topics,whiletheoverallcoursewillbetaughtbyAniketAlam.

MA6.301 Maths for Computer Science 1-Probability and Statistics 3-1-0-2

Prerequisite Course / Knowledge:

Knowledge of UG (BTech) course in Discrete Maths.

Course Outcomes (COs):

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

CO-1: Understanding the basic probability concepts sample space, events, probability mass function, conditional probability, Bayes Rule, Random Variables, Probability Mass and Density functions, Cumulative distribution function, Expectation, Variance, Bernoulli Binomial, Gaussian, Geometric, Exponential, Poisson distributions.

CO-2: Demonstrate familiarity with use of Linearity of Expectation, Markov's and Chebyshev's Inequalities, Law of Large Numbers, Central Limit Theorem.

CO-3: Apply principles of Tail bounds and Central Limit Theorem to real world problems in Estimation, Randomized Algorithms, etc.

CO-4: Derive formulas for finding Maximum Likelihood Estimates (MLE) and Maximum Apriori Estimates (MAE) for Probability Models.

CO-5: Create mathematical models using principles of Probability and analyze them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	3	1	3	1	1	1	1	2	2	1	3	1	1	1	2
CO2	1	2	2	2	1	1	1	1	2	2	1	1	3	1	1	2
CO3	2	3	1	3	1	1	1	1	2	2	1	3	2	1	1	2
CO4	1	3	2	2	1	1	1	1	2	2	1	1	3	1	2	2
CO5	1	3	2	3	1	1	1	1	2	2	1	1	3	1	1	3
CO6	1	2	1	2	2	1	1	1	2	2	1	2	3	2	2	2

'3' for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping.

Detailed Syllabus:

Unit 1: Sample Spaces, Counting, Uniform Probability, Axioms of Probability, Continuous Probability Spaces, Conditional Probability, Bayes Rule, Independence.

Unit 2: Random Variables, PMFs, Discrete Probability Distributions, Multiple Random Variables, Expectation, Variance, Covariance, Standard distributions of Bernoulli, Binomial, Geometric, Gaussian, Exponential, Poisson.

Unit 3: Continuous Probability Distributions, Tail Bounds (Markov, Chebyshev, Chernoff), Law of Large Numbers, Central Limit Theorem.

Unit 4: Bayesian Statistics, Maximum Aposteriori Estimation, Maximum Likelihood Estimation, Confidence Intervals.

Reference Books:

1. Introduction to Probability, 2nd Edition by Dimitri P. Bertsekas and John N. Tsitsiklis.
2. Introduction to Probability, Statistics and Random Processes. by HossienPishro-Nik. Texbook available online: https://www.probabilitycourse.com/
3. Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M. Ross.
4. An Introduction to Probability Theory and Its Applications, Volume 1 by William Feller.

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

Lectures will initially introduce the motivations, concepts, definitions along with simpler examples. This will be followed by assignments and quizzes that will make sure that the students have understood the concepts. These will be followed by deeper lectures and assignments which lead the students to the bigger questions in the area. These will also be supplemented with real world engineering problems so that they can apply the concepts learned by them.

If any changes in the assessment method, faculty will announce in the first class.

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

- Light In-class Quizes: 15%
- Assignments: 15%
- Class Test 1: 20%
- Class Test 2: 20%
- End Exam: 30%

MA6.302 Maths for Computer Science 2 - Linear Algebra (H2) 3-1-0-2

Faculty Name: Girish Varma

Objective: To understand vector spaces and matrices as it is used in various computer science applications.

Course Topics:

- Matrices, System of Linear Equations, Determinant, Elementary Row Operations, Cramer's Rule.
- Vector Spaces, Linear independence, dimension, basis, subspaces.
- Linear Transformations, Change of Basis, Orthogonality, Eigen Values, Diagonalization, Spectral Theorem, Fourier Transform.
- Matrix Decompositions: Spectral Decomposition, Singular Value Decomposition, Principal Component Analysis.

Preferred Textbooks:
Linear Algebra by Kenneth Hoffman, Ray Kunze
Linear Algebra Done Right by Sheldon Axler
Linear Algebra and its applications by Gilbert Strang

Faculty will announce the assessment method in the first class.

EC5.101 Networks Signals and Systems 3-1-0-4

Faculty Name: AnshuSarje & Santosh Nannuru

COURSE TOPICS:

a. Introduce the concept of signals with time-domain, how to break-down a complex signal into smaller signals, characterization (deterministic versus random), Fourier series (summation concept), time representations versus frequency representations, why sinusoidal.

b. Transition to networks with R, L, C components their interconnections and graph. Phasor diagram, concept of lag, lead properties, sinusoidal response. Introduce impedance concept, power-energy, RL, RC, RLC, network analysis, KCL, KVL, Thevenin's theorem Millman's theorem, Norton's theorem.

c. Transient and steady-state analysis, power concepts include reactive power, introduction to power-factor correction, and then leading to concept of linearity. discussion of cases when linearity holds and when it does not apply, time invariance, one-port, two-port characterization, linear system and port relationships.

d. Transition from linearity to systems with a good example where the system is defined by the input output relationship, introduce impulse response, transfer function, and the concept of feedback.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**20%**
Mid Sem-2 Exam	**20%**
End Sem Exam	**40%**
Assignments	**5%**
Quiz based on Assignments	**15%**

CS3.301 Operating Systems and Networks 3-1-0-4

Faculty Name :Krishna Reddy P
TYPE-WHEN : Core-Monsoon

OBJECTIVE : Man is a tool making animal. For every tool, there is machine part and operating part. A computer system is also a tool that contains machine part and operating part. The operating part of a computer is called as "operating system". The operating system abstracts the machine part of computer system in terms of simple services by hiding the details of the machine (hardware). The objective of this course is to (i) introduce a framework of engineering/computer system design (ii) discuss important design ideas which have been evolved for building modern operating systems and (iii) study how these design ideas have been extended to build the components of modern operating systems.

COURSE TOPICS:

(Please list the order in which they will be covered)

Introduction (1 week); Thinking about systems (1 week); Process Management (2 weeks); CPU Scheduling (1 week), Process Synchronization (2 weeks); Deadlocks (1 week); Memory management (1.5 weeks), Virtual Memory (1.5 weeks), File Systems (1 week); Protection and Security (1 week); Other topics (1 week).

PREFERRED TEXTBOOKS: Textbook:

1. Silberschatz, A, Galvin, P, Gagne, G. Operating system concepts, Addison-Wesley (latest edition)
2. Saltzer, Jerome H. and M. Frans Kaashoek. *Principles of Computer System Design: An Introduction, Part I*. Morgan Kaufmann, 2009. ISBN: 9780123749574.

***REFERENCE BOOKS:**

1. Wlliam Stallings, Operating Systems, Prentice -Hall, (latest edition).
2. Charles Crowley, Operating systems: A design-oriented approach, Tata McGraw -Hill (latest edition)
3. Tanenbaum, A., Modern Operating Systems, Prentice -Hall, Second Edition (latest edition.

***PROJECT:**

Experiments will be on the exposing the working of several system calls of LINUX OS: Installation: reversing a file; Shell writing; Process communication: Bounded buffer, semaphores, shared memory, threads; Replace "ls" with lookup; Command line for /proc; Memory management.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME:

After completing the course, the students will understand (i) key design ideas evolved since 1950 for building general systems and computer systems, (ii) the fundamental concepts of several computer operating systems such as SOLARIS, LINUX, WINDOWS and MAC, (iii) the solutions/options to interesting problems which have been encountered by the designers of the preceding operating systems, and (iv) the critical role of the operation system in designing several computer based systems like database systems, expert systems, web based information systems, real-time systems, multi-media systems, embedded systems and so on.

REMARKS: The lab is intensive

MA6.102 **Probability and Random Processes** 3-1-0-4

Faculty Name: Praful Mankar

1. **PrerequisiteCourse/Knowledge:**

Basic idea of set theory, counting

2. **CourseOutcomes(COs):**

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

CO1: Describetheprobabilityspaceassociatedwithanexperiment,conditionalprobabilityandBayes theorem
CO-2: Give examples of discrete and continuous random variables and their distributions
CO3: Calculateconditionalandmarginaldistributions,distributionsoffunctionsofrandomvariables, expectation andvariance
CO-4: Analyze the properties of independent random variables, sums of random variables
CO-5: Interpret the tail bounds, law of large numbers and central limit theorem
CO-6: Evaluate the real world applications of random variables and random processes

3. **MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs)–CourseArticulationMatrix**

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

CO 4	3	3	2	2	1	-	-	-	-	-	-	-	-	3	2	3
CO5	3	3	2	2	1	-	-	-	-	-	-	-	-	3	2	3
CO 6	3	3	2	2	1	-	-	-	2	2	-	2	-	3	2	3

Note: 3 in the box for high level mapping, 2 for medium level and 1 for low level mapping

4. DetailedSyllabus:

Unit 1 : Sets and set operations, Probability space, Conditional probability and Bayes theorem.

Unit 2: Discrete random variables, probability mass function, probability distribution function, examplerandom variables and distributions, Continuous random variables, probability density function, probability distribution function, example distributions.

Unit3: Jointdistributions,functionsofoneandtworandomvariables,expectationandvariance, Conditional distribution, densities, conditional expectation, moment generating functions, characteristicfunctions.

Unit4: Markov,ChebyshevandChernoffbounds.Randomsequencesandmodesofconvergence,Strongand weak laws of large numbers, central limittheorem.

Unit5: Randomprocesses,Meanandcovariancefunctions,Stationaryprocessesandwide-sensestationary processes, power spectral density, linear filtering of randomprocesses.

Reference Books:

1. Bertsekas, Dimitri P., and John N. Tsitsiklis. Introduction to Probability. Vol. 1. Belmont, MA: Athena Scientific,2002.
2. Henry Stark, John. W. Woods, Probability and Random Processes with Applications to Signal Processing, 3rdedition, Prentice Hall,2002.
3. Gallager,R.(2008).PrinciplesofDigitalCommunication.Cambridge:CambridgeUniversityPress. doi:10.1017/CBO9780511813498.
4. Sheldon Ross, Introduction to Probability Models, Academic Press,2010.

5. Teaching-LearningStrategiesinbrief(4to5sentences):

The course has lectures supported by tutorials. In tutorials, problems related to the concepts presented in the class are solved by teaching assistants. Quizzes and group learning activities are conducted periodically so that students can actively engage with the course material. An assignment is given towards the end of the course, which requires the students to understand various applications of the theory and prepare a report.

If any changes in the assessment method, faculty will announce in the first class.

6. Assessment methods and weightages in brief(4to5sentences):

Type of Evaluation	Weightage (in %)
Quizzes and Viva	35%
Home Assignments	25%
Mid Semester Exam	15%
End Semester Exam	25%

MA6.101 Probability and Statistics 3-1-0-4

Faculty Name **:** Pawan Kumar + Tejas Bodas

TYPE-WHEN : Monsoon,2021

OBJECTIVE: Understand basic concepts in probability, be able to translate models described in words to mathematical ones, getting familiar with applications of inference methods.

COURSETOPICS:

Probability Basics:

Counting, Sets, Sample Space, Axioms of Probability, Events, Principles of Inclusion & Exclusion, Conditional Probability, Bayes Rule.

Random Variables:

Random Variables, Prob. Mass Functions, Expectation, Mean, Variance. Joint PMFs of Multiple RVs, Conditioning & Independence of RVs. Continuous RVs, Cumulative Distribution, Correlation.

Sums of RVs and Random Processes:

Markov, Chebyshev, Chernoff/Hoeffding inequalities, Law of Large Numbers, Central limit theorem, Bernoulli, Poisson Processes, Markov Chains.

Statistics:

Bayesian Inference, Hypothesis Testing, Estimation, Classical Statistics, Maximum Likelihood Estimation, Confidence Intervals.

PREFERRED TEXTBOOKS:

Introduction to Probability, 2nd Edition by Dimitri P. Bertsekas and John N. Tsitsiklis

Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M. Ross.

Probabilistic Systems Analysis and Applied Probability Online Resource. MIT OCW

https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-041sc-probabilistic-systems-analysis-and-applied-probability-fall-2013/index.htm

***REFERENCE BOOKS:**

An Introduction to Probability Theory and Its Applications, Volume 1 by William Feller

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	35%
Quiz	-	40%
Open BookExam/ 30 Min Quiz	-	25%

OUTCOME: Understand basic concepts in probability, be able to translate models described in words to mathematical ones, getting familiar with applications of inference methods.

SC1.203 Quantum Mechanics 3-1-0-4

Faculty Name: Subhadip Mitra
TYPE-WHEN : Monsoon2021
OBJECTIVE : Introduce UG students to Quantum Mechanics

COURSE TOPICS:

Introduction: The Schrödinger equation and the uncertainty principle

- Mathematical Formalism: Review of linear algebra, complex functions, Fouriertransformation etc.
- The generalized statistical interpretation, Heisenbergpicture
- TimeindependentSchrödingerequation:Infinitesquarewell,harmonic oscillator, free particle, delta function potential, finite squarewell
- 3D Problems: Spherical coordinates - Hydrogen atom, angular momentum,spin
- Two particle systems,atoms
- Time independent perturbationtheory
- The variationalprinciple
- Bell'stheorem

PREFERRED TEXTBOOKS:

- Introduction to Quantum Mechanics by David J Griffiths
- Molecular Quantum Mechanics by P W Atkins and R S Friedman

***REFERENCE BOOKS:**

- Principles of Quantum Mechanics by RShankar
- Modern Quantum Mechanics by J J Sakurai
- Quantum Physics by Stephen Gasiorowicz

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Term Paper	-	30%
Quiz	-	20%
Open BookExam/		

30 Min Quiz - 20%

MA4.101 Real Analysis 3-1-0-4

Faculty Name : Samyadeb Bhattacharya
TYPE-WHEN : UG-Core-Monsoon-2021

COURSE TOPICS:
Sequence of real No, Bounded and Unbounded Sets, Supremum, Infimum, Limit points of a set, Closed Set, Countable and uncountable sets. Sequences, Limit points of a Sequence. Limits Inferior and Superior, Convergent sequence, non-convergent sequence, Cauchy General Principle of Convergence, bounded and monotone sequence, Infinite Series, Positive Term Series, Convergence of series of real numbers, Necessary condition, Absolute convergence and power series, Convergence tests forseries.
Mean value theorems (Rolle's Theorem, Cauchy Mean Value Theorem, Lagrange's Mean Value Theorem), Indeterminate forms, Taylors Series, Partial derivatives. Integration as a limit of a sum, some integrable functions, Fundamental theorem of Calculus, Mean Value Theorems of Integral calculus, Integration by parts, Change of variable in an integral, Second Mean value theorem, Multiple integrals, Vector, Vector operations, Products, Areas and Determinants in 2D, Gradients, Curl and Divergence, Volumes and Determinants in space.
Analytic function of complex variable, CR Equation, Integration of a function of a complex variable, M-L inequalities. Cauchy's Integral Theorem. Cauchy's Integral formula. Taylor's and Laurent Expansion, Poles and Essential Singularities, Residues, Cauchy's residue theorem, Simple contour integrals.
Differential equations of first order and first degree. Linear ordinary differential equations of higher order with constant coefficients. Elements of Partial Differential Equation (PDE).

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**5**
Quiz-2	**10**
Mid Sem Exam	**35**
End Sem Exam	**40**
Assignments	**10**
Term Paper	
otherEvaluation	

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

Faculty Name: Ashok Kumar Das

1. **Prerequisite Course / Knowledge:**
Cryptography, Network Security, System Security, Programming Languages

2. Course Outcomes (COs) :

After completion of this course successfully, the students will be able to CO-1: Demonstrateskills in solving research problems and critical thinking skills

CO-2: Demonstrate security protocols practically
CO-3: Analyse various techniques for security protocols against different potential attacks
CO-4: Demonstrate the knowledge ofFormal security verification using automated software validations tools
CO-5: Survey the literature in detail on existing security protocols to enable oneself to design, analyse and implement new security protocols

3. MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs) – Course Articulation Matrix

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

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

4. Detailed Syllabus:

- **Unit 1:**Elliptic-Curve Cryptography (ECC), Key management in hierarchical access control, Key management, user authentication and access control, Proxysignature
- **Unit2:Security**invehicularadhocnetworks/InternetofVehicles(IoV),Securityinsmartgrid/smart home, Security in Cloud/Fog computing
- **Unit 3:**Wireless Sensor Networks (WSNs) and Internet of Things (IoT)security
- **Unit 4:**Intrusion detection andprevention
- **Unit 5**:Blockchain and its security and privacy issues, Blockchain-based AI/MLsecurity

Reference Books:

1. Topresearchpapers(journalsandconferences)fromtheIEEETransactions,ACMTransactions,Elsevier, Springer, Wiley,etc.
2. WilliamStallings,"CryptographyandNetworkSecurity:PrinciplesandPractices",PearsonEducation,, 2010.
3. Bernard Menezes, "Network Security and Cryptography", Cengage Learning,2010.
4. Behrouz A. Forouzan, "Cryptography and Network Security", Special Indian Edition,2010.

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

* Recognition of interplay between theory andpractice
* Design of efficient and secure researchproblems
* Various security analysis techniques against potentialattacks
* Automated software validations tools based formal securityverfication

If any changes in the assessment method, faculty will announce in the first class.

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

- In-Class Tests:20%
- Assignments:20%
- Research Project: 40% (including report andpresentation)
- End Semester Examination:20%

EC5.201 Signal Processing 3-1-3-5
Faculty Name: Chiranjeevi Yarra + Jayanthi Sivaswamy

PrerequisiteCourse/Knowledge:

ShouldhavetakenthecourseNetworkSignalsandSystems.

Apriorknowledgeofcalculusandcomplexnumbersisrequired.

CourseOutcomes(COs):

Aftercompletionofthiscoursesuccessfully,thestudentswillbeableto..

CO-1: Describecontinuous-timeanddiscrete-timesignalsusingvariousrepresentations

CO-2: ApplyvarioustransformsincludingFouriertransform,DTFT,andZ-transformtostudysignalsandsystems

CO-3: Applysamplingtheoremtodoanalog-to-digitalconversionofsignals andperformidealandnon-idealreconstructionofsignalfromitssamples

CO-4: ExaminecomputationalcomplexityofefficientDFTimplementationsusingFFT

CO-5: Designdigitalfilterswithspecifiedrequirementstoprocesssignals

CO-6: Analyzesystemsandreal-worldsignalsusingsignalprocessingtoolsinMATLABsoftware

CO-7: Analyzeasignalprocessingapplicationorproblembyreadingresearchpapersand performingsimulationsas partofthecourseproject

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs)

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	3	1	1	2	-	-	-	-	-	-	1	-	3	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	1	1	3	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	1	-	3	1	1
CO4	3	3	3	3	2	-	-	-	-	-	-	1	-	3	1	1
CO5	3	3	3	3	2	-	-	-	-	-	-	1	1	3	1	1
CO6	3	3	3	3	3	-	-	-	3	2	-	1	1	3	1	1
CO7	3	3	3	3	3	-	-	-	3	2	2	1	-	3	1	1

Note: 3 in the box for high level mapping, 2 for medium level and 1 for low level mapping

DetailedSyllabus:

Unit1: Fouriertransform(FT)ofcontinuous-timesignals,analysisoflinearandtimeinvariant(LTI)systems using Fourier transform

Unit2: Samplingandreconstructionofbandlimitedsignals,analog-to-digitalconversion,aliasing,quantization

Unit3: Analysisofdiscrete-timesignalsandsystemsusingFouriertransform(DTFT)andZ-Transform

Unit4: DiscreteFouriertransform(DFT)forfinitelengthsequences,efficientimplementation of DFT using radix-2 fast Fourier transform (FFT) algorithms

Unit5: Digitalfilter design,techniques for FIRandIIRfilter design

ReferenceBooks:

1. SignalsandSystemsbyA.V.Oppenheim,A.S.Willskyand S.H.Nawab(2015)
2. DigitalSignalProcessing:Principles,AlgorithmsandApplicationsbyJ.G.Proakis andD.Manolakis (2007)
3. DigitalSignalProcessing:AComputerBasedApproach,S.K.Mitra(2013)
4. PrinciplesofSignalProcessingandLinearSystems,B.P.Lathi(2009)

Teaching-LearningStrategiesinbrief(4to5sentences):

Lectures are used to explain the core concepts in signal processing and work out a fewproblems. Detailed handwritten notes are shared along with book sections and practiceproblems.Ashortquestionispostedatbeginningofclasstogaugeunderstandingofpreviouslecture. Tutorials are used mainly for doubt clarifications and

problem solving. Assignmentsare given to promote application of concepts to difficult problems. The weekly lab sessionssupplement the course lectures withMATLAB software basedsignal analysiswhich areevaluatedthroughshortviva.Thecourseprojectexposesstudentstoadvancedconceptsandreal-world applications in the domain. The lab sessions and final course projects are done inteamsof twotoencouragecollaborativeproblemsolvingandteamparticipation.

If any changes in the assessment method, faculty will announce in the first class.

Assessmentmethodsandweightagesinbrief(4to5sentences):

Continuousevaluations:

- Mid Semester Tests:30%
- Assignments:10%
- Labvivaandevaluations:15%

Comprehensiveevaluation:

- Project:20%
- EndSemesterExam: 25%

CS6.302 Software Systems Development 3-0-2-4

Faculty Name: Charu Sharma

Course Description: This course aims to provide and equip you with the necessary technical skills so as to make you reasonably comfortable with various Unix-like computing environments. Throughout, you will be exposed to some useful utilities/tools and languages to help you in the journey.

Course Objectives: At the end of the course, you should be:

Comfortable enough working with various unix-like computing environments.

- Able to write simple to complex scripts to automate tasks/solve problems.
- In a position to design and implement database-driven web apps.

Course Syllabus

1. Shell Programming - Linux basic commands and _le systems, script scripting, swiss-army- knife tools (vi, grep, awk, sed ..)

2. Web Programming - Intro to basic concepts of the World Wide Web (WWW) and tools used to

develop web apps. -Client-side & server-side scripting (HTML, XHTML, CSS, Java script, Python,...)

3. Database Programming

SC2.304 Spectroscopy 3-1-0-2

Faculty Name: Marimuthu Krishnan
TYPE-WHEN: Monsoon 2020-21

PRE-REQUISITE: None for UG3-CND students. Non-CND students interested in taking this course as an elective must have secured at least B- grade in Science-I.

OBJECTIVE: The objective of this course is to understand the basic principles and applications of different spectroscopic techniques commonly used in natural sciences.

COURSE TOPICS:

- Introduction: Classical mechanical description of spectroscopy, quantum mechanics and energy quantization, energy-level diagram, energy spectrum: electronic states, vibrational states,rotational states, excitation and relaxation, absorption, and emission of electromagnetic waves by materials
- Atomic Spectra: Spectral series of hydrogen and alkali atoms, selection rules, L-S coupling, many-electron atoms, isotope shift, hyperfine splitting of spectral lines ▪ Molecular Spectra: Electronic spectrum of a diatomic molecule, Rotational spectrum of a diatomic molecule using a rigid rotator model, energy levels and spectrum of a non-rigid diatomic molecule, effect of isotopic substitution on rotational spectra,vibrational spectrum of a diatomic molecule using the harmonic and anharmonic oscillator models. Vibrational-Rotational coupling in a diatomic molecule, molecular spectra of chain molecules
- Raman and Infrared Spectroscopy: Classical and quantum theory of Raman effect, normal vibrations of CO_2 and H_2O molecules, vibrational and rotational Raman spectra, basic concept of infrared spectroscopy, interpretation of Raman and IR spectra, identification of Raman-active and/or IR-active modes based on symmetry arguments
- Introduction to Nuclear Magnetic Resonance (NMR), and Electron Spin Resonance (ESR) spectroscopy

PREFERRED TEXTBOOKS:

1. Physical Chemistry - P. W. Atkins
2. Fundamentals of Molecular Spectroscopy - C. N. Banwell
3. Spectra of Diatomic Molecules - Herzberg
4. Atomic Spectra & Atomic Structure - Gerhard Hertzberg
5. Molecular Spectroscopy - G. M. Barrow
6. Molecules and Radiation: An Introduction to Modern Molecular Spectroscopy - J. I. Steinfeld
7. Physical Chemistry - A Molecular Approach - D. A. McQuarrie and J. D. Simon

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING:
Quiz - 25%
Final exam – 40%
Assignments – 35%

OUTCOME: The students will be able to apply these concepts and techniques to their research problems.

SC3.203 Systems Biology 3-1-0-2

Faculty Name : Vinod PK
TYPE-WHEN : Monsoon
PRE-REQUISITE : Introduction to Biology
OBJECTIVE : This course builds the foundation for understanding the principles of biological systems using mathematical modelling

COURSE TOPICS:

- Systems-level thinking, Input/output relationships
- Bottom-Up and Top-Down Approaches for Systems Biology
- Representation of biological networks
- Network organization: Motifs, modules, and hierarchical networks
- Design principles of biological systems
- Introduction to modelling in biology
- Dynamic modelling of biochemical systems
- Parameter estimation and sensitivity analysis
- Modelling transcription and signalling regulatory circuits
- Biological Switches and Clocks
- Robustness, Optimality
- Constraint-based modelling: metabolism
- Biological noise

PREFERRED TEXTBOOKS:

1. **Systems Biology: A Textbook** by Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, Ralf Herwig, Wiley-VCH.
2. **An Introduction to Systems Biology: Design Principles of Biological Circuits** by Uri Alon, Chapman & Hall
3. **Mathematical Modelling in Systems Biology** by Brian P Ingalls, The MIT press

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	20%
Quiz	-	30%

Open BookExam/
30 Min Quiz - 20%

OUTCOME: This course will enable students to address questions on biological circuits by developing mathematical models.

EC5.202 Systems Thinking 3-1-0-4

Faculty Name **:** Spandan Roy + Vinod PK
TYPE-WHEN **:** ECECore,Monsoon,2nd year

OBJECTIVE:Thecourseaimstofosterabilitiestomodel,synthesizeandcontrolsystems fromamoderncontroltheoreticstandpointwithaneventualculminationinlearningmethodsfor control.Furthercasestudiesofuncommonandyetveryrelevantstateoftheartsystemssuchas biologicalsystemsarealsoplanned.

COURSE TOPICS:

1. Introduction to Control – Classical, State Space and pros andcons
2. Transfer functions, Conversion from State Space to Transfer Functions and ViceVersa
3. Poles and Stability of LTIsystems
4. State Space Modeling ofSystems
5. State Feedback/Pole PlacementControl
6. State RegulatorDesign
6. Introduction to Model Predictive Control/ Discrete Time OptimalControl
7. Introduction toRL
8. Biological signals andsystems
9. Design principles of biologicalsystems
10. Biological feedback andcontrol
11. Modeling and design of biological

Circuits PREFERRED TEXTBOOKS:

Digital Control and State Variable Methods, M Gopal, 4 Edition, MH Publishers Modern Control Engineering, OgataBiomolecular Feedback Systems, Domitilla Del Vecchio and Richard M. Murray, Princeton University Press

***REFERENCE BOOKS:**

AnIntroductiontoSystemsBiology:DesignPrinciplesofBiologicalCircuits, UriAlon,Chapman&Hall.

***PROJECT:Thisisthefirsttimethecourseisoffered.Wewillhaveabetterideaofprojectsandthe needforitonceweseehowthisgoes**

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments - 30%
Project - 20%

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

OUTCOME: Thestudentshouldbecomfortableinlookingatsystemsfromamoderncontroltheoretic standpointaswellasfromapostmodern learning standpoint.He/Sheshouldbeversatileinmodeling, analyzingsystemsandshowsufficientmaturityinlookingatnovelbiologicalsystemsfromsucha perspective.

HS0.201 Thinking and Knowing inthe Human Sciences–I 3-1-0-4

Faculty Name: Sushmita Banerji + Ashwin Jayanti

1. Prerequisite Course / Knowledge: Nil

2. Course Outcomes (COs)

After completion of this course successfully students will be able to:

CO1: Explainthe basics of philosophical discourse and develop interpretative skills

CO2: Demonstrate knowledge of conceptual challenges involved in philosophical analysis

CO3: Discuss philosophical questions about the nature of thought, knowledge and understanding

CO4: Analyzethe ways in which literary practices imagine and express our relation to the world.

CO5: Survey sets of concepts and intellectual assumptions that constitute historical, cultural, textual, and critical methods of literary analyses

CO6: Consider specific moments of intersection between "meta-inquiry" and questions of representation.

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

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

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Pl. map the COs 4, 5 and 6 also to the POs.

4. Detailed Syllabus:

Section A: Philosophy

Unit I – Philosophical tools (5 hours): conceptual distinctions, argument analysis, definition, evidence, belief, knowledge, justification, confirmation, and inference to best explanation.

Unit II – Knowledge and its limits (6.5 hours): kinds of knowledge and its sources, the problem of induction, scepticism about our senses regarding the external world, and skepticism about reflection regarding the internal world.

Unit III – Cognition and its nature (6.5 hours): dualism and the mind-body problem, functionalism and the computational account of thinking, physicalism and qualia, subjective experience and the hard problem of consciousness.

Reference books:

1) Baggini, J. and Fosl, P. 2010. *The Philosopher's Toolkit: A Compendium of Philosophical Concepts and Methods*. Wiley-Blackwell.

2) Stich, S. and Donaldson. T. 2019. *Philosophy: Asking Questions, Seeking Answers*. Oxford University Press.

3) Rosen, G., Byrne, A., Cohen, J., Harman, E., and Shiffrin, S. 2018. *The Norton Introduction to Philosophy*. W.W. Norton and Co.

4) Williamson, T. 2018. *Doing Philosophy: From Common Curiosity to Logical Reasoning*. Oxford University Press.

Section B: Literature

PREFERRED TEXT BOOKS FOR SECTION B

Unit 1. Dickens, Charles. *A Tale of two Cities.* 1859.

Wilde, Oscar. *The Picture of Dorian Gray.* 1890.

Unit 2. Lee, Harper. *To Kill a Mockingbird.* 1960

Morrison Toni. *Beloved*. 1987

Unit 3. Rushdie, Salman. *Haroun and the Sea of Stories*. 1990.
Shahid Ali, Agha. *The Country Without a Post Office.* 1997

REFERENCE BOOKS FOR SECTION B

1. Leitch, Cain, Finke, Johnson, McGowan, and Williams, eds. *The Norton Anthology of Theory and Criticism*. 2nd ed. New York: W.W. Norton & Co., 2010.

2. Eagleton, Terry. *Literary Theory*. 3rd ed. Minneapolis: University of Minnesota Press, 2008. The Norton Anthology of Poetry (6th ed.)

3. Rivkin, J. and Ryan, M., ed: *Literary Theory: An Anthology* (Blackwell, Oxford, 2nd ed.)

5. Teaching-Learning Strategies in brief:

Section A: Philosophy – the general teaching strategy employed is the use of conceptual puzzles to introduce course topics. Lectures make use of this strategy to impress upon students the need to critically reflect on problems and the relevance of doing a careful, philosophical investigation of those issues. Students are taught effective reasoning skills to engage with abstract ideas without spoon feeding them any settled philosophical truths. They are trained to think for themselves in a clear and organized manner

and encouraged to ask meaningful questions that enrich debates about what we take for granted in thinking and knowing about the world and ourselves.

Section B: Literature– Plays, novels and poetry have given their authors and their readers an opportunity to consider what it is to be human. This course looks at some the ways in which literary practices imagine and express our relation to the world. The module will survey sets of concepts and intellectual assumptions that constitute historical, cultural, textual, and critical methods of literary analyses. We shall look at specific texts to see how the field of literary studies has evolved to reformulate its primary concerns and moved beyond canon formation to questions of epistemology and subjectivity.

Students are expected to read six full texts in the course of the module.

If any changes in the assessment method, faculty will announce in the first class.

6. Assessment methods and weightages in brief:

Section A: Philosophy – questions are carefully designed to make students reflect critically on what they read. Students are assessed for abilities like logically dissecting issues, questioning assumptions, clarifying distinctions, and bringing out nuances. In assignments and exams, students are expected to demonstrate these abilities by presenting their views clearly, assessing competing positions systematically, anticipating possible objections to a reasoned conclusion and composing cogent responses to those objections. The assessment components and their weightages are as follows. Assignments: 35%, Essay 10%, and class participation: 10%.?

Section A: Literature

Type of Evaluation	Weightage (in %)
In-Class assignments (Due every week)	20%
Term Paper 1	10%
Term Paper 2	15%
Participation	5%

Pl. revisit the assessment methods and weightages. There must be an end semester exam with the weightage of 20-30%. The total marks may be 100.

HS0.202 Thinking and Knowing in the Human Sciences – II 3-1-0-4

Faculty Name : Nazia Akhtar+ Radhika Krishnan
PRE-REQUISITE : **Admission to second year of CHD program**
OBJECTIVE :

Students will be introduced to the main sociological and historiographical theories. These include the empiricist and rationalist theories, the inductive and deductive methods and the synchronic and diachronic perspectives. In history, they will deal with the various schools of history – their methods, assumptions, principles, and the foundational ideas which make the discipline. In sociology, they will briefly study key concepts like sociological imagination, structure and agency, socialization, culture and deviation. The course intends to give students a sense of how the human world appears through the lens of these two disciplines and their insights. It would equip students to engage with academic texts as well as primary sources in a theoretically informed manner.

COURSE TOPICS :

This course is divided into two parts of 13 lectures each. The first part will focus on the discipline of

History (taught by Aniket Alam) and the second part will focus on the discipline of Sociology (taught by Radhika Krishnan).

History Topics: 1. Ideas of History (Progress, Decline, Morality; Facts, Objectivity, Interpretation); 2. Concepts of Time and Space; 3. Main methods of knowing the past (Inductive and deductive methods; structuralism and post-structuralism).

Sociology Topics: 1. Sociological Concepts; 2. Key Thinkers in Sociology (Emile Durkheim, Karl Marx, Max Weber); 3. Social Institutions and Processes; 4. Sociology in India.

PREFERRED TEXTBOOKS:

1. E. H. Carr: *What is History*
2. Mircea Eliade: *The Myth of the Eternal Return*
3. Umberto Eco: *This is not the end of the book;*
4. James Scott: *Against the Grain*
5. Anthony Giddens, Philip W Sutton: *Sociology*
6. NandiniSundar, Patricia Uberoi, Satish Deshpande: *Anthropology in the East: Founders of Indian Sociology and Anthropology*
7. D.P. Mukerji: *Basic Concepts in Sociology*
8.

***REFERENCE BOOKS:** Some parts from other books and articles will be suggested over the course of the semester depending on the discussions in class and the varying interests of the students.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
In class assignments (8)	**5% each; total 40%**
Term Paper (2)	**10% each; total 20%**
Long form essay (2)	**20% each; total 40%**

OUTCOME: At the end of this course, students will have a good grasp of the methods and foundational ideas of history and sociology. This will equip them to start accessing academic literature as well as analyse primary sources and evidence independently and drawing conclusions. The students will be able to deploy theories and methods to their own research and draw interconnections between the different ways in which the human world is understood and explained.

REMARKS: This course expects the student to read about 2000 pages of academic literature and write about 12,000 words of essays and answers over the semester.

OC3.101 **VALUE EDUCATION – I** **0-2-0-2**

Faculty Name: Radhika Mamidi

1.Prerequisite Course / Knowledge: -NIL-

2.Course Outcomes (COs) :

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

CO-1: Apply the basic framework of universal human values to the self.

CO-2: Look at larger issues that (for many reasons) most are not exposed to: social, political, community, family, individual, etc. in a sensitized way.

CO-3:Understand themselves and their own roles within the bigger context. What are really, truly important to them? What are made important by others?

CO-4: Engage and connect with others and nurture the relationships.

CO-5: Think toshape and change the world, and not be mere technologists or scientists.

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

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

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1: Goal in life - short term and long term goals; Basic aspirations - Happiness and Prosperity; Role of education and human conduct; Self-exploration; Developing a holistic view

Unit 2: Gratitude and the need to acknowledge one's gratefulness; Understanding Self and Other;

Unit 3: Living in harmony at 4 levels: self-self, self-family, self-society, self-nature

Unit 4:Understanding needs of body and self; Right understanding of physical facilities and relationships; Understanding human relationships; Trust and Respect - the foundational values in relationships;

Unit5: Harmony in Society; The sense of safety, justice and peace in society; Nature and Sustainability; Self-reliance and Gandhian thought

Reference Books:

1. R.R. Gaur, R. Sangal, G. P. Bagaria. 2009. A Foundation course in Human Values and Professional Ethics. Excel books, New Delhi.

2. Randy Pausch. 2008. The Last Lecture. Hachette Books.

3. E. F. Schumacher. 1973. Small is beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.

4. P. L. Dhar, R. R. Gaur. 1990. Science and Humanism. Commonwealth Publishers.

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

This is a discussed based course. The instructor shares information on a topic and guides the discussion in the class by asking the right questions. By keeping the objectives in mind, the instructor adopts different techniques including smaller group discussions, role-play/skit, use of video clips or images to analyse and some activities to keep the students engaged in class throughout. Talks by experts who made a difference are also organised for the batch. Field trips to farms, orphanages, old-age homes, villages and jails are arranged as part of the induction programme, in parallel to the classes in VE for the first year UG batch.

If any changes in the assessment method, faculty will announce in the first class.

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

This is a Pass/Fail course. The assessment methods include submissions of assignments and term papers. Critical thinking is expected from watching relevant short films or by reading assigned books. The classroom participation is also taken into consideration for evaluation. There are a few

community-based activities and projects also. Participation in them is also **important.(weightage for each kind of assessment may be given.)**

EC2.201 **VLSI Design** **3-1-0-4**

Faculty Name : Zia Abbas
TYPE-WHEN : Monsoon-2021

Introduction : Overview of VLSI Design Full Flow, Schematics, Layout, Semiconductor Process Technology, Fabrication Process, Approach to achieve required Digital Design - FPGA and ASIC flow, Front- end and Back-end.

Transistor Implementation of Digital Gates

MOS Transistor, Transistor as switch, CMOS Logic – Inverters, Universal Gates, XOR and XNOR, Combinational Logic, MUX, Pass Transistor Logic.

Digital Blocks

Arithmetic Blocks - Adders – Ripple carry adder, Carry look-ahead adder, etc, Multiplier, Sequential Blocks - Latch, Flip-Flops and Registers, Clocking and Clock Delays, Counters, Memory Blocks - SRAM and DRAM etc. Finite State Machines.

FPGA Flow

Coding a design in VHDL or Verilog, Compilation, Synthesis, Implementation and transferring on FPGA

ASIC Flow

Coding a design in VHDL or Verilog, Compiling, Elaborating and Simulating, Synthesizing and Physical Design

Recommended Textbooks

1. Neil H. E. Weste, David M Harris, "Principles of CMOS VLSI Design", A Systems Perspective, 4th Edition, Pearson Education Pvt.Ltd.
2. Douglas A. Pucknell, K. Eshraghian, "Basic VLSI Design", Latest Edition, Prentice Hall ofIndia.
3. S. M. Kang, Y. Lablebici, "CMOS Digital Integrated Circuits", Latest Edition, Tata Mc GrawHill.
4. J. M. Rabaey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits", A Design Perspective, Latest Edition, Prentice Hall ofIndia.
5. Samir Palnitkar, "A Guide to Digital Design & Synthesis", Latest edition, PrenticeHall.

OUTCOME:

Upon completion of the course, the students should be able to:

- Implement combinational, sequential, and arithmetic circuits in FPGA and ASIC. •Understand both static and dynamic CMOScircuits.
- Understand the performance metrics of CMOS circuits. Be able to evaluate the designed circuits.
- Perform transistor-level simulation to verify and evaluate the designedcircuits.
- Perform layout design for CMOS circuits. Understand modern IC Layout design techniques, including Design Rule Check (DRC), Layout Versus Schematic (LVS), and layout parasitic extraction.REMARKS:
- Course consists of Lab Assignments and a final Project using VLSI Design Toolkits

If any changes in the grading policy, faculty will announce in the first class.

GRADING POLICY

- Homework -5%
- Laboratory Assignments -20%
- Quiz-1 -5%
- Mid-Sem Exam -20%
- Quiz-2 -10%
- Final Exam –25%
- Final project -15%

PD2.321 Business Fundamentals # 1 3-1-0-2

Faculty Name: Himanshu Warudkar

Program: M.Tech I Year I Semester – Product Design and Management*

1. Prerequisite Course /Knowledge:

No prerequisites are required

Semester, Year: 1st Sem – Year 1 (Spring, 2022). Jan – Feb.

OBJECTIVE OF THE COURSE

The course focuses on the basic concepts of business management and development including opportunity recognition; experimentation and testing of a new business idea; strategy, business model development, and business planning; financing; andplanningandmanagement ofgrowth andchange. Thiscourseprovides aprocess perspectivetonewbusinessdevelopment.Thecourse aimsatgeneratinganin-depthunderstandingofplanningand managementofgrowthandchange at the root level of business development in the Finnish business context. The course provides basictools andframeworks for analyzing business development andgrowthmanagement cases in practice.

DETAILS OF THE COURSE SYLLABUS

- Introduction to principles of Management and entrepreneurship

- Basics of business model development and business planning

- Legal aspects of new venture creation and IPR

- Entrepreneurial Marketing

- Human resource management

- Introduction to entrepreneurial finance and Accounting

- Supervisory Skills for Business Leadership
- Negotiation and Conflict Resolution

- Business Ethics

PD2.421 Business Fundamentals # 2 3-1-0-2

Faculty Name: Himanshu Warudkar

Program: M.Tech I Year I Semester – Product Design and Management*

1.**Prerequisite Course / Knowledge**:

Should have taken Business Fundamentals # 1 – PD2.121 course

Semester, Year : 1st Sem – Year 1 (Spring, 2022).

OBJECTIVE OF THE COURSE

The course focuses on the basic concepts of business management and development including opportunity recognition; experimentation and testing of a new business idea; strategy, business model development, and business planning; financing; and planning and management of growth and change. This course provides a process perspective to new business development. The courseaims at generating an in-depth understanding of planning and management of growth and change at the root level of business development in the Finnish business context. The course provides basic tools and frameworks for analyzing business development and growth management cases inpractice.

DETAILS OF THE COURSE SYLLABUS

- Strategic Management for New Business
- Introduction to entrepreneurial finance and Accounting
- Supervisory Skills for Business Leadership
- Negotiation and Conflict Resolution
- Business Ethics

PD1.401 Design Thinking – Ideate to Evaluate 3-1-0-2

Faculty Name: Raman Saxena

Program: M.Tech I Year I Semester – Product Design and Management*

L-T-P: 3-1-0

(L= Lecture hours, T=Tutorial hours, P=Practical

hours)Credits: 2

1.Prerequisite Course / Knowledge:
Should have taken **Design Thinking PD1.301-Research to Define**

Semester, Year: 1st Sem – Year 1 (Spring, 2022)

(March-April)

1. Objective

This course is the extension of the earlier course "Design Thinking101-Research to Define" and will introduce the knowledge and skills required for the second diamond of the overall design thinking process. This course is aimed at guiding the students to work through the Ideation & Prototyping (Diversion) and Test/Evaluate (Convergence) phases of the second diamond of the overall Design Thinking Process. This course will help the student appreciating the criticality and value of generating lots of ideas, early prototyping and user testing/validation of the ideas at the early stage of design development for delivering solution which has higher fit between the products and the user needs and business model.
This course is core knowledge/skill and will also serves as a foundation for further learning for any student irrespective of their specific domain such as product design, product management, user experience design,service design, software & IT, technology design and business.

2. Detailed Syllabus:

1. **REVIST THE PREVIOUS LEARNINGS AND ACTIONABLE BRIEF** *(Week 1 - Lecture 1 & 2)*
- Revise the understandings and learnings of the earlier course.
- Revisit and deliberate on the actionable brief and tweaking the same if needed.
- The process of divergence and convergence.

2. **IDEATION (DIVERGENCE) PHASE** *(Week 2 - Lecture 3 & 4)*
- Power and Value of Ideation process
- Process and techniques of Ideation to generate many ideas.
- Case study- Mainframe- Design for next generation.

3. **PROTOTYPING (DIVERGENCE) PHASE (***Week 3 - Lecture 5 & 6)*
- Why prototyping?
- Types of Prototypes – Low fidelity & high fidelity
- Creation of prototypes.
- Case study of Embrace – The Baby Warmer and deliberation/discussion.

4. **USER TESTING AND VALIDATION** *(Week 4 - Lecture 7 & 8)*
- Why Test?
- Types of user testing and evaluation.
- Process of user testing/validation using prototypes.
- Use case of user testing/validation (TBD)

5. **PPROJECT WORK- IDEA GENERATION FOR THE PROJECT WORK (***Week 5 & 6- Hand on ideageneration)*
- This week will be dedicated to generation of ideas against the actionable brief. The students willrequire to work on generating more and more ideas and lecture hours will be used for work in progress presentation by the students, discussions and feedback.

6. **PROJECT WORK - PROTOTYPE CREATION AND TESTING** *(Week 6- Hands-on User testing)*

- Students will require to developing several prototypes based on the ideas generated during theideation phase and validate the ideas for shortlisting,

7. **PROJECT WORK – TWEAKING IDEAS AND FINANLISING THE SOLUTION** *(Week 7- Project Completion)*

- Tweaking the ideas and further development of the same.
- Final presentation of the work.

Reference Books:

1. Case: Design Thinking and Innovation at Apple, Stefan T. & Barbara F. (HBS 9-609-066)
2. Case: Embrace- A Baby Warmer, Project by Stanford University.
3. Case: Mainframe design for new Generation
4. Book: HBR's 10 Must Reads on Design Thinking, by Harvard Business Review
5. Book: Change by Design by Tim Brown
6. Book: Design Thinking for Creativity and Business Innovation Series by Idris Mootee
7. Book: Design Thinking: A Culture of Innovation by Sean Koh
8. Book: Design Thinking, by Nigel Cross
9. Book: The Design of Everyday Things by Donald A. Norman

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

- The Course will divide into lectures (around 10 nos.) and hands-on work including assignments,classroom exercises, home assignment, and project.
- The course will also include fieldwork, hand on activities, learning by doing, to practice the learningfrom the lectures.
- It will also introduce and discuss couple of case studies including cases related to the new productdevelopment and ICT domain.
- It is supported by the design thinking and research approaches of various design, technology and business schools including Stanford, NID, IIM Bangalore etc. and also prestigious design consulting's including IDEO, FROG Design, Nokia Research, Nokia Design and Siemens etc. to bring both academic and industrial flavor in the content and learning.
- Other than attending the lectures and doing classroom exercises & assignments, students need tospend 4 hours per week on home/field assignments.

If any changes in the assessment method, faculty will announce in the first class.

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

1.	Class/Home activities	N= 6	18%
2.	Project in Group – with 2-3 students	N=1	40%
3.	Assignment	N=1	14%
4.	Final Exam	N=1	20%
5.	Experiment participation-based credit and Peerreview	N=2	8%
		TOTAL	**100%**

PD1.301 Design Thinking – Research to Define 3-1-0-2

Faculty Name: Raman Saxena

Program: M.Tech I Year I Semester – Product Design and Management*

L-T-P: 3-1-0

(L= Lecture hours, T=Tutorial hours, P=Practical hours)Credits: 2

1. rerequisite Course / Knowledge:

No prerequisites are required

Semester, Year: 1st Sem – Year 1 (Spring, 2022)(Jan – Feb)

2. Objective

The overall goal of this design thinking course is to help you design better solutions, products, services, systems, processes, strategies, and experiences.
This course is aimed at guiding you through the Design Thinking Process and will help you developing a solid understanding of the overall process, phases and methods in design thinking. Introduce the concept of Human-centred approach, empathy, collaboration, co-creation and product-user & product-market fit. It will provide the theory and operational skills to follow Human (User)-Centred approach and how to implement this knowledge in your professional work life.

This course is core knowledge/skill and will also serves as a foundation for further learning for any student irrespective of their specific domain such as product design, product management, user experience design, service design, software & IT, technology design and business.

3. Detailed Syllabus:

1. **UNLEARNING** *(Week 1 - Lecture 1 & 2)*
Initial part of the course will emphasize on unlearning and to cultivate a knack for design thinking, and creative problem solving among the students that will work as a good foundation before introducing them todetailed process, methods and tools of DESIGN THINKING.

2. **UNDERSTANDING DESIGN AND DESIGN DOMAIN** *(Week 2 - Lecture 3 & 4)*

- Understanding Design
- Role & Functions of design and designers.
- Design Elements – (Function, Ergonomics & Aesthetics) + Desirability, Feasibility & Viability)
- Understanding Design Domains and perspectives – Product Design, HCI, Visual Communication,Service Design and User Experience

3. **INTRODUCTION TO DESIGN THINKING** *(Week 3 - Lecture 5 & 6)*

- What is Design Thinking?
- Why Design Thinking?
- Design Thinking approach in new product development & innovative solutions

4. **DESIGN THINKING PROCESS** *(Week 4 - Lecture 7 & 8)*

- Design Thinking Process – human-focused, empathy, research, ideation and prototype-driven, innovative design approach.

- User-Centred Design / Double Diamond Process explaining stage of Discovery, Define, Design,Prototype & Test and Implement.
- Introduce/Initiate Design Thinking Pilot Project which is built into course structure and will runparallel to the course content in the DT-Part1 and will conclude in DT-Part 2.

5. **DISCOVERY PHASE (***Week 5 - Lecture 9 & 10)*
- What is Discovery and Validation phase and why?
- Understanding User Context? – Why & How to Empathies?
- Understanding the User Needs and Goals through empathy by observing their behaviour anddrawing conclusions based on qualitative information
- Understanding the Business Goals
- Tools and Methods and Deliverables

6. **DEFINE PHASE** *(Week 6 - Lecture 11 & 12)*
- Analysis and Synthesis of Data and Information.
- Driving Insights (both user and business) and solution directions
- Tools and Deliverables of the Define phase

7. **DRIVING ACTIONABLE BRIEF** *(Week 7 - Lecture 13 & 14)*
- Through the process of analysis and synthesis, identifying user-business insights, arriving at an actional brief in form of HMW statement.
- Debriefing and briefing on upcoming course "Design Thinking 101 – Research to Define"

Reference Books:

1. Case: Design Thinking and Innovation at Apple, Stefan T. & Barbara F. (HBS 9-609-066)
2. Case: Defining Innovative Mobile Strategies: How Design Thinking Offers an Effective Way to Address the "Wicked Problem" of Enterprise Mobility by SAP
3. Book: HBR's 10 Must Reads on Design Thinking, by Harvard Business Review
4. Book: Design Thinking by Tim Brown (HBR – R0806E)
5. Book: Innovation Through Design by Bill Moggridge
6. Book: Design Thinking and Social Innovation by Tim Brown and Jocelyn Wyatt in Stanford SocialInnovation review

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

- The Course will divide into lectures (around 12 nos.) and hands-on work including assignments,classroom exercises and home work.
- The course will also include fieldwork, hand on activities, learning by doing, to practice the learningfrom the lectures.
- I will also introduce and discuss couple of case studies including cases related to the new productdevelopment and ICT domain.
- It is supported by the design thinking and research approaches of various design, technology and business schools including Stanford, NID, IIM Bangalore etc. and also prestigious design consulting'sincluding IDEO, FROG Design, Nokia Research, Nokia Design and Siemens etc. to bring both academic and industrial flavor in the content and learning.
- Other than attending the lectures and doing classroom exercises & assignments, students need tospend 4 hours per week on home/field assignments.

If any changes in the assessment method, faculty will announce in the first class.

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

1.	Class/Home activities	N= 6	18%
2.	Project in Group – with 2-3 students	N=1	40%
3.	Assignment	N=1	14%
4.	Final Exam	N=1	20%
5.	Experiment participation-based credit and Peerreview	N=2	8%
		TOTAL	**100%**

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

Faculty Name: Venkateshwarlu M

TYPE-WHEN: Monsoon Semester

1. **Prerequisite:** Calculus, Linear algebra
2. **Detailed Syllabus**

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

References:

J.N. Reddy, An introduction to the finite element method
S.S. Rao, The finite element method in engineering
Y.W. Kwon, The finite element method

3. **Teaching-Learning Strategies**

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

If any changes in the assessment method, faculty will announce in the first class.

4. Assessment Methods and Weightage

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

CE9.609 IoT Workshop 2-0-3-4

TYPE-WHEN **:** Monsoon 2021

FACULTY NAME **:** Nagamanikandan Govindan, Sachin Chaudhari

PRE-REQUISITE : Introduction to IoT

OBJECTIVE **:** This is a hands-on course on embedded systems based on learning by doing method. Students must choose a real-life problem related to structural engineering such as health monitoring of a structural component. They should design, develop and deploy a basic proof of concept prototype. The main emphasis in this course is on considerations of practical issues that come in the field while deploying. The project in this course is team activity, which will also develop interpersonal skills.

COURSE TOPICS :

1. **Basic properties of electricity and electrical circuits –**
    a. DC, Voltage, Current, Power, Energy, Resistance, Ohm's Law, Circuit Diagrams
    b. Kirchoff's voltage and current laws, series and parallel resistance, Voltage and Current divider
    c. Online Simulations using TinkerCAD
    d. Basic Circuits, Mesh analysis, Node analysis.
2. **What is IoT, Embedded Systems, Components of Embedded Systems,** Microcontrollers, Sensors and Actuators, Analog/Digital conversion, Internet structure, Protocols, TCP/IP
3. **Arduino Environment, C Programming, Arduino programming and debugging, URAT Protocol**
4. **Sensing/Actuators and Interfacing**
    a. Sensor/Actuator selection (using data sheets)
    b. Physics of sensors and actuators related to projects
    c. Interfacing: Serial interfaces, Analog out, SPI, UART, I2C, "propriety" such as DHT22
5. **Controller, Embedded Systems and Peripherals** -
    a. Platform selection – ATMEL328, ESP32, STM8 Architecture; timers, interrupts, AVR, SAMR architectures
    b. Embedded Systems: power management, interrupts, memory managements, leaks, OTA firmware update, reliability, onboard debugging
    c. Peripherals: RTC, ADC channels, resolution, onboard memory, power, external/internal watchdog
6. **Communications, Networking and IoT Architecture**
    a. **DifferentIoT communication protocols:** Comparison of

Zigbee/WiFi/BLE/4G/5G/eSim/LoRaWAN
   b. **Data Protocols:** MQTT/HTTPS/CoAP
7. **Data Storage and Computation**
   a. **Cloud storage and computing**
   b. **Data retrieval optimization**
   c. **IoT standards for interoperability:** Implementation using oneM2M
8. **PCB and Enclosure Design**
9. **Data privacy and security**
10. **Dashboard and Visualization**
    a. Software/Approaches: UI/UX and Time Series Data Visualization; Front-end and back-end technologies
11. **Documentation**
    a. User document and developer's documentation
    b. Best practices for writing the two documents
    c. Referring style manual. For example, *Microsoft/Chicago manual of style*

PREFERRED TEXTBOOKS:

- P. Lea, *Internet of Things for Architects*, Packt, 2018
- D. Norris, *The Internet of Things*, McGraw Hill, 2015
- A. Kurniawan, *Internet of Things Projects with ESP32,* Packt, 2019

***REFERENCE BOOKS:**

- O. Hersent, D. Boswarthick, O. Elloumi, *The Internet of Things*, Wiley, 2016
- A. Bahga and V. Madisetti, *Internet of Things*, University Press, 2016
- Raj Kamal, *Internet of Things,* McGraw Hill, 2018

***ONLINE COURSES:**

1. Linear Circuits 1: DC Analysis by Georgia Institute of Technology
   URL: https://www.coursera.org/learn/linear-circuits-dcanalysis/home/info
   Week 1 - Full week, 5 lessons; except Module 1 - Extra problems
   Week 2 - Full week, 6 lessons; except Module 2 - Extra problems
   Week 3 - Full week, 4 lessons; except Module 3 - Extra problems
2. Introduction to the Internet of Things and Embedded Systems by University of California, Irvine
   URL: https://www.coursera.org/learn/iot/home/welcome
3. The Arduino Platform and C Programming
   URL: https://www.coursera.org/learn/arduino-platform?specialization=iot
4. Interfacing with the Arduino
   URL: https://www.coursera.org/learn/interface-with-arduino?specialization=iot

If any changes in the assessment method, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid 1	10
Mid 2	10
EndSem	20
Lab	10
Project	50

OUTCOME:

After completion of this course, a student will be able to

 Evaluate different solutions for a real-life application and choose the solution, which is practical in given conditions.

 Design, develop and deploy a proof-of-concept solution

 Test, debug, and redesign the solution based on field experiences

---

Product Design Course #1 [User Interactions](H1)

Product Design Course #2 [Maker Lab](H1)

Product Management 101 (H1) **Pending**

CS6.302 Software Systems Development 3-0-2-4

Faculty Name: Charu Sharma

Course Description: This course aims to provide and equip you with the necessary technical skills so as to make you reasonably comfortable with various Unix-like computing environments. Throughout, you will be exposed to some useful utilities/tools and languages to help you in the journey.

Course Objectives: At the end of the course, you should be:

Comfortable enough working with various unix-like computing environments.

- Able to write simple to complex scripts to automate tasks/solve problems.
- In a position to design and implement database-driven web apps.

Course Syllabus

1. Shell Programming - Linux basic commands and _le systems, script scripting, swiss-army- knife tools (vi, grep, awk, sed...)

2. Web Programming - Intro to basic concepts of the World Wide Web (WWW) and tools used to develop web apps. -Client-side & server-side scripting (HTML, XHTML, CSS, Java script, Python, ...)

3. Database Programming

CE1.501 Structural Dynamics 3-1-0-4

FACULTY NAME : Sunitha P
TYPE-WHEN : Monsoon 2021
PRE-REQUISITE: Mechanics of Materials & Structural Analysis
OBJECTIVE : To learn how to analyze the behavior of buildings & structures subjected to dynamic loadings.

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

- Introduction to structuraldynamics
- Free vibration Single degree of freedomsystems
- Forcedvibrations
- Response to stepfunction
- Numerical evaluation of dynamicresponse
- Concept of responsespectrum
- Concept of designspectrum
- Generalized single degree offreedom
- Multi degree of freedomsystems
- Approximate methods for finding naturalfrequency
- Dynamics of rigidblocks
- Control ofvibration
- Introduction to RandomVibrations

PREFERRED TEXTBOOKS:

1. Dynamics of Structures by Anik KChopra

2. Structural Dynamics by Clough andPenzein

***REFERENCE BOOKS:**

1. Thomson: Theory ofvibration
2. Leonard meirovitch: Elements of vibrationanalysis
3. MadhujitMukhopadhyay: StructuralDynamics

***PROJECT:** One project on MDOF (1)

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME: Understand the behavior of structures when subjected to dynamic loads such as earthquakes, wind, machine, etc.

CE1.502 Structural Engineering Design Studio I 3-1-0-4

FACULTY NAME **:** Pradeep Kumar R

TYPE-WHEN **:** H2 Monsoon 2021

PRE-REQUISITE **:** B.Tech in Civil Engineering

OBJECTIVE **: The primary objectives of the course are to help students:**

1. Set background for use of computer programs, to develop structural analysis softwares;
2. Provide a platform to get familiarised with structural analysis & structural design methods followed by design practitioners, using commercially available analysis and design softwares.

COURSE TOPICS:

1. MATLAB (4 lecture + 2 tutorials)
    a. Vectors, Arrays and Matrices, Branching Statements and Loops
    b. Introduction to Plotting, Linear Algebra, Curve Fitting, Script and Functions,
    c. Graphics -2D and 3D, Development of GUI Tool.
    d. Applications: Shear force and bending moment diagrams, Deflected shape of beams, plotting of vibration response, etc
2. STAAD & RAM (5 lecture + 3 tutorials)
    a. Modelling of structure (Using different material models)
    b. Analysis & design for gravity loads

c. Analysis for dynamic loads
d. Modelling of Flat Slabs

3. SAP, ETABS & SAFE (5 lectures + 3 tutorials)
   a. Bare frame analysis
   b. Modelling of infills
   c. Dynamic analysis
   d. Pushover Analysis - Demo

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

1. Chapman, S.J., (2007), *MATLAB Programming for Engineers*, Thomson Learning, Canada.
2. Pratap, R., (2003), *Getting Started with MATLAb: A Quick Introduction for Scientists and Engineers*, OXFORD University Press, Oxford, UK
3. Computers and Structures Inc. (CSI), (2012), *Structural Analysis Program* (SAP) 2000, Version 16, USA

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME:

Demonstrate and apply understanding of concepts of structural analysis & design, using computer programs and commercial structural analysis softwares, to address practical structural design problems.

CS9.424 **Technology Product Entrepreneurship**- Tools & Techniques 3-1-0-2

Faculty: RamesLoganathan.

Description:

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

hands on assignments concurrent with course modules.

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

Key Takeaways:

Pedagogy Format

• Classroom sessions, guest lectures (from serial tech entrepreneurs/investors) and case study discussions in class

• Assignments applied on tech product ideas from the class

Prerequisites:

• A technology product idea that has come out of an internship, research work or honors workin 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	2
7	PositioningSales & 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 considerations _ Leveraging Mobile and Cloud	1
10	Corporate Technology Innovation _ Applying research technology in corporate environments	1
11	Tech Product Pitch/Plan presentations _ What makes a good product pitch and demo	1
12	Final Demo and presentations	1
TOTAL		**17 classes**

If any changes in the Evaluation, faculty will announce in the first class.

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 andplan; 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 functionality 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 DorfReference 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 Businessby Clayton M. Christensen
4. Running Lean: Iterate From Plan A to a Plan That Works by Ash Maurya
5. Positioning: The Battle for Your Mind by Al Ries and Jack Trout
6. Venture Deals by Brad Feld and Jason Mendelson
7. Lean Analytics by Alistair Croll and Benjamin Yoskovitz
8. Crossing the Chasm by Geoffrey A. Moore

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

TYPE-WHEN : Monsoon Semester

FACULTY NAME: Dr. P. Pravin Kumar Venkat Rao

PRE-REQUISITE: Solid Mechanics

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

COURSE TOPICS:

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

Torsion of bar, Membrane analogy, Theory of failures.

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

REFERENCE BOOKS:

1. Ugural, A. C., & Fenster, S. K. (2003). Advanced strength and applied elasticity. Pearson education.
2. Timoshenko, S. P., & Goodier, J. N. (1971). Theory of Elasticity, McGraw-Hill, New York, 1970. Fok-Ching Chong received the BS degree from the Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan, in.
3. Shames, I. H. (1964). Mechanics of deformable solids.
4. Srinath, L. S. (2003). Advanced mechanics of solids. Tata McGraw-Hill.
5. Chakrabarty, J. (2012). Theory of plasticity. Butterworth-Heinemann.
6. Timoshenko, S. (1953). History of strength of materials: with a brief account of the history of theory of elasticity and theory of structures. Courier Corporation.
7. Boresi, A. P., Chong, K., & Lee, J. D. (2010). Elasticity in engineering mechanics. John Wiley & Sons.
8. Popov, E. P., & Balan, T. A. (1968). Mechanics of solids. Mexico City, Mexico: Pearson Education, 2000) (in Spanish).
9. NPTEL Lecture Notes: IIT, Madras.
10. Hill, R. (1998). The mathematical theory of plasticity (Vol. 11). Oxford university press. 11. Lubliner, J. (2008). Plasticity theory. Courier Corporation.
11. Wong, M.B. "Plastic Analysis and Design of Steel Structures", Elsevier Publications, 2009.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

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

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

CS9.501 User Research Methods 3-1-0-2

Faculty Name: **Prof. Priyanka Srivastava**
Program: M.Tech I Year I Semester – Product Design and Management*

1. **Prerequisite Course / Knowledge:**
No prerequisites are required

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

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

CO-1: Will be able to use common experience research methods, like 3-dimensional framework usingattitudinal and behavioural, qualitative and quatitative, and context of use; conduct field studies, stakeholder interviews, log analysis; affinity wall etc.
CO-2: Learn to understand users' need and pain points by creating user stories, empathy maps, personas,
user journey maps
CO-3: Identify and recognize the problem and gaps, generate possible solutions to user problems
CO-4: Ethics of conducting study and observations
CO-5: User research data presentation and summary

4. Detailed Syllabus:

Unit 1: Understanding User

Unit 2: Lab and Field, Quantitative and Qualitative

methodsUnit 3: Ethics in User Research

Unit 4: Statistics – How to present User Research Results

Unit 1	Unit 2	Unit 3	Unit 4
Understanding User	Observation Techniques	Ethics	Data Visualization and Presentation
Introduction and Qualitative Research Overview – foundation of user experience, key terms, highlight the hall of shame, why user-centric design and control is important; attitudinal and behavioural dimension	Conducting studies in usability lab, Lab studies – eye-tracking, behavioural observations, control design observations	Code of conduct; Participants Rights, Privacy -data safety, Respect – individual rights, time and effort, Sensitive and Empathetic; Risk analysis; Informed Consent	Qualitative Analysis – Thematic, values, product quality etc. organize and summarise data
User need assessments, Qualitative research method,	Field study, site visits, naturalistic observations, controlled field		Quantitative Analysis – count, accuracy, response time or time

Interview protocols followed up with activities. Know your user – age, gender, cognitive / psychological perspectives, people with disability or accessibility, role of persona in understanding user, empathy and journey map	experiment, individual and group survey and focused interviews, customer satisfaction, remote testing		taken to complete the task or speed analysis, visualization, learning curve,
How to conduct interview, make observations, and extract data from interview, ethics and consent, user research	Industry practice - A/B and Multivariate testing, card sorting or tree testing, qualitative and quantitative method,		

protocols, survey-based observations	How to deliver user research results		
Affinity Wall and Analysis – Qualitative and quantitative analysis, log, survey and questionnaire analyses and affinity diagram to cluster and bundle ideas/ facts/ experience together	Secondary research – literaturereviews, market research		

Reference Books:

1. Elizabeth Goodman and Mike Kunaivsky (2012), Observing the User Experience: A Practitioner's Guideto User Research, 2nd Edition, publisher: Morgan Kaufmann

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

- The course will offer primarily lecture and activity-based learning course.
- Students will be required to participate in activities and discuss the observations with their peers in classand will be asked to present their observations.
- Students will be encouraged to take assignments inspired from their everyday experiences and will be askedto evaluate the event/phenomenon/ processes critically and scientifically using user research methods.
- These activities will be performed either as individual or as a team, where they will be asked to demonstratethe individual contribution to the team activities.

If any changes in the assessment method, faculty will announce in the first class.

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

1.	Class/Home activities	N= 6	18%
2.	Project in Group – with 3-4 students	N=1	40%
3.	Assignment	N=1	14%
4.	Final Exam	N=1	20%
5.	Others		8%
		TOTAL	**100%**

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

FACULTYNAME **:** Deva Priyakumar

TYPE-WHEN **:**Monsoon semester: Domain core (M Tech I Bioinformatics) + Domain requirementforMSbyresearch/PhD(Bioinformatics)+ScienceElectiveforBTech

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 inBiology

COURSE TOPICS:

- MoleConcept
- Atomic structure and the periodictable
- Quantum mechanical approach to atomic structure andbonding
- Bonding and intermoleculerforces
- Nomenclature andisomerism
- Configuration andConformation
- Structure and properties ofmolecules
- Computation of energies of molecules and theirinteractions
- Smallbiomolecules
- Biological macromolecules: Proteins, Nucleic acids, Lipids andcarbohydrate

Syllabus and topic wise Coverage:

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

Assignment – 1: Introductory lectures – **DueABA 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**

If any changes in the Grading component, faculty will announce in the first class.

26 ABA 26: Revision

Grading Component	Weightage (%)	
	UG (Science Elective)	M Tech-1(Bio) (Core)
Quiz-1	7.5	6.25
Quiz-2	7.5	6.25
Mid Sem Exam	15	12.5
Assignment& Surprise Quizzes	40	40
End Sem Exam	30	25
Lab Exam	-	-
Project/any other evaluation (Domain Supplement: Dry Lab + Theory)	NA	10

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

***REFERENCE BOOKS:** 1. Bio-Chemistry – Stryer 2.Biochemistry – Voet, Voet and Pratt

3.Ralph H. Petrucci, General Chemistry: Principles & Modern Applications, 8th Edition,

Addison Wesley Longman (2003)

4.P W Atkins, Elements of Physical Chemistry, 5/E, Oxford University Press (2010)

OUTCOME: Expected outcome:

1. Ability to carry out chemicalcalculations
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 biologicalmolecules
4. Ability to understand standard IUPAC nomenclature andnumbering
5. Ability to understand structural features including Chirality and prochirality, structure

parametersincludingtorsionangles,theirdefinitions,andstandardvaluesforbiomolecules
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 andtheir ensembles
8. Abilitytohandlefilescontainingstructuralinformationofmoleculesandmine structure databases of biological molecules

REMARKS: Load:Totalcontacthours~5hoursperweek Live lectures: Two 1.5 hr lectures perweek

Labs and/or Tutorials 1.5 - 2 hr per week

Assignment hours (including lab and reading assignments) around 3-4 hours perweek

---

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

Faculty Name: Ankit Gangwal

TYPE-WHEN: Bouquet Core, Monsoon

PRE-REQUISITE: Computer Networks

COURSE OBJECTIVE: Introduce Advance Networking Concepts, Theories and Tools.

COURSE TOPICS:

ReviewofNetworkingBasics;Queuingtheory;AdvanceTopicsinIPv4andTCP;TelecomNetworks, SwitchingTechniques;MulticastRoutingprotocols;IPv6,IPv4toIPv6;QoS;NetworkMonitoring– SNMP,RMON;VLAN;VPN;FirewallandIPSConcepts;NetworkRedundancy,LoadBalancers,Caching, StorageNetworks;VSAT,GSM/CDMA/WiMax;Ad-Hocnetworks,SensorNetworks;NetworkSimulation.

PREFERRED TEXTBOOKS:

- RFCsandStandardsDocuments CommunicationNetworking–
- AnAnalyticalApproach,Anurag-Manjunath-Joy
- ProbabilisticModellingbyIsiMitrani

REFERENCE BOOKS:

- TCP/IP Illustrated (Vol.1,2),Stevens
- Data Networks,Bertsekas-Gallager
- AnEngineeringApproachtoComputerNetworkingbyS.Keshav

More books/references will be identified in due course

If any changes in the Grading method, faculty will announce in the first class.

GRADING:

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

OUTCOME:

- Understanding core concepts/theories/algorithms of computernetworks
- Somehands-oncapabilityonvariousnetworkdevicesandtools
- Capabilitytodesignandimplementacomputernetwork

REMARKS:

Course may have lab component, depending on class strength

CS5.502 Advanced Graphics, AR & VR 3-1-0-4

Faculty Name: Avinash Sharma + Narayanan P J

1. Prerequisite Course / Knowledge:

……

2. Course Outcomes (COs) :

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

CO-1 Explain the 3Dshape representation and modelling for Computer Graphicsapplications.

CO-2 Analyze Graphics libraries for development of graphics applications.

CO-3 Explain advance Graphics concepts/algorithms for realistic rendering of 3D objects.

CO-4 Apply various Geometry Processing algorithms for 3D shape processing.

CO-5 Apply the fundamental constructs in Augmented and Virtual Reality systems and develop a virtual platform

CO-6 Explain the real world AR/VR systems after interaction with industry experts via invited talks

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

	PO 1		PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PS O1	PSO 2	PSO 3	PSO 4
CO 1	3		3	1	2	2	1	1	1	1	1	1	2	3	2	1	2
CO 2	2		1	2	1	3	1	1	1	3	1	1	2	3	2	2	3
CO 3	2		3	3	3	3	1	1	1	3	1	1	2	3	3	2	3
CO 4	2		3	3	3	3	1	1	1	2	2	1	2	3	3	2	3
CO 5	2		3	3	3	3	2	2	1	3	3	3	3	3	3	3	3
CO 6	2		2	3	3	2	1	1	1	1	2	1	3	2	3	3	3

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

4. Detailed Syllabus:

Unit 1: Computer Graphics :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.

Unit 2: Advance Concepts in Computer Graphics: View Frustum Culling, Depth Buffering, Lighting Shading & Shadows Mapping, Texture Mapping, BRDF, raytracing.

Unit 3: Geometry Processing Methods: 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.

Unit 4: AR/VR Module: 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.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

Unit 5:Invited talks: Industry experts to discuss various challenges for developing an AR/VR system.

Reference Books:

1. Computer Graphics with OpenGL by Hearn and Baker

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

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

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

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

The course lectures will include interactive graphics content for effectively conveying the basic concepts as well as small activities to promote the understanding of the lecture content. Significant focus will be on problem solving aspect and concepts will be introduced in the context of relevant research challenges. Tutorials will further try to bridge the gap between theoretical understanding and practical aspects of problem solving. Assignments are designed to to solve problems that are based on simple extensions of concepts described in the lectures. Course project will encourage learning collaborative skills with goal to induce system building capability among students to complement lecture based learning.

If any changes in the assessment method, faculty will announce in the first class.

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

Homeworks/Assignments: 30%

Course Project: 20%

Mid semester exam1: 10%

Mid semester exam 2: 10%

End SemesterExam: 30%

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

Faculty Name **:** Sunitha P

Type-when **:Monsoon 2021**

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

Objectives:

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

wall-frame structural systems in buildings; and

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

Course Contents

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

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

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

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

Select References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Expected Course Outcome

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

CS3.306 Algorithms&OperatingSystems 3-1-0-4

Faculty: Lini Thomas

Pre-Requisite: Data Structures and Programming

Objective: The plan is to introduce students to the twin topics of algorithms and operating

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

Course Topics: Topics in Operating Systems: Basic concepts in Operating Systems, Process management, Memory management, File management, Resource management, Concurrency control, Inter-process communication. Tentative List of Topics in Algorithms: Basic concepts in Algorithms, Design methodologies, Greedy algorithms, Online algorithms with application to paging and power management, Advanced data structures for file management, Graph algorithms with application to resource management.

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

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

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

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

FACULTY NAME **:** Abhishek Srivastava

TYPE-WHEN **:** Monsoon2021

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

COURSE TOPICS:

Basics of analog design: MOS model for analog circuits, large signal modeling, incremental modeling, MOS parasitics, mismatches, speed (f_T), passive components for IC design (R, C and L), biasing, negative feedback for biasing, introduction to layout, Gain-BW-Swing-Power-Noise- Area trade-offs.(4)
Amplifier design: Review of single stage amplifiers, single-ended and differential amplifier design, gm/Id design technique, sub-threshold design technique for low power consumption, techniques to increase gain of amplifiers- active loads, cascade, differential amplifier with current mirror load, mirror pole, stability issues and utility of negative feedback in high gain amplifiers.(7)
Operational amplifier design: Review of op amp characteristics, CMRR, offset, single stage op amp, high gain op amps - telescopic, two stage, stability and frequency compensation, fully differential amplifier (FDA), common-mode-feedback, review of low noise, low voltage op amp design techniques. (8)
Other topics: Noise, layout techniques, effect of off-chip components and packaging on IC design, oscillators, phase noise and PLLs.(7)

PREFERRED TEXTBOOKS:

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

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

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

Faculty Name: Vinoo Alluri
When **:** Monsoon 2021

OBJECTIVE :

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

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

COURSE TOPICS:

1. Introduction to Research Methods: Qualitative and Quantitative Approaches; Conducting Behavioral Research; Ethics in Research; Institute Review Board (IRB) Process
2. Starting on Research, Experimental Design: Hypothesis Testing, Type I and II errors, Hypothesis-based vs Exploratory Research, Operationalizing Research, Literature Review; Sampling, Types of variables and levels of Measurements, Designing an Experiment; Validity, Reliability and Cross-validation in Research
3. Types of Experimental design: Non-Experimental Designs, Pilot Testing; 4. Data Collection: Surveys Questionnaires; Data Representation: Levels of Measurement, Human Annotation, Different types of design: Simple randomized design, Factorial designs, Simple repeated measures design, Randomized blocks design, Latin square type designs, Between-subject and within-subject factors in an experiment; Scaling Behavioral Experiments: web and mobile experiments, crowdsourcing, big data, large-scale experiments, citizen science, online data collection (PsiTurk, Mechanical Turk, etc).
4. Data Visualization and Analysis: Descriptive Statistics, Tests of Normality and Data Transformation, Outliers, Collinearity in Data, Data Summarization vs Data Reduction Techniques: Exploratory Factor Analysis, Principal Component Analysis, Discriminant Factor Analysis

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

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

REFERENCES:

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

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

SC3.321 Biomolecular Structure Interactionsand Dynamics 3-0-1-4

Faculty Name : B. Gopalakrishna
Type When : Monsoon-2021
Pre-requisites : Advanced Biomolecular Architecture or General and StructuralChemistry or equivalent Max. No. of students (limit, if any): Science/Open elective for 'nonCNS' B.Tech students – no limit.

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

Textbook:

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

Week 1

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

Week 2

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

Assignment 1 : Due Week 3

Week 2 I 4

4 I 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 I 9 Reactions and reaction mechanisms Classification of reactions and their mechanismsI application to classification of biochemical reactions and their enzymes Assignment 3: Due Week 6

Week 5 I 6

10 I 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 I 9

13 I 18 Exploration and analysis of biomolecular structures and interactionsExperimental methods and techniques for analyzing structures and interactions I 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 I 12

19 I 24 Molecular modeling and docking I 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 I 14

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

Laboratory:

I Visualization & rendering

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

I Rendering of various aspects of structures of biomolecules I Web based tools

I Query tools: i) Sequence retrieval, ii) Structure retrieval I Protein structure analysis tools:

i) Structure alignment.
ii) Homology search.
iii) Domain assignment.
iv) Fold recognition and analysis

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

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

I 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.

If any changes in the Grading Component, faculty will announce in the first class.

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 I appreciation of principles of kinetics and thermodynamics for understanding mechanisms of interactions and reactions of biomolecules 3. Appreciation of the experimental methods used for exploring structures of biomolecules 3. Understanding of important structural concepts used for the analysis of protein and nucleic acid structures4.Learning to use and understanding the principles of molecular modeling, docking and molecular dynamics simulations

for inferring structures, functions and interactions from sequences 15.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.

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

Faculty Name: Radhika Mamidi

PRE-REQUISITE: CL-1 or NLP-1

OBJECTIVE

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

COURSE TOPICS

1. SEMANTICS: Meaning Representation

Word meaning: Sense and reference

Lexical semantic relations - Synonymy, Antonymy, Hyponymy, Toponymy, Meronymy,

Metaphor and Metonymy; Polysemy and Homonymy.

Semantic fields. Lexical ambiguity. Content words and Function words.

Lexical ambiguity, context variation.

Word Sense Disambiguation

Building resources: Dictionaries, Ontologies, Word Nets, Verb Nets, Verb Frames

Formal Semantics: Formal representation of natural language - semantic features,semantic primitives. Variability and unambiguous representation. First order logic.Variables and quantifiers, Lambda notation. Inference. Event, state, and timerepresentation. Predicate logic. Proposition. Inference. Notation for representing aproposition.

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

Resources: Dependency Treebanks, Prop banks, Frame net.

2. Computational Discourse Analysis

2.1 Discourse CohesionStudying Structure of text and coherence, Discourse connectives and relationsRhetorical Structure theory

Coreference Chains, anaphora resolution, entity linking.
Sentiment Analysis. Humour Analysis.

3. Computational Pragmatics:

Language Understanding; Meaning beyond textual context; speaker's intention andhearer's inference; inference - bridging inferences, causal and spatial inferences,elaborative and restrictive inferences.

Dialogue Systems, dialogue acts.

Resources: Discourse Treebank, Coreference chains, dialogue data.

PREFERRED TEXTBOOKS

Daniel Jurafsky & James H. Martin (2000); Speech and Language Processing, PearsonEducation/Prentice Hall.

James R. Hurford & Brendan Heasley (1983). SEMANTICS - a course book. CambridgeUniversity Press.

Judith Greene (1986). Language Understanding - a cognitive approach. Open UniversityPress.

REFERENCE BOOKS:

Lyons, John. (1977). Semantics. Cambridge University Press.

Levinson, Stephen C. (1983). Pragmatics. Cambridge University Press.

Leech, Geoffrey. (1983). Principles of Pragmatics. Longman.

Brown, G and Yule, G. (1983). Discourse Analysis. Cambridge University Press. Cutting,

Joan (2002). Pragmatics and Discourse: A resource book for students. Allen, James

(1994). Natural Language Understanding. Pearson.

PROJECT

Students will do one term project which will include issues related to semantics,

pragmatics and discourse.

SEMINAR

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

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN

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

OUTCOME

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

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

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

TYPE-WHEN: Bouquet Core for CSE, offered mainly in Monsoon, and Spring Semesters (depending on interest).

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.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

ADBI – As Decided by Instructor

OUTCOME:

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

REMARKS:

A cool bouquet course on database systems.

CS7.601 Deep Learning: Theory and Practices 3-1-0-4

FACULTY NAME : Naresh Manwani

TYPE-WHEN : Spring 2020
PRE-REQUISITE : Good background in Linear Algebra and Probability theory, Statistical Methods in AI (Optional), Optimization Methods (Optional)

OBJECTIVE: The course is designed to cover the fundamentals of Deep Learning in depth. The objective of this course is to familiarize the audience with the theoretical as well as practical aspects of deep learning.

COURSE TOPICS:

CO-1: Representation power of feedforward neural network, limitations of shallow networks, why and when can deep networks avoid curse of dimensionality.

CO-2: Perceptron, convergence proof. Feedforward neural network, back propagation, loss surfaces, learning rates, optimization for deep networks: gradient descent (GD), momentum based GD, Nesterov accelerated GD, stochastic GD, AdaGrad, RMSProp, Adam.

CO-3: Bias variance tradeoff: overfitting and under-fitting. L2 regularization, early stopping, dataset augmentation, parameter sharing and tying, injecting noise at input, ensemble methods, dropout. Greedy layerwise pre-training, better activation functions, better weight initialization methods, batch normalization

CO-4: Auto-encoders and relation to PCA, regularization in auto-encoders, denoising auto-encoders, sparse auto-encoders, contractive auto-encoders, variational auto-encoders (VAEs), mutual information and the information bottleneck, Word2vec and its relationship to latent semantic indexing (LSI).

CO-5: Convolutional neural networks (CNNs), backpropagation in CNNs, LeNet, AlexNet, Inception, VGG, GoogLeNet, ResNet.

CO-6: Recurrent neural networks, backpropagation through time (BPTT), vanishing and exploding gradients, truncated BPTT, stability, bidirectional RNNs, gated recurrent units (GRUs), long short term memory (LSTM), solving the vanishing gradient problem with LSTMs.

CO-7: Encoder Decoder Models, Attention Mechanism, Hierarchical Attention, Transformers, Variational autoencoders, Restricted Boltzmann Machines, Unsupervised Learning, RBMs, Contrastive divergence for RBMs, Autoregressive Models: NADE, MADE, PixelRNN, Generative Adversarial Networks (GANs).

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO2	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO3	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO4	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO5	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO6	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO7	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3

PREFERRED TEXT BOOKS:

1. Simon Haykin. 1998. Neural Networks: A Comprehensive Foundation (2nd ed.). Prentice Hall PTR, Upper Saddle River, NJ, USA.
2. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
3. R. Rojas: Neural Networks, Springer-Verlag, Berlin, 1996.
4. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, 2021

REFERENCE BOOKS: Recent research papers in deep learning (papers published in ICLR, ICML and NIPS)

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Small Quizzes (10 quizzes)	25%
Quiz-1	10%
Quiz-2	10%
End Sem Exam	10%
Assignments	30%
Project	15%

OUTCOME: By the end of the course, it is expected that students will have very good familiarity with the topics in deep learning, and they should be able to apply deep learning to a variety of problems. They will also be in a position to understand the current literature in deep learning and extend their knowledge through further study (research).

CS9.429 Design for Social Innovation 3-1-0-4

Faculty Name: Ramesh Loganathan & Ramana Gogula

TYPE-WHEN Fall2021

PRE-REQUISITE None. Any UG3, UG4, M.Tech., MS, and Ph.D. student can take it
Design For Social Innovation (DFSI) is a project-based course that will enable students to do a deep dive into societal challenges being addressed by NGO(s), social enterprises & the government and build solutions to alleviate these complex social problems through immersion, design & technology.

OBJECTIVE:

The course will provide a rigorous overview of social sector and the need for technology led innovations in addressing the same. Leading to insights, concepts, and tools for designing solutions for social impact.

A social immersion led course to understand the problems and needs of the grassroots and solve them in creative ways leveraging technology. Work with social organizations or NGOs to get a first- person view of the ground reality and understand problems that need to be solved.

Understand the tools and frameworks they need to define and design technology for social impact. Explore creative solutions to address these social problems, leveraging emerging technologies.
Inspire social enterprises through the technology led journey.

PEDAGOGY

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersions with NGOs/social sector will be a key part of the course. Will all lead to the course project that will address needs of the social sector.

COURSE TOPICS

The course will introduce social context and various players in the social space, present approaches to discover and understand social needs. Social immersion and inspiring conversations that will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

The course will comprise of four modules, one in each month. Each module will address few topics through lectures, chance to meet the social change makers through guest lectures, up close work with NGOs and in parallel work on the course project.

MODULE [I] ***Social Immersion***

- **What Is SocialInnovation**
- Interaction With LeadingChangemakers
- Identifying Core Developmental Sectors [Agri, Fintech, Healthcare, Edu etc] & FieldVisits
- Student Paper [I] Case Study On A Social Innovation OfChoice
- Hackathon #1: Needs Identification (maybe, during a field immersion/at anNGO)

MODULE [II] ***Societal Challenge Identification***

- **Deep Dive into Defining theProblem**
- Market Research/CompetitiveLandscape
- Circular Validation from Stakeholders [Organizations/Customers/EndUsers]
- Student Paper [II] White Paper on The Chosen SocialInnovation
- Hackathon #2: Design thinking/Problemdefinition

MODULE [III] ***Design for Change***

- **Ideation/Design Thinking on ProblemBreakdown**
- Build An SRSDocument
- Identify Technology Components for SocialInnovation

- Project Design & ExecutionPlan.
- Hackathon #3: Solution design, Design thinking &Prototypes

MODULE [IV] *Technology for Social Innovation*

- **Updates On Building theTechnology**
- Examples of technology used in socialinnovation
- Teams to build in the use of emergingtechnology/research.
- Hackathon #4: Final hackathon. Complete thesolution*Finale*
- **Deploy Solution in Stakeholder/End User Environment. MeasureImpact**
- 15 Minute Presentation *Structure to BeDesigned*
- Term Paper *Technology for SocialInnovation*

PREFERRED TEXTBOOKS: Course material and reference/prescribed reading will be shared.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Quizzes	**10**
Assignments [Paper [I/II]	**15**
Hackathons (2)	**30**
Technology Demonstration	**15**
Stake Holder Presentation	**15**
Final demos & Term paper (based on social immersion)	**15**

Reference courses

- Stanford: Center for Social Innovation offers Design for Extreme Affordability (OIT333link)
- LSE: Social Innovation design(MG4G2-link)
- UPenn impact immersion week program (NPLD 585link)
- Columbia- Design for social innovation(link)

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

Faculty Name: Usha Gogineni (Guest Faculty)

TYPE-WHEN: Monsoon 2021

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

OBJECTIVE: Toexposethestudentstothevarioustechniquesadoptedtomakethetesting (complicated)ofmanufacturedICs.Tomakethestudentstotakecareofthetestingaspects intoaccountatthedesignstageitself.

COURSE TOPICS:

1) Introduction:Testingofelectronicgadgets,varioustypesoftests,VLSIdesignflow,roleof modeling

and simulation intesting.
2) Faultsandfaultmodeling,detectionoffaults,faultsimulationanditsapplications,functional testing,exhaustiveandnon-exhaustivetesting,automatictestingprocedures.
3) Designfortestability:Variousfeaturesaretobeincorporatedforcarryingouttestingfrom input&outputpins,scanarchitecture,boardleveltesting,signatureanalysisandtesting.
4) BuiltinSelfTest(BIST),BISTconcepts,textpatterngeneration,BISTarchitectures.
5) TestingofAnalogandmixedsignalICs,testingofsystemonchip.

PREFERRED TEXTBOOKS:

1) MironAbramollici,MellinABreur,ArthurD.Friedman,Digitalsystems,testingandtestable design,Jaicopublishinghouse,2001
2) StanleyL.Hurst,VLSITesting,DigitalandMixedAnalog/DigitalTechniques,Institutionof ElectricalEngineers,1998,London,UnitedKingdom.
3) MichaelL.Bushnell,VishwaniD.Agarwal,EssentialsofElectronicTestingforDigital&Mixed SignalFLSICircuits,Springer2000

*REFERENCE BOOKS:

1. "VLSITestPrinciplesandArchitectures:DesignforTestability",Laung-TerngWang,Cheng- Wen Wu, XiaoqingWen
2. "VLSITesting",StanleyLeonardHurst
3. "ElectronicDesignAutomation",Laung-TerngWang,Yao-WenChang,Kwang-Ting(Tim) Cheng
4. "System-on-ChipTestArchitectures:NanometerDesignforTestability",Laung-TerngWang, Charles
5. E.Stroud,NurA.Touba
6. "TestingofDigitalSystems",JhaandGupta

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	10%
Project	-	25%
Term Paper	-	15%
Quiz	-	20%
Open Book Exam/		
30 Min Quiz	-	30%

OUTCOME: REMARKS:

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

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

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

Signal Processing is useful but not mandatory. Knowledge of one of the following scriptingsystems(MATLAB,Python)willbecrucialfortimelysubmissionofassignmentsand projectwork.

OBJECTIVE:Digitalimagesarenoweverywhere.Thereisnolimittotheusefulapplications builtbyharnessingtheinformationcontainedinsuchimages.Ifyouareexcitedtoworkwith images,thiscourseisforyou.Thegoalofthecourseistoimpartstrongfundamentalsinimage processingalgorithms,coveringboththetheoreticalandexperimentalaspects.Thiscourseis alsoabuildingblockforunderstandingmoreadvancedtopicssuchasComputerVision.

COURSE TOPICS:

1. Introduction and Fundamentals ofdigital imaging
2. Image enhancement in thespatial domain (intensity transforms, histogram processing, spatial filteringetc.)
3. Image enhancement by transformation to a different space (fourier transform, wavelet transformetc.)
4. GeometricImageProcessing(transformingspatialgeometryofimages)
5. Color ImageProcessing
6. MorphologicalImageProcessing(extractingandanalyzingstructuralpropertiesofimages)
7. ImageSegmentation
7. Feature-based representation anddescription
8. Image Restoration andReconstruction
9. ImageCompression
10. IntroductiontoVideoProcessingandMotionEstimation

*REFERENCE TEXT: Digital Image Processing (Gonzalez and Woods)
***PROJECT:The course will include a final project**

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	20%
Term Paper	-	15%
Quiz	-	35%

OUTCOME:

1) Understandhowimagesarecaptured,storedandrepresentedindigitalmachines

2) Understandvariousapproachesforenhancingimages
3) Understandvariousapproachesfortransformingthespatialgeometryofimages
4) Understandhowcolorisrepresentedinimages,transformationfromRGBtoothercolor spaces and respectiveapplications
5) Understandhowtoextractandanalyzestructuralpropertiesofentitiesintheimage
6) Understandapproachesformodellingandremovingnoiseinimages
7) Understandhowstoragespaceforimagescanbesignificantlyreducedwithoutnoticeable perceptualdifferences
8) Understandvarioususefulfeaturesthatcanbeextractedfromimagesandhowtheyaidin higher-leveltasks
9) Studyavarietyofmodernapplicationsinimageandvideoprocessing
10) Understand theoretical aspects of image processing algorithms (to understand research papers and implementthem)
11) Gainhandsonexperienceindevelopingimageprocessingalgorithms
12) Getinitiatedtowardshigher-levelcomputervisiontasks

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

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

Logical Time:

A framework for a system of logical clocksScalar time, vector time and efficient implementation of vector clocks Synchronization of physical clocks. NTPGlobal state and snapshot recording algorithms:System model and definition SnapshotalgorithmsforFIFOchannels 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 AlgorithmSughal‘s dynamic information – Structure Algorithm Quorum-based mutual exclusion Algorithm Maekawa‘s Algorithm Deadlock detection in Distributed Systems: Modelsofdeadlocks,Knapp‘sclassificationofdistributeddeadlockdetectionalgorithms.MitchellandMerri t‘salgorithmforsingleresourcemodel Consensus and agreementalgorithm: Problemdefinition.Agreementinafailure-freesystem(synchronousorasynchronous).Agreementin (messagepassing)synchronoussystemwithfailures.Agreementinas synchro nousmessagepassingsystemswithfailures.

The syllabus includes the following topics:

- RPC, Googleprotobufs
- Logicalclocks,vectorclocks,generalizedclocks
- Totally orderedmulticase
- Mutualexclusion,leaderelectionalgorithms
- Deadlock detection/preventionalgorithms
- Consensus algorithm, Paxos (possibly Raft)
- Consistency, eventual consistency, monotonic reads,readyourwrites,etc
- Failure modes,types of failures
- Distributedtransactions,2phasecommit,3phasecommit
- Cap theorem
- Apache HDFS,MapReduce
- GoogleBigTableAmazon DynamoDBKafka

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Grading policy
Scheduled Quiz Exams: 25%
In-class Quiz Exams: 15% (Cumulative over several)
HomeWorks: 20%
Project: 20%
Final Exam: 20%

Reference Books

1) Ajay D.Kshemkalyaniand Mukesh Singhal DistributedComputingPrinciples,AlgorithmsandSystem‖, Cambridge University Press 2008.
2)SukumarGhosh, —DistributedSystems–an Algorithmic Approach‖,Chapman&HallICRC, 2007.
3)M.L. Liu,—DistributedComputingPrinciplesandApplications‖,Pearson,2004.
4) GeorgeCoulouris,JeanDollimore,TimKindbergandGordon Blair, — DistributedSystemsConceptsand Design‖, Fifth Edition, Pearson 2011.
5)MukeshSinghalandNiranjan G. Shivaratri, —AdvancedConceptsinOperating Systems ‖,TMH, 1994, 2010

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

Faculty Name: Sujit Gujar

TYPE-WHEN: Monsoon 2021

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 whereas there is a section of population who believe this is just a bubble. What is that makes bitcoin so interesting? Answer is its underlying blockchain technology that not only enabled a first successful crypto currency but also many real-world applications through smart contracts as blockchain offers a distributed trustworthy append-only ledger that have anonymity. In this course, we will study about bitcoins, blockchains and smart contracts along with key basic crypto fundamentals. In addition, we will touch base upon other aspects of privacy of database, useful in machine learning, a differential privacy.

COURSETOPICS :

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

PREFERRED TEXTBOOKS:

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

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

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME:

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

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

TYPE-WHEN : Monsoon Semester

FACULTY NAME: : P. Pravin Kumar Venkat Rao

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

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

COURSE TOPICS:

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

REFERENCE BOOKS:

12. Drysdale, R. G., Hamid, A. H. and Baker, L. R., "Masonry Structure: Behavior and Design", Prentice Hall, Englewood Cliffs (1994).
13. Schneider, R.R. and Dickey, W. L., "Reinforced Masonry Design", 3rd Ed, Prentice Hall (1994).
14. Paulay, T. and Priestley, M. J. N., "Seismic Design of Reinforced Concrete and masonry

Buildings", John Wiley & Sons (1995).
15. Amrhein, J. E., "Reinforced Masonry Engineering Handbook," Masonry Institute of America, CRC Press (1998).
16. Hendry, A. W., "Structural Masonry", Macmillan Press Ltd. (1998).
17. "Prestandard and Commentry for the Seismic Rehabilitation of Buildings," FEMA 356, Federal Emergency Management Agency, Washington, D.C.9 (2000).
18. Tomazevic, M., "Earthquake Resistant Design of Masonry Buildings", Imperial Colleges Press (2000).
19. Donald Anderson and Svetlana Brzev, "Seismic Design Guide for Masonry Buildings," Canadian Concrete Masonry Producers Association (2009).

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

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

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

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

Faculty Name **:** Radhika Krishnan
TYPE-WHEN **:** Monsoon 2021
PRE-REQUISITE: UG 3, UG 4. Students who have attended the Introduction to Sociology/ Introduction to Politics courses will be preferred.
OBJECTIVE: This course aims to introduce students to concepts of environmental justice, environmental politics and environmental citizenship. It will touch upon environmental history and the emergence of 'environment' as a concern globally as well as in India. The course will deal with the dynamics aroundenvironmental legislation (including legislation related to forests, conservation and climate change), as well as environmental concerns in urban India. It will look at how environmentalism in the global North is substantially different from environmentalism in the global South, by studying their respective demands, agendas, strategies and concerns. This course is essentially intended at understanding environment as a political agenda, the reasons for its emergence and the limitations the environmental movement faces inIndia and elsewhere.
COURSE TOPICS: (1) Environmental History, Emergence of 'environment' as a discourse (2) Principles of Environmental Justice and Environmental Citizenship (3) Indigeneity and the Environmental Question (4) Environmental Legislation – Land, Air, Water, Forests, Climate Change, Wildlife Conservation (5) Environmental Politics in Urban India
PREFERRED TEXTBOOKS: (1) Archana Prasad (ed.), Environment, Development and Society in Contemporary India: An Introduction (New Delhi: MacMillan India, 2008). (2) Ramachandra Guha and Joan Martinez Alier, Varieties of Environmentalism: Essays North and South (London: Earthscan, 1997).

***REFERENCE BOOKS**:

1.Alpa Shah, In the Shadows of the State: Indigenous Politics, Environmentalism and Insurgency in Jharkhand, India (New Delhi: Oxford University Press, 2011).

2. Amit Prakash, Jharkhand: Politics of Development and Identity (New Delhi: Orient Longman, 2001).

3. Amita Baviskar, In the Belly of the River: Tribal Conflicts over Development in the Narmada Valley (New Delhi: Oxford University Press, 2004 [reprint, 1995]).

4. Andrew Dobson, Environmental citizenship and pro- environmental behavior (Rapid research and evidence review, The Sustainable Development Research Network, 2010).

5. Anil Agarwal et.al., State of India's Environment: The First Citizens' Report (New Delhi: Centre for Science and Environment, 1982).

6. Anil Agarwal, The Anil Agarwal Reader Volume I (New Delhi: Centre for Science and Environment, 2008).

7. Anil Agarwal, The Anil Agarwal Reader Volume II (New Delhi: Centre for Science and Environment, 2008).

8. Anil Agarwal, The Anil Agarwal Reader Volume III (New Delhi: Centre for Science and Environment, 2008).

9. Archana Prasad, Environmentalism and the Left: Contemporary Debates and Future Agendas in Tribal Areas (New Delhi: Left Word Books, 2004).

10. Darryl D'Monte, Temples or Tombs? Industry Versus Environment Three Controversies (New Delhi: Centre for Science and Environment, 1985).

11. Jairam Ramesh, Indira Gandhi: A Life in Nature (New Delhi: Simon and Schuster, 2017).

12. Joan Martinez-Alier, The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation (New Delhi: Oxford University Press, 2005).

13. John Bellamy Foster, Marx's Ecology: Materialism and Nature (Kharagpur: Cornerstone Publications, 2001).

14. Madhav Gadgil and Ramachandra Guha, This Fissured Land: An Ecological History of India (New Delhi: Oxford University Press, 1992).

15. Mahesh Rangarajan (ed.), Environmental Issues in India: A Reader (New Delhi: Pearson Longman, 2008).

16. Mahesh Rangarajan and K. Sivaramakrishnan (eds.), India's Environmental History: A Reader Volumes 1 and 2 (New Delhi: Permanent Black, 2013).

17. Mukul Sharma, Green and Saffron: Hindu Nationalism and Indian Environmental Politics (New Delhi: Permanent Black, 2012).

18. Raka Ray and Mary Katzenstein (eds.), Social Movements in India: Poverty, Power, and Politics (Lanham, MD: Rowman and Littlefie, 2005).

19. Ram Dayal Munda and S. Bosu Mullick (eds.), The Jharkhand Movement: Indigenous Peoples' Struggle for Autonomy in India (Denmark: International Work Group for Indigenous Affairs, 2003).

20. Ramachandra Guha, Environmentalism: A Global History (New Delhi: Oxford University Press, 2008).

21. Ramachandra Guha (ed.), Social Ecology (New Delhi: Oxford University Press, 1994).

22. Rohan D'Souza, Drowned and Dammed: Colonial Capitalism and Flood control in Eastern India (1803-1946) (New Delhi: Oxford University Press, 2006).
23. Sanjay Sangvi, The river and life – story of the Narmada Bachao Andolan (Kolkata: Earthcare Books, 2002).
24. T.K. Oommen (ed.), Social Movements Part II: Concerns of Equity and Security (New Delhi: Oxford University, 2010).
25. Wolfgang Sachs, Environment and Human Rights (Wuppertal: Wuppertal Institute for Climate, Environment, Energy, 2003).
26. W.M. Adams, Green Development: Environment and sustainability in the Third World (London and New York: Routledge, 2001).

***REFERENCE ARTICLES/DOCUMENTS:**

***** ILO Convention 169 concerning Indigenous and Tribal Peoples in Independent Countries.
***** ILO, 'Indigenous & Tribal Peoples' Rights in Practice. A guide to ILO Convention No. 169' (2009).
***** J. Tarter, 'Some live more downstream than others', in J. Adamson et.al. (eds), The Environmental Justice Reader (Arizona: University of Arizona Press, 2002), 213-228.
***** P. Mohai et.al, 'Environmental Justice', Annual Review of Environment and Resources 34 (2009): 405-430. ***** 'The Principles of Environmental Justice', First National People of Color Environmental Leadership Summit (1991). United Nations Declaration on the Rights of Indigenous Peoples. 2008.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

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

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

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

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

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

COURSE TOPICS:

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

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

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

Environmental Impact Assessment: Procedure, regulations, and case studies

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

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

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 greenaccounting.

PREFERRED TEXTBOOKS:

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

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

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

Reference Books

1. EnvironmentalScience–Thenaturalenvironmentandhumanimpact(1998):A.R.W. JacksonandJ.M.Jackson,Longman
2. EnvironmentalScience(2001):S.C.Santra,NewCentralBookAgency(P)Ltd
3. EnvironmentalScience(6thed)(1997):Jr.G.T.Miller,WadsworthPub.Co.
4. DimensionsofEnvironmentalandEcologicalEconomics(2005):N.C.Sahu&A.K. Choudhury (Ed), Universities Press

***PROJECT:**Simulationandmodelingofenvironmentalprocesses,developmentofopen-sourcetools relatedtoenvironmentalapplications,replicationofcasestudiesorworkingonnewproblem.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments	-	30%
Project	-	30%
Any other	-	10%

Open Book Exam/

30 Min Quiz - 30%

OUTCOME:

Understandingvariousenvironmentalissuesofconcern
Identifyandevaluateenvironmentaltechnologies.
Comprehendgreenaccountingandevaluationmethodsforecosystemgoodsandservices
ImplicationsofITtocombatemergingenvironmentalproblems.

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

Instructor: Dr. Sujit Prakash Gujar

1. Prerequisite Course / Knowledge:

Course: Statistical Methods in AI,

Knowledge: Machine learning, probability theory, Complexity Theory and Advanced Algorithms

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

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

CO-1 Understand sources of unfairness in AI systems

CO-2 Demonstrate familiarity with different notions of individual fairness as well as group fairness

CO-3 Synthesize algorithms designed to ensure individual fairness such as envy-free ness, proportionality, max-min share etc. and apprehend the complexities involved in ensuring

CO-4 Create algorithms methods to mitigate discrimination based on sensitive attributes such gender/race/age etc. (group fairness) for fairness measures such as disparate impact, equalized odds, accuracy equity, predictive parity etc.

CO-5 Explain the attacks on the machine learning models and databases to interpret the data

CO-6- Apply different techniques using differential privacy to ensure privacy of individuals leading to transparency in the system

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4

CO 1	1	1	1	2	1	3	1	3	1	2	1	2	2	3	1	2
CO 2	1	1	1	2	1	1	1	2	1	2	1	3	3	2	1	2
CO 3	2	3	3	2	1	1	1	3	2	1	1	3	2	2	1	2
CO 4	2	3	3	3	1	1	1	3	3	2	1	3	2	2	3	3
CO 5	1	1	2	2	1	1	1	1	1	3	1	2	3	2	1	2
CO 6	2	3	3	2	1	1	1	3	2	2	1	3	2	2	2	3

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

4. Detailed Syllabus:

Unit 1: Bias in the data, causality, Individual fairness vs group fairness

Unit 2: Individual fairness: envy free ness, max-min share, proportionality. Algorithms to achieve them such as round robin, cycle elimination, etc.

Unit 3: Impossibility of fair classifier with perfect calibration

Unit 4: Group fairness (equalized odds, disparate impact, accuracy parity, predictive parity). Different preprocessing, post processing techniques and over all approach to build AI to mitigate discrimination

Unit 5: Differential Privacy (DP), Need for newer privacy measures, especially when federated learning is on rise. Possible attacks even data is anonymized

Unit 6: Techniques such as Laplace mechanism, gaussian mechanism, local DP, Bayesian DP

Reference Books:

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

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

And also, relevant recent papers.

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

This course is good mix of mathematical foundations of ethical AI and practice. Hence, it will involve lot of discussion in class. The students will be expected to solve problems in the class regularly and will also be tested through surprise quizzes. To enable group based learning and better exposure, the students will be assigned two programming assignments, reading assignment and use case study. These activities will be in groups. Also students will be asked to scribe the lectures – produce high quality notes for a lecture assigned to the group that can be used by other students.

If any changes in the assessment method, faculty will announce in the first class.

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

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

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

Faculty Name :Sushmita Banerjee
TYPE-WHEN : Monsoon

PRE-REQUISITE : None

OBJECTIVE : To introduce students to basic concepts in gender theory and Feministpractice and help students locate themselves using these concepts. Literature and film shall be taught to demonstrate the various ways in which popular culture establishes, represents, perpetuates, and occasionally disrupts gender roles.

COURSE TOPICS :

Unit 1: Core concepts and terms

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

Unit 2: Power, Ideology and Intersectionalities

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

Unit 3: <u>Representation of Gender</u>

A: Who writes women? Short Stories on, about, and by women.

B: Films - Three films. Popular representations of women. How does the popular visual circulation affect gender politics.

PREFERRED TEXTBOOKS:

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

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

***REFERENCE BOOKS:**

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

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

Routeledge.

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

McCann, Carole R. and Seung-Kyung Kim, eds. Feminist Theory Reader: Local and Global

Perspectives. New York: Routledge, 2003.

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

Centre for Women's Development Studies, 1985.

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

Tharu, Susie and K. Lalita eds. *Women Writing in India: 600 B.C. to the Present. I and II. Delhi:*

Oxford University Press, New York: Feminist Press and London: Harper Collins, 1990-1993.

Uberoi, Patricia (2006) Freedom and Destiny: Gender, Family, And Popular Culture In India.

USA: Oxford University Press.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

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

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

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

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

Faculty Name: Shaik Rehana.
TYPE-WHEN: OpenEngineeringElective-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.Developmentandreal-worldapplicationofvariouswaterresourcessoftwaretechnologies, information, anddecisionsupportsystems.

COURSETOPICS :

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

- Subrahmanya, K., 2008, Engineering Hydrology, Tata Mc Graw Hill Pub. Co., New Delhi.
- Chow, V. T., Maidment and Mays, L. A., 2010, Applied Hydrology, Tata Mc Graw Hill Pub.

Co., NewYork.

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

If any changes in the Grading Plan, faculty will announce in the first class.

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.

CSE.406 Information Retrieval and Extraction 3-1-0- 4

Faculty Name: **Vasudeva Varma Kalidindi**

1. Prerequisite Course / Knowledge:

Basic principles of Computer programming, Statistical Methods in Artificial Intelligence, Programming languages, and Algorithms.

2. Course Outcomes (COs)

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

CO-1. Develop algorithms to retrieve information from unstructured data

CO-2. Design and architect information retrieval systems for world wide web

CO-3: Design Web crawling systems

CO-4. Design algorithms to process noisy data in document repositories

CO-5. Develop information extraction systems

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	3	3	3	3	1	1	-	2	2	2	2	3	3	2	2
CO 2	3	3	3	3	3	1	1	1	2	2	2	2	3	3	2	2
CO 3	3	3	3	3	2	1	1	1	2	2	2	2	3	3	2	2
CO 4	3	3	3	3	2	1	1	-	3	2	2	2	3	3	2	2
CO 5	3	3	3	3	2	1	1	-	3	2	2	2	3	3	2	2

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1: Introduction to Information retrieval, Information Extraction and Information Access systems. (6 hours)

Unit 2: Information Retrieval Models and Evaluation of IR systems (7.5 hours);

Unit 3: Web Information Retrieval (4.5 hours)

Unit 4 Natural Language Processing in IR (7.5 hours)

Unit 5: Machine Learning in Information Retrieval Systems (12 hours)

Unit 6: Information Extraction (4.5 Hours)

Unit 7: IR Applications (12 Hours)

References :

- Introduction Information Retrieval – Chris Manning et al (the Stanford IR Book) (ISBN-13: 978-0521865715)
- Search Engines: IR in Practice – Bruce Craft et al (ISBN-13: 978-0136072249)
- Research papers

5. Teaching-Learning Strategies in brief:

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing one mini-project and a major project by the students

If any changes in the assessment method, faculty will announce in the first class.

6. <u>Assessment methods and weightages in brief</u> :

Assignments in theory: 10 marks

Quizzes in theory: 10 marks

Mid Semester Examination: 20 marks

End Semester Examination: 60 marks

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

Course Information

Instructor Information Faculty: Dr Vishnu Sreekumar

TAs: TBD

Day/Time: Mondays and Thursdays: 2:00 pm – 3:25 pm.
Virtual Office Hours: By appointment (please email).
E-mail: vishnu.sreekumar@iiit.ac.in

Course Information

Course Description: Cognitive Science is a highly interdisciplinaryfield of study that seeks to understand how the mind works. In thiscourse, we will discuss a diverse range of perspectives from philosophy, linguistics, psychology, neuroscience, and computer science, on how to unravel the mysteries of human cognition.

Credits: 4
L-T-P: 3-1-0 (L = lecture hours, T = tutorial hours, P = practicalhours)
Prerequisite: None

Textbook & Course Materials

Recommended Texts & Other Readings: Lecture slides andsupplementary readings will be posted to Moodle.

Course Technology Requirements

- You will need access to the following tools to participate in thiscourse.
    - Laptop/desktop computer
    - webcam
    - microphone

- a stable internet connection (don't rely on cellular)

Course Structure

This course will be delivered fully in-person in a physical classroomunless COVID restrictions make us move online (Microsoft Teams).

Student Expectations

In this course you will be expected to complete the following types oftasks.

- communicate via email
- complete basic internet searches
- download and upload documents to the course site onMoodle
- read documents online
- view online videos
- participate in online discussions
- complete quizzes/tests online
- upload documents to a Dropbox/Moodle
- participate in synchronous online discussions

Expected Instructor/TA Response Times

- We will attempt to respond to student emails within 24 hours. Ifyou have not received a reply from us within 24 hours, please resend your email. Please email both of us to maximize the probability of a quick response.
  - ***If you have a general course question (not confidential or personal in nature), please post it to the Course Q&A Discussion Forum found on the course homepage on Moodle. We will post answers to all general questions thereso that all students can view them. Students are encouraged to answer each other's questions too.
- We will attempt to reply to and assess student discussion postswithin 48 hours.

Course Outcomes (COs)

After successful completion of this course, students will be able to:

- CO-1: demonstrate familiarity with seminal research findings in cognitivescience.
- CO-2: read, interpret, critique, and evaluate research in cognitive science.
- CO-3: critically think about the relationship between diverse fields such asAI, philosophy, neuroscience, and cognitive science.
- CO-4: identify flaws in how scientific results are communicated and critique scientific work in terms of confounds, experimental design, etc.
- CO-5: appreciate the nature of scientific debate in cognitive science andbe able to generate well-informed perspectives on these debates.

You will meet the outcomes listed above through a combination of thefollowing activities in this course:

- Attend lectures and participate in class discussions (CO-1, CO-2, CO-3,CO-4, CO-5)
- Debate sessions (CO-1, CO-2, CO-3, CO-5)
- Quiz 1, Quiz 2, and end-semester exam (CO-1, CO-2, CO-3, CO-5)
- Complete a term paper/debate reaction paper (CO-1, CO-2, CO-3, CO-5)

List of topics and activities

- **Introduction**
- **Evolution of Cognitive Science**
- **A free-form discussion on consciousness**
- **Empirical approaches in cognitive science**
- **Brain: Organization; Intro to sensation and perception**
- **Sensory systems**
- **Perception and Perceptual Learning, Cross-modal interactions**
- **Vision**
- **Attention**
- **Learning**
- **Development**
- **Memory**
- **Language and Cognition**
- **Knowledge Representation**
- **Special topics: e.g. Music, mind, and technology**
- **Several debate sessions with student debate teams**

If any changes in the Grading Policy, faculty will announce in the first class.

Grading Policies

Graded Course Activities

Description	Percentage
Quiz 1 (10 marks)	10%
Quiz 2 (10 marks)	10%
Debate reaction paper or debate team participation (20 marks)	20%
Mid-Sem exam (20 marks)	20%
End semester exam (40 marks)	40%
Total (100 marks)	100

Quizzes

Quiz 1 will cover topics covered until Quiz 1, and Quiz 2 will cover topics taught between Quiz 1 and Quiz 2. They will contain mostly multiple choicequestions.

Mid-semester exam (20 marks)

The mid-semester exam will cover all material taught up to that point, andmay include both multiple choice and descriptive questions.

End semester exam (40 marks)

The end semester exam will cover material taught during the whole semesterand will include both multiple choice and descriptive type questions.

Debate participation (20 marks = 10 marks forpresenting + 10 marks for a short report)

We will reserve at least 3-4 lecture slots for student debates on contemporary issues in Cognitive Science. A list of representative topics areas follows:

1. Are there top-down influences on basic perception? Evidence for andagainst.
2. Do 3 year olds have a theory of mind?
3. Is cognition/consciousness a computational process?
4. Do we need representations for cognition?

Each debate team will have 3 members. They will read the recommendedmaterial for the chosen topic, and organize their arguments distributed across the 3 members. Each member gets 5 minutes to present their arguments (15 minutes per team). They may choose to use slides or notbut the arguments must be clearly presented. At the end of both teams' presentations, each team gets 5 minutes for rebuttal when they can pick2-3 claims made by the opposite team and present counterarguments.

The students participating in debate teams will only be required towrite a short report but the ***remaining students will need to write areaction paper to any one debate session OR write a term paper on any other topic that they choose (see next main section).***

For debate team students (each person writes this separately without discussion with other team members, plagiarism software will be used tocheck your work), your short report should contain the following:
The paper will first summarize the problem (2 marks), and then summarize the arguments made by both sides (3 marks), and then will provide the student's OWN opinion about where they stand on the debateand what arguments were convincing to them (5 marks).

Recommended: 2-3 pages, font size 12, single-spaced.

The debate teams will be made on a first-come first-serve basis. TAs will open sign-up forms and make announcements on the course page on Moodle. It is important to check announcements on Moodle regularly for thisreason.

Submission window for the short report: Nov 1-10
No extensions will be given because this is a wide window.
You are welcome to make multiple submissions within this window.

IMPORTANT: See the last section of this syllabus for policies about plagiarism.There will be no exceptions to those policies.

Term Paper or debate reaction papers for non-debateteam students (20 marks)

1. Introduction and clarity of describing the background literature andspecifying the nature of the problem – 3 marks
2. Describing the different schools of thought that tackle the question – 7marks
3. Offer your own thinking on the matter (either siding with one school ofthought, or offering a new insight or suggestions for experiments or investigations, providing appropriate justifications) – 5 marks
4. Overall clarity, organization of thoughts, and originality – 3 marks
5. Formatting (Citations, References) – 2 marks

Recommended: 8-10 pages, font size 12, single-spaced.

Submission window for the term paper/debate reaction paper: Nov1-10
No extensions will be given because this is a wide window.
You are welcome to make multiple submissions within this window.

Participation

Students are expected to participate in all activities as listed on the coursecalendar. *Failure to participate will result in students being unable to complete the term paper satisfactorily. The exams may also include questions from the in-class activities such as the debates and any resulting effect on the final grade is entirely the student's responsibility.*

Complete Assignments

All assignments for this course will be submitted electronically through the course page on Moodle unless otherwise instructed. Assignments must be submitted by the given deadline or special permissionmust be requested from instructor *before the opening of the submission window with documented evidence of an emergency*.

Late or missing assignments will affect the student's grade.

Late Work Policy

Be sure to pay close attention to deadlines—there will be no make-upassignments or quizzes, or late work accepted without a serious and compelling reason and instructor approval.

Viewing Grades on Moodle

Points you receive for graded activities will be posted to the course page onMoodle. Click on the Grades link to view your points.

If any changes in the assessment method, faculty will announce in the first class.

Letter Grade Assignment

Final grades assigned for this course will be based on the percentage of totalpoints earned and are assigned as follows:

Letter Grade	Percentage
A	[92,100]%
A-	[84,92)%
B	[76,84)%
B-	[68,76)%
C	[60,68)%
C-	[52,60)%
D	[45,52)%
F	< 45%

IMPORTANT NOTE: [x,y) indicates that x is included (square bracket) in therange and y is not (curly bracket). The normal rules of rounding will apply: So if you get 75.5, it will be rounded to 76 and you will get a B. However, if you get 75.444, it can only be rounded downwards and hence the final gradewill be B-. No disputes on this matter will be entertained and such emails willnot get a response.

Course Policies

Netiquette Guidelines

Netiquette is a set of rules for behaving properly online. Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerantspirit of academic discourse. You are encouraged to comment, question, or critique an idea but you are not to attack an individual. Working as a community of learners, we can build a polite andrespectful course community.

The following netiquette tips will enhance the learning experience foreveryone in the course:

- Do not dominate any discussion.
- Give other students the opportunity to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do notcapitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This couldpossibly lead to misinterpretation.
- Never make fun of someone's ability to read or write.
- Share tips with other students.
- Keep an "open-mind" and be willing to express even yourminority opinion. Minority opinions have to be respected.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.
- Always assume good intentions and ask for clarification.Communication online is difficult without facial and gesturalcues.

Adapted from:

Mintu-Wimsatt, A., Kernek, C., & Lozada, H. R. (2010). *Netiquette: Make it part of your syllabus*. Journal of Online Learning and Teaching,6(1). Retrieved from http://jolt.merlot.org/vol6no1/mintu-

wimsatt_0310.htm

Shea, V. (1994). Netiquette. Albion.com. Retrieved from: http://www.albion.com/netiquette/book/.

Build Rapport

If you find that you have any trouble keeping up with assignments or other aspects of the course, make sure you let your instructor know asearly as possible. As you will find, building rapport and effective relationships are key to becoming an effective professional. Make surethat you are proactive in informing your instructor when difficulties arise during the semester so that we can help you find a solution.

Inform Your Instructor of Any Accommodations Needed If you have a documented disability and wish to discuss academic accommodations, please contact your instructors as soon as possible.

Statement of Policy

The instructors of this course will modify requirements as necessary toensure that they do not discriminate against qualified students with disabilities. The modifications should not affect the substance of educational programs or compromise academic standards; nor should they intrude upon academic freedom. Examinations or other procedures used for evaluating students' academic achievements maybe adapted. The results of such evaluation must demonstrate the student's achievement in the academic activity, rather than describe his/her disability.

If modifications are required due to a disability, please inform theinstructor

Commit to Integrity

As a student in this course (and at IIIT Hyderabad) you are expectedto maintain high degrees of professionalism, commitment to active learning and participation in this class and also integrity in your behavior in and out of the classroom.

IIIT Hyderabad Academic Honesty Policy & Procedures

Student Academic Disciplinary Procedures

(1) Academic misconduct is an act in which a student:

(a) Seeks to claim credit for the work or efforts of another withoutauthorization or citation;
(b) Uses unauthorized materials or fabricated data in any academicexercise;
(c) Forges or falsifies academic documents or records;
(d) Intentionally impedes or damages the academic work ofothers;
(e) Engages in conduct aimed at making false representation of astudent's academic performance; or
(f) Assists other students in any of these acts.

(2) Examples of academic misconduct include, but are not limited to: cheating on an examination; collaborating with others in work to be presented, contrary to the stated rules of the course; submitting a paper or assignment as one's own work when a part or all of the paperor assignment is the work of another; submitting a paper or assignment that contains ideas or research of others without appropriately identifying the sources of those ideas; stealing examinations or course materials; submitting, if contrary to the rules of a course, work previously presented in another course; tampering with the laboratory experiment or computer program of another student; knowingly and intentionally assisting another student in any of the above, including assistance in an arrangement

whereby any work, classroom performance, examination or other activity is submitted or performed by a person other than the student under whose name the work is submitted or performed.

We will be using plagiarism detection software. Please do not copy- paste from other papers. If you use direct quotes, you have to use thequotation marks "xyz" and cite your source: e.g. (Johnson & Johnson,1988, p. 5). Please use APA format. If plagiarism is detected, for the first violation, you will get 0 for the term paper or assignment in question. If plagiarism is detected a second time in another assignment/project write-up, then one letter grade will be deducted from the final grade (e.g if you get a B/B-, that will be changed to
C/C-) and you will be reported to the appropriate authorities forfurther disciplinary action.

Note: This syllabus was adapted from a template provided at www.uwsp.edu

---

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

Faculty Name : Priyanka Srivastava
Type when : Monsoon 2021
Pre-requisite : None

Objective: The aim of the course is to introduce various research -driven topics in psychologicalscience.Thiscoursewillhelpyouunderstandhowweperceive,think,feeland act,bothas anindividualaswellasasocial-culturalbeing.Emphasizingtheroleofcritical thinking, empirical investigation and research design in psychology, this course will specifically highlighthowpsychologicalphenomenaandprocessesarescientificallyinvestigated.

Topics:

1. Introduction toPsychology
2. The Matter of theMind
3. EvolutionaryPsychology
4. HumanDevelopment
5. Sensation, Perception, Attention, andAwareness
6. Consciousness
7. Learning
8. Memory
9. The SocialMind
10. Motivation andEmotion
11. Stress, Coping, andHealth

Books:

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

Teachingapproach: Thecoursewillbelecturecumseminarcourse.Studentswillbeintroduced toundergraduate-levelintroductorytopicsandissuesinpsychology.Relevantlecturevideos andreadingmaterialwillbeprovidedbeforeeachtopic.

In this course, we'll use online lectures from active scientists in the field of Psychological Sciences fromMITandUniversity ofToronto.Ihaveplannedtofollow MITandCoursera, IntroductiontoPsychologyCourseforlectures,followedbytwiceaweekactivediscussionin our scheduled classes. Mostly the lectures will be considered from Coursera videos on

IntroductiontoPsychologybyProf.Joordens,exceptTopic10and11,whichwillbecovered fromMITopencourseware(OCW)byProf.Gabrielli.

Toensuretheparticipationofeachstudent,eachstudentwillbegivenachancetobrieflytalk aboutthetopicbasedontheassignedreadings.Eachstudentwillberequiredtodoatleastone presentation.

Assignments: This exercise will consist oftwo brief write-ups (about 1000-1500 words) about psychologicalphenomenathatwillbeassignedtothembasedonoureverydayexperiences.For instance,someofthequestionswillbeasfollowing:

1. How media affect the way we think? 2. Do we freely choose our actions or are they determinedbeforehandbyfactorsbeyondourawarenessandcontrol?3.Howourbrain sculpted?4.Howdowedevelopanattitudeaboutpeople,things,andevents?5.How yourbehaviorgetshaped?6.Aretherelawsofperception?

The purpose of the assignment is to evaluate the conceptual mapping of the everyday phenomenontopsychologicalinvestigationandscopeofgeneralization.Thisexercisewill involvecriticallyreviewofpeer-reviewedjournalarticlesand/orbookchaptersandstatetheir positioninreferencetothetopicassignedtothem.Generalfeedbackwillbegiventostudents afterevaluation.

Project: Inthisexercisestudentswillberequiredtoconductanempiricalstudytounderstand the psychological phenomena or processes by employing the research methods used in psychologicalsciences.Studentswillbeencouragedtoreplicatetheclassicpsychological studiesandgetmesmerizedwithsimilar/contradictoryfindings.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

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

1. understandtheresearchissuesinPsychologicalScience
2. conduct an empirical investigation, by employing experimental or non - experimental approach and resultinterpretation

Remarks:

Maximum number: 35-40 students

Online Courses Link – massive open online courses

1. Coursera–Prof.SteveJoordens,UnivesityofToronto,Ontorio,Canada (https://class.coursera.org/intropsych-001)
2. CMU–OpenLearningInitiative–Prof.… withNormaBierdirectorofOLIgroup.

3. YaleUniversity–Prof.PaulBloom,LecturesavailableonYoutube. (https://www.youtube.com/playlist?list=PL6A08EB4EEFF3E91F&feature=plcp)
4. MIT–Prof.JohnGabrieli(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/)

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

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

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 oftime;
(3) Makingofthemoderndisciplineofhistory;
(4) Themaintheoriesofhistory;
(5) Themainmethodsofhistory.
PREFERREDTEXTBOOKS: E.H.Carr:*WhatisHistory*.

Marc Bloch, *The Historian's Craft.*

***REFERENCEBOOKS:** RomilaThapar,*TimeasaMetaphorofHistory:Early India*.

BernardS.Cohen,"HistoryandAnthropology:TheStateofPlay".Chapterin*An AnthropologistamongtheHistoriansandOtherEssays.*

RanajitGuha,"OnSomeAspectsoftheHistoriographyofColonialIndia".Chapter one in *Subaltern Studies* Vol1.

Mircea Eliade, *The Myth of the Eternal Return: Cosmos and History.*

***PROJECT:**Writtenanalysisofeitheronefilmornoveloracontemporarynews event using historicalmethods.

If any changes in the Grading Plan, faculty will announce in the first class.

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: Thestudentwillbeabletoidentifythemaintheoriesandmethodsof thedisciplineofhistory.S/hewillalsobeusesomeofthesetounderstandand explain contemporaryevents.

REMARKS: Thecoursewillbedividedintotwoparts.PartOnewillconsistof lecturesandreadingswhichwillintroducethestudentstothereadingsandalso giveinformationaboutthemaintheoriesandtheoreticiansofhistory.Thereadings willtotalabout250printedpages.PartTwowillconsistofclassdiscussionsand grouppresentations,basedonanalysingfilms,novelsandcontemporarynew reportsusingideasandmethodslearntinpartone.

HS1.204 Introduction to Literature 3-1-0-4

Faculty Name **:** Nazia Akhtar
TYPE-WHEN **:** Humanities Elective, Monsoon

PRE-REQUISITE **:** BTech students should have passed Introduction to Human Sciences
OBJECTIVE **:** This course is for those who have little or no introduction to reading literature in the classroom. It will introduce students to the study of literature and equip them with a foundational understanding of major concepts, methods, and theories used to analyze and interpret literary expression, including in the present digital age, which has thrown up new genres and media to accommodate the needs and aspirations of new generations. On successful completion of the course, the student will have an appreciation of the perspective of a literary scholar and understand the importance of creative verbal expression.

Literature acquires meaning and, indeed, finds realization in how it is read and interpreted by readers, who have the opportunity to appreciate different worldviews, experiences, and subject positions through such reading. Over the duration of this course, we will reflect on three key questions through our reading of short stories, novels, poetry, and plays: what is literature, and why and how do we study it? The course will discuss issues fundamental to the study of literature – the meaning of literature; its relation to other artistic productions; an overview of traditional genre classifications of literature; an understanding of the role of canon in maintaining the visibility of certain texts and writers; and the social, cultural, and historical contexts of literary production, publication, and reception. In other words, we will look at the world of the literary text and attendant aspects of reading cultures and communities.

COURSE TOPICS:

1. Defining Literature and Its Place in the World.
2. The "Literariness" of Literature; Representation and Reality.
3. Major Genres of Literature.
4. Major Concepts, Methods, and Theories of Literature; and
5. Literature in the Digital Age
6.

PREFERRED TEXTBOOKS:

Ali, Agha Shahid. "Arabic" and other poems (various years; poetry)

Ao, Temsula. "Laburnum for my Head" (2009; short story).

Baldwin, Shauna Singh. *What the Body Remembers* (1999; novel)

G. Shyamala. "But Why Can't the Baindla Woman Ask for Her Land?" (2012; short story)

Hyder, Qurratulain. "A Night on Pali Hills" (1995; play)

Margaret, Mercy. "Prega News" and other poems (various years; poetry)

Masud, Naiyer. "The Woman in Black" (2006; short story)

Merchant, Hoshang. "Secunderabad Sans Light" and other poems (various years; poetry)

Narayan, R.K. "Like the Sun," "Chippy" (1985; short stories)

Nongkynrih, Kynpham Sing. Selections from *Time's Barter: Haiku and Senryu* (2015; poetry)

Pritam, Amrita. "Today I Say Unto Waris Shah" and other poems (various years; poetry)

Tendulkar, Vijay. "Silence! The Court is in Session" (1967; play)

REFERENCE BOOKS:

Abrams, M.H. *A Glossary of Literary Terms* (1957)
Barnet, Sylvan, ed. *An Introduction to Literature: Fiction, Poetry, and Drama* (1961)
Eagleton, Terry. *How to Read Literature* (2013)
Moretti, Franco. *Distant Reading* (2013)
Woolf, Virginia. "How to Read a Book" (1925)

FURTHER READING:

Anderson, Benedict. *Imagined Communities* (1983)

Barry, Peter. *Beginning Theory* (1995)
Barth, John. "It's a Short Story" (1993)

Bhabha, Homi. "Introduction: Narrating the Nation." Nation and Narration (1990)

Farner, Geir. *Literary Fiction: The Ways We Read Narrative Literature* (2014)

Habib, M.A.R. *A History of Literary Criticism and Theory* (2005)

Hutcheon, Linda. *Historiographical Metafiction* (1989)

Limbale, Sharankumar. *Towards an Aesthetic of Dalit Literature* (2004)

Lockers, Matthew J. *Macroanalysis: Digital Methods and Literary History* (2013)
Klages, Mary. *Literary Theory: A Guide for the Perplexed* (2006)
Mufti, Aamir R. "A Greater Story Writer than God: Genre, Gender and Minority in LateColonial India" (2002)

Natarajan, Nalini. *Handbook of Twentieth Century Literatures of India* (1996)

Nussbaum, Martha. *Not for Profit: Why Democracy Needs the Humanities* (2010)

Mukherjee, Meenakshi. "Indian Novels in Translation" (1972)

Paniker, K. Ayyappa. *Indian Narratology* (2003)

PROJECT:

The project in this course will consist of writing a 2500-word research essay on a literary text from a list made available to students. To write this essay, students will draw from the literary terms and concepts they will have learned, as well as broader phenomena associated with society, history, and culture in the context of the production of the text. This essay will be ably supported by documented secondary sources.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Short Writing Assignments	**30% (6 x 5%)**
Presentation	**30%**
Project	**40%**
Other Evaluation _____	

OUTCOMES:

On successful completion of this course, students will be equipped with foundational skills in literary concepts and methods that are necessary to critically interpret, analyze, and appreciate literature. These skills are portable and will stand students in good stead in the study of text and narrative in broader contexts. Among other applications, they will have acquired a basic foundation to conduct computational research on creative writing. Students will also be able to differentiate between literature and other forms of cultural production and assess the aesthetic and didactic aspects of literary texts. They will have improved their ability to think and communicate carefully about the literary merit of creative texts beyond casual impressions or

value judgements, acquiring – in the process – fundamental skills in oral and written communication. They will have learnt new things that will challenge them and allow them to see society and culture through perspectives that they were not aware of or might not have seriously considered, which in turn will enable a greater appreciation of the connection between human, creative expression and the issues that make up and are made by the world in which we live.

REMARKS:

1. This is a literature course and will involve a significant amount of reading (about 600-800 pages) and intensive engagement with set texts and other sources. Students should expect to read and prepare continuously throughout the course *in advance* of the class in which texts will be discussed. Not completing assigned readings or lagging behind will make it tough for students to successfully complete this course.
2. Students will be required to bring assigned texts to the class in which they will be discussed.
3. This is a writing-intensive course. Students should expect to write at least 6000 words in the duration of the course.
4. Classroom interactions in this course will combine discussions, lectures, and activities associated with the readings. The course will entail active participation of students in class discussions.
5. While some of the texts covered in this course were written in English, most were originally published in Indian languages and will be made available to students in English translation (original language texts can also be shared with students wherever available).
6. The presentation and project will be on separate texts and topics. Students will study these and submit their work using guidelines supplied by the instructor.

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

Faculty Name: Bapi Raju S
TYPE-WHEN: Monsoon semester
PRE-REQUISITE:
Interest in Neuroscience and Cognitive Science, Basic background in Calculus, Probability and Statistics, Linear Algebra, Ordinary Differential Equations and aptitude for programming.
OBJECTIVE:
This is an introductory course on computational models used in Neuroscience and Cognitive Science. The emphasis is on multiple scales (three levels) of modeling – Single Neuron-level, Network-level and Abstract (Connectionist) models. The course emphasizes the need for and role of theory and computation in Neuroscience and Cognitive Science.
COURSE TOPICS:
Part I: Introduction to Neuroscience; Compartmental models of neuron; Spiking Neuron models. Part II: Neural population codes; information representation; neural encoding and decoding; hierarchy and organization of sensory systems; Spiking Network models of sensory systems; Neuroplasticity and learning. Part III: Introduction to Hebbian, Competitive and Error-driven learning rules; Neural Network models of Perception, Attention, Memory, Language and Executive Function.
PREFERRED TEXTBOOKS:
REFERENCE BOOKS:
1) R. O'Reilly & Y. Munakata (2000). Computational Explorations in Cognitive Neuroscience: Understanding the Mind by Simulating the Brain. MIT Press.

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

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

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

CS9.423 Introduction to Neuroeconomics 3-1-0-4

Faculty Name: Kavita Vemuri + Guest Faculty
Note: Please use course code for previously existing course

TYPE-WHEN : Monsoon 2021

FACULTY NAME : Kavita Vemuri , guest faculty

a) Prof Viswanath Pingali (IIMA) (VP) -3 lectures
b) Dr.Srijita Ghosh (Ashoka University) (SG)-2 lectures
c) Dr. Prithwiraj Mukerjee (IIMB) (PM) – 1 or 2 lecture(s)

PRE-REQUISITE : Cognitive neuroscience, Intro to Brain and Cognition, Intro to cognitive science.

OBJECTIVE : Extend the understand of brain and behavior to economics and decision making.

The course will be a seminar-style course covering the brain and behaviour pertaining to decision making as applied to economic theories. The course will begin with introduction to classical economics, the brain (brief intro to anatomy) structures attributed to learning, decision making, emotions, reward etc. The core part will be modern neuroeconomics and applications.

The classes will be a combination of lectures, which will in the first half of the semester and followed by student presentations on the selected topics and papers. The quizzes and exams will be based on student presentation plus instructors' notes.

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

1. A Brief History of Neuroeconomics (kv/VP/SG/PM) – 1 lecture
2. Basic Methods from Neoclassical Economics (SG) - 1 lectures
3. Experimental Economics and Experimental Game Theory (VP/KV) - 1 lecture
4. Overview of behavioral economics.(SG/VP) - 1 lecture
5. Introduction to Neuroscience & Experimental Methods in Cognitive Neuroscience (KV) – 2 lectures
6. Decision making (KV, VP, PM) - 3 lectures

Student presentations & discussions

7. Risk /Ambiguity (student presentations) (2 lecture hours or 4 presentations)
8. Choice (student presentation) (2 lecture hours or 4 presentations)
9. Time (2 lecture hours or 4 presentations)
10. Reward/Loss (student presentations or 4 presentations)
11. Reinforcement Learning ((student presentation) (2 lecture hours or 4 presentations)
12. Social behaviour (student presentation) (2 lecture hours or 4 presentations)
13. Neuro-Morality (1 lecture (KV), followed by 2 student presentation)

PREFERRED TEXTBOOKS:
***REFERENCE BOOKS:**

1. NEUROECONOMICS, Decision Making and the Brain, SECOND EDITION Edited by PAUL W. GLIMCHER & ERNST FEHR
2. NEUROSCIENCE OF DECISION MAKING, Oshin Vartanian & David R. Mandel (eds)

***PROJECT:** Require the students to design and conduct an experiment, analyze the results and explain the findings based on existing theories

If any changes in the Grading Method, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	**20**
Assignments	
Term paper	

Project	**40**
Open book exam or 30-minute quiz	20
Other Evaluation __Class presentation___& Viva_____	**20**

OUTCOME: The students will be introduced to classical/neo classical and behavioral economics theories plus the mechanisms for measuring brain and human choices.

REMARKS: The collaboration with faculty from IIMs and Ashoka is very important for the course and it has taken almost 1.5 to 2 years to put it all together. We feel that discussions and interactions in the course will give rise to new areas of research and bring in the diversity of Indian diaspora to economic theories.

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

Faculty Name **:** Radhika Krishnan
TYPE-WHEN **:** Monsoon2021

FACULTYNAME **:** RadhikaKrishnan

PRE-REQUISITE : UG 3, UG4

OBJECTIVE: Thiscourseaimstointroducestudentstobasicconceptsandtheoriesinthe field of sociology, while briefly discussing various sociological methods. It will introduce studentstosociologicalapproachestovarioussocialinstitutionssuchascaste,class,tribe, family, religion, and gender. It will also touch upon sociological approaches to politics, urbanization,industrialization,development,andecology.

COURSE TOPICS:

(1) Sociologicalconcepts
(2) Sociologicalmethods
(3) StudyofsocialinstitutionsinIndia
(4) SociologyofPolitics,urbanization,industrialization,anddevelopment

PREFERRED TEXTBOOKS:

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

*REFERENCE BOOKS:

AlpaShah,*IntheShadowsoftheState:IndigenousPolitics,Environmentalism,andInsurgencyin Jharkhand,India*(Durham,NC:DukeUniversityPress,2010).

Carol Upadhyay, *Reengineering India: Work, capital, and class in an offshoreeconomy*(Delhi: Oxford University Press, 2016).

FriedrichEngels,*Theoriginofthefamily,privateproperty,andtheState*(NewDelhi:Penguin, 2010).

GailOmvedt,*DalitVisions:theAnticastemovementandIndianCulturalIdentity*(NewDelhi: 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).

NiveditaMenon(ed.),*GenderandPoliticsinIndia*(NewDelhi:OxfordUniversityPress:2001).
RamachandraGuha(ed.),*SocialEcology*(NewDelhi:OxfordUniversityPress,1994).

ShilpaPhadkeet.al.,*WhyLoiter:WomenandRiskonMumbaiStreets*(NewDelhi:Penguin, 2011).

UmaRamaswamy,*Work,UnionandCommunity:IndustrialmaninSouthIndia*(Delhi:Oxford University Press,1983).

*REFERENCEARTICLES:
Willbesharedwithstudentsduringthecourseofthesemester.Eachmoduleinthiscoursewill haveareferencereadinglistwhichcanbeusedbystudents.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME: Thestudentwillgetanoverviewoftheories,concepts,andmethodsinSociology. The lectures, discussions, readings, and projects will enable the student to relate to contemporarydebatesandtoengagewiththecomplexityofcontemporaryIndiansociety. Apartfromunderstandingvarioussocialinstitutionsin India,s/hewillgrapplewithmodern sociologicalconcernsrelatedtogender,theurbanspace,industrialization,andtheecological contradictions ofdevelopment.
REMARKS: Thecoursewillbebasedonlecturesandthestudentswillbeexpectedtoreadthe materialmentionedinthereadinglist.

SC1.320 Introduction to Stochastic processes 3-1-0-4

Faculty Name : Bhaswar Ghosh
TYPE-WHEN : Fall 2021

PRE-REQUISITE :Any UG3, UG4, M.Tech., MS, and Ph.D. student should be able to take it

OBJECTIVE: Stochastic processes are wide-spread both in natural sciences and engineering systems. This course will provide an overview of basic concepts in stochastic processes in Physics, Chemistry and Biology. The stochastic effects in physical systems lead to fluctuations in observables giving rise to error in measuring quantities. The precision in measurement is quantified

using information theory. The course will further introduce fundamental concept of information in stochastic processes.

TOPICS:

Introduction
Stochastic processes: Markov processes
The Markov property, stationary Markov processes, decay processes Birth and death Markov processes
Langevin dynamics and Fokker Planck equation
Introduction. Derivation of Fokker Planck equation, Brownian motion
Random walk and diffusion; Langevin treatment of Brownian motion, Applications
First passage timeMaster equation and solution through small noise approximation Numerical Monte Carlo methods to solve master equation
Information theory for stochastic processes

Entropy, Relative Entropy, Mutual and fisher information Entropy,Joint entropy, and conditional entropy

The second law of thermodynamics.

Entropy production rates in random walk and chemical reactions
Connection between information and thermodynamics Maxwell's demon
Szilard engine Landauer's principle
work and entropy in information channels

Information transmission and power dissipation through noisy biochemical networks

Preferred books

Theory and Applications of Stochastic Processes: An Analytical Approach by Zeev Schuss. Stochastic Methods: A Handbook for the Natural and Social Sciences by Gardiner, Crispin Elements of Information Theory by Thomas M. Cover, Joy A. Thomas

If any changes in the Grading Plan, faculty will announce in the first class.

GRADE PLAN

Types of evaluation	Weight (%)
Quizzes	20
Assignment	20
Term paper	20
Projects	
Final exam	30
Other evaluation_ Class presentation/viva	10

Outcome

On completion of the course, the students will acquire the basic concepts of stochastic processes and their applications to sciences. The course will further focus on the methods of simulating a stochastic process and analyzing the data using concepts from statistics and information theory.

Remarks

Although the course mostly emphasizes on application of stochastic processes in sciences, the basic concepts taught in the course would in general help students to apply them in other fields as

well ranging from engineering to financial markets etc..

SC1.421 Introduction to Quantum Field Theory 3-1-0-4

Faculty Name: Diganta Das

TYPE-WHEN: Monsoon2021

PRE-REQUISITE **:** Quantum Mechanics, Special Theory ofRelativity

OBJECTIVE **:**Quantum Field Theory (QFT) is the main mathematical framework to perform calculations in condensed matter physics and particle physics. It combines ideas from quantum mechanics, special relativity, and classical field theory. In this course, the ideas of QFT and the mathematical tools are introduced through applications in particlephysics.

COURSETOPICS **:**

1. Introduction: review of backgrounds, motivations forQFT
2. Elements of Classical Field Theory: symmetries and Noether'stheorem
3. Functional Formalism: path integral formalism, functional quantization,Feynman diagrams, quantization of scalar field, phi-4 theory
4. S-matrix: scattering cross-section and decay rates, from Feynman diagrams toS-matrix
5. Dirac Field: Dirac equation and its solutions, gamma matrices, quantization,Green's function
6. Quantum Electrodynamics (QED): Feynman rules for QED, cross-section ofsimple QEDprocesses
7. Introduction toRenormalization

PREFERRED TEXTBOOKS:

1. A. Zee: Quantum Field Theory in aNutshell
2. Ashoke Das: Field Theory—A Path integralApproach
3. Michio Kaku: Quantum Field Theory—A ModernIntroduction
4. Lewis H. Ryder: Quantum FieldTheory

***REFERENCE BOOKS:**

5. Amitabha Lahiri & Palash B. Pall: A First Book of Quantum FieldTheory
6. David Tong: Quantum Field Theory (https://www.damtp.cam.ac.uk/user/tong/qft/qft.pdf)
7. Michael E. Peskin & Daniel V. Shroeder: An Introduction to Quantum FieldTheory

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	
Assignments	30

Mid semester exam	30
Project	
End semester exam	40
OtherEvaluation	

OUTCOME: By the end of the course, the students will acquire the mathematical tools to perform calculations in particle physics phenomenology. The specific tools they will learn include calculations of Feynman amplitudes, and calculations of scattering cross- sections and decay rates of particle physicsprocesses.

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

Faculty Name **:** Pradeep Kumar R
TYPE-WHEN **:**Monsoon

PRE-REQUISITE: ReinforcedConcreteDesign,StrlAnalysis,EQE

OBJECTIVE: Tounderstandandinterpretthecodesandusethemindesign

COURSETOPICS: IS16700-2017:CriteriaforStructuralSafetyofTallConcreteBuildings(8classes)

a. Generalrequirements
b. Loads and loadcombinations
c. Structuralanalysisoftallbuildings
d. Structuraldesign of tall buildings
e. Foundations for tallbuildings
f. Non-structuralelementsintallbuildings
g. Recommendationsformonitoringdeformationsintallbuildings

2. IS1893-2016:CriteriaforEarthquakeResistantDesignofStructures(6classes)
   a. Generalprinciples
   b. Designcriteria
   c. Design ofbuildings
   d. Regular & Irregularbuildings
3. IS13920-2016:DuctileDesign&DetailingofRCstructuressubjectedtoseismicforces – Code of Practice (5 classes)
   a. Generalspecifications
   b. Beams,Columns&Inclinedmembers
   c. Special Confinementreinforcement
   d. Beam-columnjoint
   e. Specialshearwalls
   f. Gravity columns inbuildings
4. IS15988-2013:Seismicevaluation&strengtheningofexistingRCBuildings-Guidelines (5classes)
   a. Preliminaryevaluation
   b. Detailedevaluation
   c. Seismicstrengthening

BOOKS:

- IS16700-2017:CriteriaforStructuralSafetyofTallConcreteBuildings
- IS1893-2016:CriteriaforEarthquakeResistantDesignofStructures
- IS13920-2016:DuctileDesign&DetailingofRCstructuressubjectedtoseismicforces – Code of Practice
- IS456-2000PlainandReinforcedConcrete-CodeofPractice
- IS15988-2013:Seismicevaluation&strengtheningofexistingRCBuildings-Guidelines

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME:

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

CS9.439 Learning and Memory – From Brain to Behaviour 3-1-0-4

Faculty Name: Bhaktee Dongaonkar

Name of the Program :Cognitive Science
Semester, Year : Monsoon 2022
(Ex: Spring, 2022)

Pre-Requisites : not applicable

Course Overview
This course is designed for students to learn the core concepts of learning and memory mechanisms in the brain. The course will go in-depth and discuss important scientific experiments and theories, and neural models that have helped to shape the understanding of learning and memory behaviour. The content is a mix of cognition, neuroscience, and neural network models.

Course Outcomes :

- CO1- Understand the basic principles of learning and memory in the brain
- CO2- Apply the fundamentals of behaviour to brain network models
- CO3- Examine the experimental results from research in the field of learning and memory

- CO4- Evaluate a chosen topic, understand its current status and propose new ideas
- CO5- Develop an experimental design that can propel the field ahead

Course Topics :

Introductory Module

- Psychology of Learning and Memory
- Neuroscience of Learning and Memory

Learning Module

- Habituation, Sensitization, and Familiarization: Learning About Repeated Events
- Classical Conditioning: Learning to Predict Significant Events
- Operant Conditioning: Learning the Outcome of Behaviors
- Generalization, Discrimination Learning, and Concept Formation

Memory Module

- Episodic Memory and Semantic Memory
- Skill Memory
- Complementary learning systems in the brain /Memory network in the brain
- Working Memory and Cognitive Control

Integrative Module

- Emotional/Stress Influences on Learning and Memory
- Social Learning and Memory: Observing, Interacting, and Reenacting
- Development and Aging: Learning and Memory Across the Lifespan

Preferred Text Books :Learning and Memory- From Brain to Behavior (3rd edition, 2020)- Mark A. Gluck, Eduardo Mercado, Catherine E. Myers, Worth Publishers (Macmillan, New York)

Reference Books :
E-book Links :https://www.macmillanlearning.com/college/ca/product/Learning-and-Memory/p/1319107389

If any changes in the Grading Plan, faculty will announce in the first class.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
In class quizzes	**40% (8 quizzes x 5%)**
Mid Sem-Exam	**15%**
End Sem Exam	**30%**

In-class discussions& presentations	**15%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

PO1- Demonstrate conceptual knowledge of cognition at brain and behaviour level
PO2 - Evaluate and analyze scientific work done in the field
PO3 – Apply the knowledge to address important unanswered questions in the field
PO4 - Demonstrate ability to think of potential experiments
PO5 – Apply the scientific ability to work on real-world problems in the field of cognitive science

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	1	1	1	1
CO2	1	2	2	1	1
CO3	1	3	3	2	1
CO4	1	3	3	3	3
CO5	1	2	2	3	3

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

The textbook will be used as a reference to cover the important topics and basicsin the field of learning and memory. Published experimental results will be discussed in class with students to understand how experimental work is conducted and analyzed. Students will then choose a topic of their interest, understand it in-depth, design a study that fills a gap and explain it to the class.

SC3.316 Mathematical Models in Biology 3-1-0-4

Faculty Name :Abhishek Deshpande
TYPE-WHEN : Fall2021

FACULTYNAME : AbhishekDeshpande
PRE-REQUISITE : LinearAlgebra

OBJECTIVE : This course is meant to introduce mathematical techniques used in modeling biological systems. In particular, the focus will be on analyzing biological systems from a dynamical systems point of view. Applications include analysis of enzymatic pathways, reaction networks, epidemic models and stability of steadystates.

OURSETOPICS :

1) Short treatise on Differential Equations: Existence and uniqueness of solutions, System of differential equations, Eigenvalues and eigenvectors. Application to population

dynamicsmodels.

2) Introduction to dynamical systems: Flows, Fixed points andlinearization.

3) Introduction to reaction networks: Persistence, Permanence, Globally Attracting sets, Deficiency and Multistability (Species-Reactiongraphs).

4) Applicationstobiological signal transduction pathways, phosporylation- ephosphorylation cycles and MAPKcascades.

5) Numerical simulations and analysis of dynamical systems using pplane and MATLAB.

6)

REFERRED TEXTBOOKS:

1) Nonlinear Dynamics and Chaos: With Applications To Physics, Biology, Chemistry, And Engineering, by StevenStrogatz.

2) Foundations of chemical reaction network theory by MartinFeinberg.

3) MartinFeinberg'slecturenotes:https://crnt.osu.edu/LecturesOnReactionNetworks

4) JeremyGunawardena'slecturenotes:https://vcp.med.harvard.edu/papers/crnt.pdf

5)

REFERENCE BOOKS:

1)Anintroductiontosystemsbiology:designprinciplesofbiologicalcircuits, by UriAlon.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Assignments	25
Midterm I	20
Midterm II	20
Final	35

OUTCOME: At the end of the course, students would have

(i) learnt to apply modeling techniques to biologicalproblems.

(ii) learnt to use softwares like pplane, MATLAB to performnumerical simulations.

(iii) been acclimatized to basic concepts in reaction networktheory.

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

Faculty Name: Madhava Krishna

TYPE-WHEN: Elective-Monsoon

OBJECTIVE:

Thecourseintroducesthestudenttofairdetailonthebasicmodulesforautomatingamobilerobot suchasstateestimation,visualodometryandmapping,planning,andcollisionavoidance.Thecourse drawsuponstate oftheartpracticesinprobabilityandstatisticalmethods,optimizationtechniquesand showshowtheyaredovetailedtoaroboticssetting.Thecoursehasastrongcodingcomponentinthe formofassignmentswhereinthestudentisexpectedtosimulateandimplementthealgorithmstaught inclass.

COURSE TOPICS:

Vision: Rigidbodytransformations,Projectivegeometry,Cameramodelling,Cameracalibration,Two-viewgeometry,Stereo,Triangulation,Resection,Visualodometry,BundleadjustmentStateestimation:Bayesianfilters-Kalmanfilter,ExtendedKalmanfilter,LocalizationandMappingusing EKF

Pathplanning:AI-styleplanning,Kinematics,Randomizedplanning,Trajectoryoptimization,Collision avoidance in dynamicenvironments

REFERENCE BOOKS:

Hartley,R.,&Zisserman,A.(2003).Multipleviewgeometryincomputervision.Cambridgeuniversity press.

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

***PROJECT:** 3 projects

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME: Thestudentisexpectedtobeawareofstateoftheartmobileroboticalgorithms andshouldfeelcomfortablereadingandassimilatingstateoftheartresearchpapersinareas covered in thecourse/class.

EC5.411 Modern Coding Theory 3-1-0-4

Faculty Name: Prasad Krishnan

Name of the Program : B.Tech ECE (Elective)

Semester, Year : Monsoon 2022

Pre-Requisites : Linear Algebra (must have good conceptual understanding of vector spaces, basis, subspaces, nullspace and rank of linear transformations), **Probability and Random Processes (or Probability and Statistics)** : must have understanding of important distributions (Gaussian, Bernoulli, Binomial), concept of joint probability distributions and conditional distributions with associated chain rule, Bayes theorem, Central Limit Theorem, basic ideas of functions of random variables and their expectation.

Course Outcomes :

Students at the end of the course should be able to:

1. Define and name some examples the notion of channels, channel capacity and capacity achieving codes, with examples such as LDPC codes, Reed Muller Codes and Berman Codes, and their application to 5G communication.
2. Understand principle of message passing decoding (MPD) and employ MPDfor LDPC Codes for Binary Erasure Channel and Binary Symmetric Channel.
3. Define Reed Muller Codes and demonstrate majority logic decoding.
4. Illustrate Capacity Achieving properties of Reed Muller Codes via Boolean function analysis.
5. Demonstrate principles of recursive code construction in Berman Codes and Polar Codes, with corresponding capacity achievability results.

Course Topics :

1. Channels and their Capacity ; Notion of Capacity achieving Codes; Examples codes achieving capacity on various channels. Application in 5G and beyond.
2. Basics of Block Codes, Concept of LDPC Codes, Idea of Code Ensembles
3. Message Passing Decoding of LDPC Codes, Analysis of decoding via Density evolution
4. Reed Muller Codes : Definition, Properties, and Proof of Capacity achieving nature in Binary Erasure Channels, Idea of Capacity Achieving nature in other binary memoryless channels. .
5. Recursive Constructions for Berman Codes and Polar Codes: Definitions, basic properties,idea of capacity achieving nature in BMS channels.

Preferred Text Books :

1. T. Richardson and R. Urbanke, Modern Coding Theory, Cambridge Press, 2008

Reference Books :

1. E. Sasouglu, Polarization and Polar Codes, Now Publishers.
2. M. Mezard and A. Montanari, Information, Physics, and Computation, Oxford Press, 2009
3. Research papers.

E-book Links :

If any changes in the Grading Plan, faculty will announce in the first class.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Mid SemExam	**20**
End Sem Exam	**40**
Assignments	**20**
Project	**20**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

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

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

The students' learning in this course would strongly supported by project and assignments which would be done in teams possibly. The assignments would have a number of programming questions where the students learn how to simulate the encoding and decoding algorithms of various codes being discussed in the classroom to effectively learn about how these codes perform when deployed in the field.

CS7.507 **Multi-Agent Systems** **3-1-0-4**

Faculty Name: Praveen Paruchuri & Meghna Lowalekar
Name of the Program : Computer Science

Semester, Year : Monsoon 2022
(Ex: Spring, 2022)

Pre-Requisites : Machine, Data and Learning

Course Outcomes : After completion of the course students will be able to

CO1: Demonstrate a familiarity and the ability to apply the concepts related to different sub-areas within multi-agent systems field.

CO2: Build anegotiation agent using automated negotiation algorithms.

CO3: Identify and formulate relevant real world city scale resource allocation problems as sequential decision-making problem and solve it using approximate dynamic programming framework

CO4: Design and evaluate solutions for constraint satisfaction and constraint optimization problems.

CO5: Identity, formulate and efficiently solve the real-world problems of providing maximum security coverage with limited security resources using the framework of Bayesian Stackelberg security games.

CO6: Work in a team to critically analyze and implement research papers in multi agent systems field and communicate the results to others using presentations.

(list about 5 to 6 outcomes for a full 4 credit course)
The action verbs to be used for writing the course outcomes can be found on slide 22 in the following presentation. You may remove this line and the following link after the course outcomes are formulated.

https://iiitaphyd-my.sharepoint.com/:b:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Reference%20Documents/Curriculum%20Design%20in%20NBA%20Framework%20and%20Course%20design%20for%20all%20faculty%20IIIT%20Hyderabad%207th%20july%202021.pdf?csf=1&web=1&e=387W1k

Course Topics :
(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

a) Introduction and Applications
b) Automated Negotiation Algorithms
c) CSPs
d) MDP, Decentralized MDP
e) Large scale sequential decision making problems under uncertainty
f) Approximate dynamic programming
g) Distributed Constraint Optimization
h) Review of Game Theory Basics
i) Bayesian Stackelberg Games and Applications
j) Project presentations: Will be spaced through semester and will be part of exam syllabus

Preferred Text Books :Artificial Intelligence by Russell and Norvig,
Reference Books :Approximate Dynamic Programming: Solving the Curses of Dimensionality By Warren B Powell

E-book Links :**https://zoo.cs.yale.edu/classes/cs470/materials/aima2010.pdf**

If any changes in the Grading Plan, faculty will announce in the first class.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**0**
Mid SemExam	**15**
Quiz-2	**5**
End Sem Exam	**30**
Assignments	**20**
Project	**25**
Term Paper	**0**
Other Evaluation	**5**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

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

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

The course will introduce both theoretical concepts and will encourage students to apply the knowledge gained to build useful applications. The real-world application examples used during the course will help students to understand how the concepts taught during the course are useful in finding solutions to some important problems.

The project and assignment presentations will encourage class discussions.The course project will enhance collaborative learning. By discussing ideas with their teammates, they will be able to learn better.

Note: This course description format comes into effect from Spring 2022.

MA4.405 Multivariate Analysis 3-1-0-4

Name of Faculty: Venkateswarlu Mandadi

1. **Prerequisite:** Basic statistics, Matrix analysis, Calculus
2. **Course Outcomes**

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

CO 1	Explain the intricacies of simultaneous analysis of several variables
CO 2	Discuss the theoretical foundation for multivariate analysis
CO 3	Discuss the different areas of applications of multivariate analysis
CO 4	Discuss the statistical inference in the context of several variables
CO 5	Analyze the multivariate extensions of standard univariate procedures

CO 6	Demonstrate the knowledge ofthe additional multivariate techniques and apply them to solve problems

3. Course Articulation Matrix

Course outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	3	3	1			1	1		2				
2	3	3	1	1	3	1			1	1		2	2	1	3	2
2	3	2	2	1	2	1			1	1		2	3	1	2	3
4	3	3	2	2	3	1			1	1		2	3	1	2	2
5	2	3	2	2	3	1			1	1		2	3	2	2	2
6	3	2	1	1	2	1			1	1		2	2	2	3	3

Note: 3 in the box denotes high level mapping, 2 for medium level and 1 for low level mapping

4. Detailed Syllabus

Unit 1	Random variables, vectors, and matrices. Partitioning. Linear functions. Mahalanobis distance	3 hours
Unit 2	Multivariate Normal, properties, estimation of parameters, Maximum likelihood method, Wishart distribution	3 hours
Unit 3	Hotelling T-square tests, likelihood ratio test, Union-Intersection test, Confidence intervals and Tests, Tests on subvector	6 hours
Unit 4	Multivariate analysis of variance, one way classification, Two-way analysis, Tests on subvector	6 hours
Unit 5	Discrimination, Two groups, Several groups, Tests of hypotheses, Classification, Two groups, Several groups, Estimation of error rates	6 hours
Unit 6	Multiple regression, Multivariate regression, Fixed x's, Estimation, Hypothesis tests.	6 hours
Unit 7	Canonical Correlations and variates, Properties, Tests of significance, Interpretation of canonical variates	6 hours

Unit 8	Principal Components, Methods for discarding components, Interpretation, Relationship between Principal Components and Regression	3 hours
Unit 9	Basic factor model, estimation of loadings and commonalities, Determining the number of factors, Rotation of factor loadings	3 hours

References:

R.A. Johnson, Applied multivariate statistical analysis, Publishers, Edition, Year?
T.W. Anderson, An introduction to multivariate analysis, Publishers, Edition, Year?
K.V. Mardia, Multivariate analysis, Publishers, Edition, Year?

5. Teaching-Learning Strategies

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

If any changes in the assessment method, faculty will announce in the first class.

Assessment Methods and Weightage

Assignments: 20, Quizzes: 20, Mid SemesterExam:20, End Semester Exam: 40 marks.

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

FACULTY NAME **:** Samyadeb Bhattacharya, CSTAR.

Note: Please use course code for previously existing course

TYPE-WHEN : Monsoon

PRE-REQUISITE **:** 1. Basic Linear algebra 2. Basic introduction to Quantum Mechanics

OBJECTIVE **:** Preparing a student in basic quantum information science tools and exposure to current research trends.

COURSE TOPICS **:**

(Please list the order in which they will be covered)

1. Introduction to Quantum mechanics and linear algebra
2. Quantum states, density matrices and Von Neumann algebra.
3. Quantum Dynamics: from unitary operations to completely positive trace preserving maps.
4. Operators 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 TEXTBOOKS:1.John Preskill lecture notes, 2. Theory of open quantum systems by H P Breuer & F Petruccione.

***REFERENCE BOOKS:** Lecture notes in open quantum systems by Alicki & Lendi

***PROJECT:** Construction of basic quantum heat engines and other devices.

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

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

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

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

Faculty Name : Venkatesh Choppella +Mrityunjay Kumar (Ph.D Scholar)

PRE-REQUISITE : Programming in any programming language.

OBJECTIVE

This course is an introduction to the principles behind the design and interpretation of programming languages. We wish to understand the abstraction mechanisms in any programming language and their implementation.

One way to do so is to understand that programs are translated (compiled) into another, lower-level language, which is executed by hardware. This is the compiler route and not the goal of this course.

Another way is to think of a program as an expression built from mathematical objects since programming languages draw their foundations from mathematical logic, universal algebra and the theory of computation. This is the route we take in this course, and lambda calculus forms the underpinning for much of our discussions (even though it is introduced formally only in the later part of the course).

In this course, we take an interesting approach. To examine the key constructs of a language, we build a series of *interpreters*, each a virtual machine for a mini language with specific features. We use a functional programming language, Scheme, to build these interpreters through assignments, while our focus in the class is on the operational semantics of these languages we

invent. 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.

Clarification on frequent queries on the course

Q: Does this course improve my programming skills?

A: In short term, certainly not. In fact, it can confuse you in short term, because you will start questioning why you have not been using functional programming all your programming life! What this course will do is it can make you a good language designer. Before you run away thinking course is useless because you don't need to design a new language, consider this: most sophisticated software systems of current generation embed within them a plethora of domain-specific languages (DSLs): rules engine, interaction environments, complex user inputs, custom data interfaces. They all benefit from a carefully designed language, and as interactions between human and machine become more complex (think conversational, synaptical..), they need to be mediated by DSLs.

Q: Why do you use functional programming in this course? Is it useful for me outside this course?

A: Functional programming is very close to the lambda calculus which is the underpinning of this course. So this is a straightforward language choice, Scheme is a paradigm shift for many students who take this course since it is their first exposure. If you have not done declarative programming, functional programming can show you its beauty and power – you will write high quality and succinct code and will require much less time coding (and debugging) and much more time thinking. Shift to functional programming in industry is still niche but it is happening, and this course can be your kickstart.

COURSE TOPICS:

Functional programming – list manipulation, higher order functions

Abstract Syntax Trees and interpretation/evaluation

Arithmatic and algebraic interpreters

Lexical environments

Scope and Binding

Procedures and Closures

Recursion, implementing recursion

Stores

Lambda Calculus

Tail recursion, iterative systems

Continuous-passing style (CPS) and converting to CPS, interpreters

Modeling exceptions and threads

The textbook we will use for the course will be "Essentials of Programming Languages (EoPL)" by Friedman and Wand. Prentice Hall India.

If any changes in the assessment method, faculty will announce in the first class.

GradingPolicy

We plan to have the following:

Item	#	Weight	Total Weight
Small homework	3	5 * 3	= 15%
Large homework	1	10	= 10%
Quizzes	2	10 * 2	= 20%
Midsem	1	25	= 25%
Endsem	1	30	= 30%

EC2.409 Principles of Semiconductor Devices 3-1-0-4

Faculty Name: Anshu Sarje

1. Prerequisite Course / Knowledge:
AEC, EW1 & EW2

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

After completion of this course successfully, the students will be able to..
CO-1Describe quantum mechanics basics: Heisenberg's principle, energy band (conduction & valance bands, energy gap).
CO-2 Explain the basic physics for PN junctions, MOS, MS junctions, MOSFET & BJT
CO-3Calculate basic semiconductor device parameters and solve problems related to design of above mentioned semiconductor devices.
CO-4 Design very simple diode & MOSFET circuits

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

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

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

4. Detailed Syllabus:
Unit 1: Semiconductor Properties
Unit 2: Quantum Mechanics and Energy Band Theory
Unit 3: Carriers in equilibrium, G-R processes
Unit 4: Carrier Transport
Unit 5:PN Junction physics
Unit6: MOS & MOSFET
Unit7: BJT

Reference Books:
1. Advanced Semiconductor Fundamentals by Robert Pierret
2. Semiconductor Device Fundamentals by Pierret

5. Teaching-Learning Strategies in brief (4 to 5 sentences):
Students will be applying the lecture discussion to solved examples shared with them in the class. The assignments given will reinforce the concepts. Class room learning will be done in interactive method as much as possible. Occasionally self assessment test (1minute paper) will be given. In lab class, students will make simple circuits using simple basic components.

If any changes in the assessment method, faculty will announce in the first class.

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

Type of Evaluation [3 credit- lecture]	Weightage (in %)
Mid Sem Exam 1	15*
Mid Sem Exam 2	15*
End Exam	25*
Assignments	15
Mini Project	25
1 minute paper (in class) [weekly prescheduled]	5

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

Faculty Name: Deepak Gangadhran
Note: Please use course code for previously existing course

TYPE-WHEN : Monsoon term

PRE-REQUISITE : Computer Systems Organization, Basic Operating Systems, Algorithms and Complexity Analysis (desirable but not necessary)

OBJECTIVE :

Learning Outcomes-

1) Understanding Real-Time System concepts
2) Insight into the various models of real-time tasks in a system.
3) In depth understanding of the various Real-Time Scheduling and Schedulability Analysis Techniques (both unicore and multicore)
4) Handling shared resources
5) Ability to implement real-time tasks and scheduling algorithms
6) Ability to use Real-Time Operating Systems (will have exercises with one RTOS)
7)

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 TEXTBOOKS:

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
3)

***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.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME:

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

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

Faculty Name: Ashok Kumar Das

Type When: Monsoon 2021

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

OBJECTIVE: Thiscourseisintendedtointroducestudentstheexcitingworldofinformation securityresearch.Themainfocusofthiscoursewouldbeonnon-cryptographicsecurity researchi.e.topicsrelatedtosoftwarevulnerabilities,malware,intrusiondetection/prevention systems.TherenownedCryptographerDr.BruceSchneieroncesaidthat"securityisachain and is as strong as its weakest link. Cryptography is already a string l ink, problem lies somewhereelse-innetworksandsoftware…."

Followingtheaforementionedsuggestion,thecourseisdesignedtointroducesoftware securityissuesandstate-of-the-artintechniquestoaddressthoseissues.Attheendofthe course, the studentsshould:

1. understandthevariousissuesinsoftwaresecurity.
2. understandthetechniquesthatareappliedinordertoaddresssecurityissues.
3. understandthemajorityoftheattacksthathamperthesecurityofthenetworks,e.g.bug exploitation (akahacking);
4. learnbasicsofmalwareanalysisanddefensivetechniques.
5. learnbasicsofprogramanalysis(staticanddynamicprogramanalysis)thatareappliedto analyzesoftwareforvulnerabilitydetection.
6. getfamiliarwiththestate-of-the-artinsecurityresearchtolayfoundationfortheiradvance research.

COURSE TOPICS:

Syllabus

* Elliptic-CurveCryptography(ECC)
* Keymanagementinhierarchicalaccesscontrol

* LightweightSecurityProtocolsforWearableDevices
* SecurityprotocolsforImplantableMedicalDevices
* Keymanagementinwirelesssensornetworks
* Userauthenticationinwirelesssensornetworks
* Useraccesscontrolinwirelesssensornetworks
* Accesscontrolinwirelesssensornetworksandwirelessbodyareasensornetworks
* Proxysignature
* Password-basedremoteuserauthenticationandkeyagreementusingsmartcards
* Biometric-basedremoteuserauthenticationandkeyagreementusingsmartcards
* Security in vehicular ad hocnetworks
* Security in smartgrid
* Security in cloudcomputing
* Intrusiondetectioninwirelessnetworksecurity
*

PREFERRED TEXTBOOKS:

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

*REFERENCE BOOKS:

= Any compiler book for dataflow analysis
= Assembly book for x86
= Practical malware analysis, by Sikorski and Honig

***PROJECT**:Studentcanchoosesometopicthatcanbeextendedtomajorprojectforthemaster'sdegreeoradvanceresearch.However,ifstudentchoosetoworkontheprojectduringthe course,theycando.So,thisisoptional.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

Assignments - 30%

Project - 30%

Quiz - 20%

Open Book Exam/

30 Min Quiz - 20%

OUTCOME: Thestudentswillbewellawareofstate-of-the-artinnon-cryptographicsecurity issuesandtheirproposedsolutions.Thestudentwillalsogettoknowabouttheopportunities thatexistintheresearchspace.Someofthetopicsareverypracticalfromindustrypointof view, especially when it comes to proactive approach to security i.e. security during developmentprocess.

REMARKS: Thecourseishighlyflexibleinitscontentsandapproach.Basedonthestudent's participationandinterest,thecoursemayprogressinaparticulardirection.

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

Faculty Name: Spandan Roy + Nagamanikandan Govindan

Note: Please use course code for previously existing course

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.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME:

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

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

TYPE-WHEN **:** Monsoon

FACULTY NAME : Santosh Nannuru

PRE-REQUISITE **:** Probability Theory and Random Processes

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

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

Detection Theory:

8. Hypothesis testing, Neyman-Pearson (NP) theorem, Likelihood ratio test (LRT), Receiver

operating characteristic (ROC), Minimum probability of error, Bayes Risk, Minimum Bayes risk detector, MAP detector.

9. Detection of deterministic signals: Matched filter for WGN and non-WGN, Binary and M-array signal detection using matched filter.
10. Detection of random signals: Estimator correlator, Linear model, Examples- energy detector and Rayleigh fading.
11. Detector of deterministic signals with unknown parameters: Composite hypothesis testing, Generalized LRT (GLRT), Bayesian approach, Rao test, Wald test.

PREFERRED TEXTBOOKS:

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

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

***REFERENCE BOOKS: Same as the preferred textbooks**

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	**40**
Assignments	**20**
Term paper	**15**
Project	
Surprise class quizzes	**25**
Other Evaluation _____	

CS9.425 Intro to a Social Science Perspective on Human-Computer Interaction 3-1-04

Name of the Academic Program: B. Tech. in CSE

Faculty Name: Nimmi Rangaswamy

Prerequisite Course / Knowledge:

UG3 and above – no other prerequisite knowledge

2. Course Outcomes (COs)- After completion of this course successfully, the students will be able to -

CO-1. Develop understanding of the fundamentals of Human Computer Interaction [HCI] and Human sciences

CO-2. Apply the main theoretical foundations of HCI from a human centric perspective

CO-3: Discuss the concepts and application of Design in HCI systems

CO-4. Analyze case studies of HCI systems

CO-5. Develop a research project around a HCI platform, system or theory

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

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

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Course Structure in Detail

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] Radically different ways of interacting with computationally based systems are possible, ranging from the visual [surfaces, input devices] to the invisible [sensor technologies, backend 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].

Broad Objectives:

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 domain 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

Introducing seminal topics and key concepts: 10 Hours

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 topics including social and context aware computing, design research and evaluation methods.

Role of Objects in the Social sciences: 4 Hours

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 understanding 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.

Idea and application of Design in HCI: 6 Hours

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.

Context and Mediation in HCI systems- 6 Hours

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:

Case Studies- 14 Hours

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 the readings. Students will be evaluated with a quizzes, research project design, research report, and 2 class presentations. The students will also be evaluated on the ability in engaging with and comprehending the course readings in classroom discussions. The quiz/test and the research projects will be based on the class lectures and readings assigned for the course

PREFERRED TEXTBOOKS:

***REFERENCE BOOKS:**

Lucy Suchman Human-machine reconfigurations, Cambridge University Press

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

Miller, D and Sinanan, J, *Webcam*, Polity Press

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

Rogers, Y. *HCI Theory: Classical, Modern, and Contemporary*. Morgan & Claypool

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

***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.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes/ Mid Semester exams	**40%**
Individual Research Project	**50%**
Class participation	**10%**

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

---

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

Faculty Name **:** Rajan KS

TYPE-WHEN **:** Open Elective

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

OBJECTIVE :

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

temporal Analytics, 3D GIS, Ontology and GML,etc.

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

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

1. What is Geographical Information Systems(GIS)?
2. Fundamental concepts ofSpace
3. Geospatial data and its Digital representation – Vectors andRasters
4. GIS Data collection, Editing and Dataformats
5. Data structures for Spatial data and Spatial data management (Geospatial database)
6. Spatial Data Query and Analysis – Spatial Analysis, NetworkAnalysis
7. Data compatibility - Projections andGeoreferencing
8. Spatial reasoning anduncertainty
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 SpatialInformatics
1. 3DGIS
2. Open-Source Initiatives inGIS/RS

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

PREFERRED TEXTBOOKS:

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

If any changes in the assessment method, faculty will announce in the first class.

<u>Course Assessment Plan (Monsoon 2021)</u>

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

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

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

Faculty Name: Anil Kumar Vuppala

PrerequisiteCourse/Knowledge:

SuggestedtohavecompletedaSignalProcessingcourseorDSAcourse.

Course Outcomes(COs):

Aftercompletionofthiscoursesuccessfully,thestudentswillbeableto..

CO-1 :Explain the speech production and modeling of it.

CO-2: Analyze the algorithms for speech events extraction.

CO-3: Apply mathematical foundations of signal analysis for speech featureextraction.

CO-4:Analyzethespeechsignalsusingexcitationsourceandprosody.

CO-5: Explain the basics of speech applications.

CO-6: Design the algorithms for speech events detection and speech applicationsbuilding.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) andProgram Specific Outcomes (PSOs)

	PO 1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PS O2	PS O3	PS O4
CO 1	2	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-

CO 2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 4	3	2	2	1	1	2	1	1	2	1	1	2	-	3	-	-
CO 5	2	3	2	2	1	2	2	1	2	1	1	3	-	3	-	-
CO 6	2	3	3	3	2	2	2	1	3	2	2	3	-	3	-	-

Note:'3'intheboxfor'High-level'mapping,2for'Medium-level'mapping, 1 for 'Low'-level'mapping

DetailedSyllabus:

Unit 1: Overview of signal processing, speech production, speech perception, typesofspeech, and LTImodel of speech production.

Unit 2: Pitch, formants, epochs and vowel region extraction.

Unit 3: Speech analysis: STFT analysis, Linear prediction analysis and cepstralanalysis.

Unit 4: Prosody analysis and excitation source analysis of speech.

Unit-5: Applications of speech processing such as speech recognition, speakerrecognition and speech synthesis.

ReferenceBooks:

1. Introduction to Digital Speech Processing by Lawrence R. Rabiner andRonaldW.Schafer,nowPublishersInc.Hanover,USA,2007.
2. DiscreteTimeSpeechSignalProcessing:PrinciplesandPractice-ThomasF.Quateri, Ed., PE, 2004.
3. SpeechCommunicationsHumanandMachinebyDouglasOShaughnessy,2nd Edition, IEEE Press, 2000.
4. Speech and Audio Signal Processing, Processing and Perception of Speechand Music- Ben Gold and Nelson Morgan, Wiley- India Edition, 2006.

Teaching- Learning Strategies in brief(4to5sentences):

Itisanintroductiontospeechprocessingcourse,so regular software orientedassignmentsaregiventounderstandtheconcepts.Surpriseclasstestsareconducted based on assignments to test the seriousness in assignment solving.

As apart of teaching, practical systems like speech recognition, speaker recognition etcare demonstrated in the class. Course projects are given on the concepts learned todesign speech applications.

If any changes in the assessment method, faculty will announce in the first class.

Assessment methods and weightages in brief (4to5sentences):

Assignments	25%
Mid Semester Exams	25%
Project	20%
EndSemester Exam	25%

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

Faculty: Anoop Namboodiri
TYPE-WHEN: Monsoon -2021

COURSETOPICS:

. Introduction, Feature Representation

. Nearest Neighbor Classification

. Random Variables, Probability Densities, Multivariate Densities

. Bayesian Decision Theory

. Naive Bayes Classifier

. Maximum Likelihood Estimation (MLE)

. Linear Discriminant Functions

. Perceptron Learning

. Minimum Squared Error Procedures

. Logistic Regression

. Neural Networks, Backpropagation, Training Methods

.PrincipalComponentAnalysisandEigenFaces

. Linear Discriminant Analysis and FischerFaces

. Max-Margin Classification (SVM), SVM variants, Kernelization

. Data Clustering, K means (EM) and variants, Hierarchical Clustering

. Decision Trees
. Graphical Models, Bayesian Belief Networks

. Combining Classifiers, Boosting

REFERENCE BOOKS:

*****PatternClassification byDuda,Hart&Stork
* Machine Learning –A probabilistic Perspectiveby Kevin Murphy (free eBook availableonline),
* NeuralNetworks-AComprehensiveFoundationbySimonHaykin

Pre-requisite:BasicsofLinearAlgebra,Calculus,ProbabilityTheoryandStatistics. Pro grammminginMatlab and C/C++.

If any changes in the Grading Scheme, faculty will announce in the first class.

GRADING Scheme:
***** Assignments3:20%(1Mini-project+2Assignments)
***** Homeworks:30%(2-4problemsgivenaftereachlecture;Top80%counted)
***** TwoMidSems :30%
***** Final Exam:20%

OUTCOME:

Thiscoursewillenablestudentsto understand patternrecognitiontechniquesnamely, classificationandclusteringindetailincludingboththeoreticalandpracticalaspects.

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

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

OBJECTIVE: Todevelopadetailedunderstandingaboutwindengineering,variousprinciples involved in the design of wind loads, wind induced responses on structures, applicationonsolvingwindinducedproblemsonstructures

COURSETOPICS **:**

- Wind climate, nature and types of high winds and storms
- Wind damages, damage index, wind impact on structures
- Estimation of design wind speed and pressuredistribution
- Estimation of wind loads on buildings, factors affecting windload
- Prediction of design wind speed and structuralsafety
- Estimation of extreme windspeeds
- Atmospheric boundary layer and wind turbulence: mean wind speed profiles, windspectra, topographicmultipliers
- Structural interaction with aerodynamic forces, pressure, lift, drag and moment effectson structures
- Wind loads, codes andstandards

PREFERRED TEXTBOOKS:

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

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

If any changes in the Grading, faculty will announce in the first class.

GRADING PLAN:

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

OUTCOME:

Integratingwindinducedresponsesinthedesignofvariousstructuressuchastunnels,tall buildingsetc.

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

Faculty Name:Pawan Kumar

TYPE-WHEN: Monsoon

PRE-REQUISITE: Linear Algebra, Calculus, Statistics, and any one of the programming languages: C/C++/Python/Matlab/Octave to write codes for assignment problems. Basic knowledge of machine learning (linear regression, logistic regression, SVMs, NN) is desirable, but notnecessary.

OBJECTIVE : To learn selected advance optimization techniques, and toapply them to solve selectedproblemsstemmingfromdatasciences,andscientificcomputing.

COURSE TOPICS:

0. Review of Linear Algebra, Calculus, Probability andStatistics.
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: 1st order and 2nd order methods.Precon
5. Algorithms for Non-smooth Optimization: Sub-gradient Methods; Primal-dual sub-gradientmethods; Stochastic subgradient methods.Applications.
6. Variants of Conjugate Gradient Methods and Truncated Newton Methods. Applications.
7. Algorithms for Non-convex Minimization andApplications.

PREFERRED TEXTBOOKS:

1. ***Numerical Optimization***, J. Nocedal, S. J. Wright, Springer,1999
2. **Optimization Methods for Large Scale Machine Learning**, arXiv2016
3. ***Optimization for Machine Learning***, Suvrit Sra et. al., MITPress

***PROJECT:**ProjectswillbeprimarilyfromthedomainsofScientificComputingandMachineLearning.A studentwillbeaskedtoreadapaper,implementoptimizationalgorithmsmentionedintheepaper,andpresenttheirworkusingoverheadprojectors.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

OUTCOME: Aftertakingthiscourse,studentshouldbeabletoformulateaproblemasoptimization problem,selectappropriatealgorithm,andimplementitefficiently.

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

Faculty Name : Raghu Reddy Y

Offered : Monsoon2021

PRE-REQUISITE : Knowledge of AI and Learning techniques and familiarity with Software

Engineering;orKnowledgeofSoftwareEngineeringandfamiliaritywithAI/ML;orconsento fthe instructor.

Course Description:

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

Over the last decade AI techniques have really matured, and AI models are being applied in SE much more – e.g. for automation, monitoring project health, providing assistance to engineers or managers,providingguidancefordecisions,etc.BesidesusingAIfortheactivitieshelpingp rojects or engineers, AI techniques can also be used by companies which execute hundreds of projects, to benefit from better monitoring and control of their portfolio of projects, better utilization and planningofresources,betterriskmanagement,etc.TheuseofAIinSEisanemergingareawi tha lot of promise andactivity.

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

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

COURSE OUTCOMES:

- Familiarity about how AI is being used for addressing different problems inSE
- In-depth understanding of use of AI techniques in one particular SEissue
- Understanding of how to apply AI techniques for a different domain (SE in thiscase)
- Improvedabilitytoreviewresearchliteratureand understandthestateoftheartinsome area
- Improved ability to do independentresearch

COURSE TOPICS:

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

- equirementsengineering
- Performance (software or system) tuning orprediction
- Defect prediction anddetection
- Automatic bug repair / system/softwarerepair
- Making testing moreeffective
- Coderefactoring
- Assisting code review and codeanalysis
- Effective developer/designer assistance (through recommendations,…)
- Project management (various aspects like estimation, risk management,…)
- Improving the monitoring of health of aproject
- NLP/Information Retrieval in SoftwareEngineering

- Applying ML for bugtriaging
- Analyzing logs and user comments (for bug detection, issues,etc.)

*REFERENCE BOOKS/Papers:

- The Art and Science of Analyzing Software Data. Eds: Christian Bird, Tim Menzies,ThomasZimmerman
- Seminal papers published in thisarea

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN (subject to modification):

Peer Evaluation and Class participation: 20%Presentation on the topic: 20%

State of art Report on the chosen topic: 20%

Research in the chosen topic - R&D problem formulation and some work: 20% FinalExam: 20%

CL5.401 Topics in SSMT 3-1-0-4

Faculty Name : Anil Kumar Vuppala + Dipti M Sharma + RajeevSangal

Note: Please use course code for previously existing course

PRE-REQUISITE : CL-1 or NLP or Speech SignalProcessing

Objective : The objective of the course is to discuss the state of the art of SSMT subsystems and future research topics inSSMT.

COURSETOPICS :

Introduction to SSMT
withdemos ASR stateof theart
MT state of thearts
Detecting and marking ASR output
Analyzing the translation of phrasal/clausal utterance units
Simplifyingsource language text
Discourse - inter sentential
elements TTSstate of the art
Prosody information in speech
synthesis Knownspeaker/domain
Corpus
standards
Humanin the
loop

PREFERRED TEXTBOOKS:

Relevant research papers and material will be shared to students as it is the topics course.

***REFERENCE BOOKS:**
***PROJECT:**Projects will be on subtopics of SSMT.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type ofEvaluation	Weightage (in %)
Quizzes	20
Assignments	30
Term paper -	
Project	50
Open book exam or 30 minute quiz	
Other Evaluation	

OUTCOME: Students will be familiar with SSMT and subsystems and may continue to work onfuture research problems inSSMT.

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

Faculty Name : Saroja TK
TYPE-WHEN **:**OpenElective-

Monsoon2021 **PRE-REQUISITE**

:Instructorsconsen

t OBJECTIVE

1. ConceptualstudyofragabyintroducingaroundtenragasinbothNorthandS outhIndian musicsystems.
2. PracticeofdifferentSemiclassicalformsincludingsomefolkformsofIndianmusic
3. UnderstandingtheimportanceofSemiclassicalgenreinIndianmusic.
4. Roleofmusicinbringingouttherichideasandexpressionsinthecompositions. inter relationshipofthemusicalandlinguisticexpressions.
5. Introducingdifferentcomposerswhosemusicalexperiencesandideasresultedintheexistin g semiclassicalforms.
6. Experiencingthetechniquesofcomposingandlearntocomposesomesimplesongs.

COURSETOPICS:
(Please list the order in which they will be covered)
Lesson1,2,3:Introductiontoragas.Basicexercisesindifferent ragas.Lesson4
Lesson 6, 7: Bhajans

Lesson 8, 9,10: Annamayya compositions

Lesson11,12,13:ContributionofsomeComposerswhosecompositionsareidentifiedas separategenresinIndianmusic.
Lesson 14, 15: Ghazals

Lesson 16, 17: Techniques of composing

Lesson 18: Qawwali
Lesson19,20:AbhangandPurandaradasacompo
sitions
Lesson21,22:Contributionofsomemoreco
mposers.
Lesson 23: Comparative study of Semi classical forms and Folk forms of music.

Lesson24:Studyoftheinterrelationshipofmusicalandlyricalexpressionsinbringingout thebeautyofthecompositions.
Lesson 25, 26: Practical exercises of all the concepts.

PREFERRED TEXTBOOKS:
***REFERENCE BOOKS:**

1.TheHinduSpeaksonMusic-compilationof232selectivemusic articles by TheHindu.2.ASouthernMusic(Thekarnaticstory)byT.M.Krishna
3. Videosandaudiostodemonstratedifferentconcepts.
***PROJECT:** Practical

oriented project

If any changes in the Grading Plan, faculty will announce in the first class.

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	**-----**
OtherEvaluation_____	**For all the exams Practicals 60% and Theory 40%**

OUTCOME:

1. Abilitytorecognizesomeragaswiththeirverycharacteristics.
2. Ability to identify, sing or play different semi classicalcompos

3. Understandtheimportanceofragain Indianmusic.
4. Knowtheimportanceandroleofthecomposersinbringingout variety inmusic.
5. Basicattempttocomposesimplesongs.
6. Knowledgeofdifferentrhythmicstructuresthatplayamajorrole in thecompositions.
7. Abilitytosingorplaycompositionsinatleast10ragas.
8. Videosandaudiostodemonstratedifferentconcepts.

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

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

Faculty Name : Ubaidulla

TYPE-WHEN **:** Monsoon2021

PRE-REQUISITE

:Basicsofrandomvariables(GaussianRVs,andrandom vectorsand functionsofGaussians),DigitalCommunication(Comm.Theory1)

OBJECTIVE

:Learnfundamentalsofwirelesscommunicationswithfocusonmobile technologies,andunderstandthecurrentfrontiersofresearch

COURSETOPICS

:(Note:Moretimewillbespentonthefundamentals,andmorecomplex topics(eventhosenotlisted)willbeoptionallytakenupbasedontimeavailable)

1. Wirelesschannelmodelling(Single-inputsingleoutput):Timeandfrequencycoherence, fading
2. ProbabilityoferrorvsSNR:exploitingchanneldiversity.
3. Cellularsystems:Frequencyreuse,GSM,CDMA.
4. Capacityconsiderations
5. Beamforming
6. MIMOChannelmodel,transmissionschemesandreceivers.
7. MultiuserMIMO.
8. 5Gphysicalchannelmodels,transmissiontechniques.
9. Interferencechannel,Interferencealignment,topologicalinterferencealignment.

PREFERRED TEXTBOOKS: Fundamentals of Wireless Communication by David Tse and PramodVishwanath

***REFERENCE BOOKS**: Wireless Communications- Principles & Practice (Rappaport).

***PROJECT:** (List of topics will be mentioned later)

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2021)

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

PD1.501 Human- Computer Interation 3-1-0-2

Faculty Name: Raman Saxena

1. Prerequisite Course / Knowledge:
No prerequisites are required

Semester, Year : 2nd Semester – Year 1 (Monsoon, 2022)

2. Course Objecoves & Outcomes (COs)

This course provides knowledge about the interac?on between human(user), computer(machine) and environment. The course will examines the HCI from the science, technology and human-centered design perspec?ve.
Lecture topics are aimed at guiding the students through analysing and discussing the interac?on between products and people based on cogni?ve, physical and emo?onal factors. It will introduce fundamentals of interac?on design such as mental models, human ac?on cycles and difference between User Experience, User Interface and Interac?on Design. It will look at the various types of human-computer interac?on and how it affects the people intended goals and objec?ves. How a good HCI design delivers higher perceive usefulness, usability or ease of use leading to posi?ve and delighPul user experience. It will build understanding the factors that influence the interac?on between people and products in a desired direc?on. The course will explain the process of User-centered soRware design and development and the deliverables within the same such as user cases, user stories, work flow, task analysis, informa?on architecture, wireframes, storyboards and low fidelity and high fidelity prototypes. The course will also introduce the concept and prac?ce of usability tes?ng and evalua?on. The course will also looks into the technology trends such as AI, Chatbots. etc. and their influence on theinterac?ons between human and computers. The course will also cover User Experience, The Course will divide into lectures including classroom exercises, quizzes, a short project and home assignments.
The students of this course will be able to apply the knowledge/learning's from this course to
their own professional work as HCI Designer, Interac?on designer, UX Designer and design interac?on layer of the soRware/IT products including Mobility, Healthcare, Learning, E- commerce and U?lity etc. The course will include a short project to offer opportunity to the students to experience the full HCI cycle.

ALer compleoon of this course successfully, the students will be able to…

CO-1 Demonstrate good understanding of Human-Computer Interac?on and How it influences
the User Experience of digital products, systems, solu?ons and services.
CO-2 Demonstrate good understanding of methods and tools used to understand the HCI from the perspec?ves of technology, human-centered design and human/social sciences such as cogni?ve, and digital anthropology perspec?ve.
CO-3 Demonstrate good understanding of incorpora?ng human-centered approach in HCI to deliver useful and easy to use soRware and IT products including Mobility, Healthcare, Learning, E-commerce and U?lity etc.
CO-4 Demonstrate the ability to create, document and present the various deliverables and communica?ons related to HCI, UX and UI Design including Human-Ac?on Cycle, Personas, Use Cases, Task Flow and Analysis, Informa?on Architecture diagram, Wireframes, UI Design, and Usability Tes?ng etc.
CO-5 Demonstrate the ability to plan and execute usability tes?ng including crea?ng test cases, usability matrix, performs tes?ng, record test data and analyse the same to iden?fy usability issues and report the same for upda?ng the design.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	3	3	1	3			
CO 2	3	3	3	2	3			1
CO 3	3	3	3	2	3			3
CO 4	3	2	3	3	3			3
CO 5	3	3	3	3	3			3

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

3. Detailed Syllabus:

UNIT 1. Introducoon to Human-Computer Interacoon *(Week 1 - Lecture 1)*

- Introduc?on to HCI?
- History of HCI
- How Human interact with outside world?

- Human Conceptual/Mental models
- Conflict between Mental Models and Design Models.

UNIT 2. UNDERSTANDING Human-Machine System *(Week 1 - Lecture 2)*

- Understanding Human-Machine System
- Human-Ac?on Cycle (HAC)
- 7 stages of Human-ac?on cycle.
- Classroom exercise on HAC
- User Experience

UNIT 3. Art and Science of User Experience and UI Design *(Week 2 - Lecture 3 & 4)*

- Aaen?on and Memory
- Gestalt theory and principles
- UI Elements including colour and interac?on model
- Informa?on and Interac?on Design principles

UNIT 4. User-Centered approach to the SoLware Design *(Week 3 - Lecture 5 & 6)*

- Perceived Usefulness and Perceived Ease of Use
- Understanding User Persona
- Why user person is important
- Use cases, User stories
- Task Flows & Task Analysis
- Human-centered soRware Design Workflow.

UNIT 5. User Experience and UI Design *(Week 4 - Lecture 7 & 8)*

- Informa?on Architecture
- Wireframes and Storyboards
- Low and High Fidelity prototypes

UNIT 6. Usability Engineering and Tesong (*Week 5 - Lecture 9 & 10)*

- What is Usability, usability requirements and how to measure it?
- Heuris?cs evalua?on
- Usability Test planning and conduc?ng usability test.
- Usability matrix and test repor?ng

UNIT 7. Usability Engineering and Tesong *(Week 6 - Lecture 11 & 12)*

- Short term project
- Project comple?on, documenta?on and submission

Reference Books & Case Studies:

1. Book: Human-Computer Interac?on in the New Millennium, by Carroll, John
2. Book: Learn Human-Computer interac?on: Solve human problems and focus on rapidprototyping and valida?ng solu?ons through user tes?ng., by Christopher Reid Becker
3. Book: Lean UX: Designing Great Products with Agile Teams, by Jeff Gothelf & Josh Seiden
4. Book: Designing with Mind in Mind: Simple guide to understanding User InterfaceGuidelines, by Jeff Johnson
5. Book: Sketching User Experiences: Ge ng the Design Right and the Right

Design, by Bill Buxton

6. Book: Human-Computer Interac?on: Solve human problems and focus on rapid prototyping and valida?ng solu?ons through user tes?ng, by Christopher Reid Becker
7. Book: Interac?on Design: Beyond Human-Computer Interac?on, By Helen Sharp,Jennifer Preece & Yvonnes Roger
8. Book: Designing User Interfaces: Exploring User Interfaces, UI Elements, DesignPrototypes and the Figma UI Design Tool , Dario Calonaki
9. Book: Designing Interfaces: Paaerns for Effec?ve Interac?on Design , By JenniferTidwell, Charles Brewer and Aynee Valencia
10. Book: UX for XR: User Experience Design and Strategies for ImmersiveTechnologies (Design Thinking), by Cornel Hillmann
11. Book: AI and UX: Why Ar?ficial Intelligence Needs User Experience , by Gavin Lew ,Robert M. Schumacher Jr.
12. Book: Informa?on Visualiza?on: Design for Interac?on, by Prof. Robert Spence
13. Book: Modera?ng Usability Test: Principles and Prac?ces for Interac?ng, by Dumas, Joseph
14. Case study : Design of a complex soRware system- CMS of a media organisa?on
15. Case study : Defining a Mainframe System
16. Case Example: Conversa?onal UI's

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

- The Course will divide into lectures (around 12 nos.) and hands-on work includingassignments, classroom exercises and home work.
- The course will also include fieldwork, hand on activities, learning by doing, to practicethe learning from the lectures.
- Introduce and discuss couple of case studies including cases related to HCI, UserExperience and UI Design of software products.
- A short term project to practice HCI, UX, UI and Usability learnings.
- Other than attending the lectures and doing classroom exercises & assignments,students need to spend 4 hours per week on home/field assignments.

If any changes in the assessment method, faculty will announce in the first class.

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

1.	Class/Home activities		40%
2.	Short-term project		50%
3.	Viva		10%
			100%

PD2.422 **Business Finance** **3-1-0-2**

Faculty Name: Mayank Mathur

Name of the Program: M. Tech in Product Design and Management program

Semester, Year : 2nd Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)

Pre-Requisites : None

Course Objective :

As a part of the Business Finance course, we go over the fundamentals of business finance in the contemporary world. We discuss some basic definitions and concepts of business finance regarding organizations required to understand their financial health concerning the markets. The managers need to know, understand and analyze the three main arms of the organization's financial health. The course will cover the financial statements in detail. The course also covers aspects of assets, liabilities, debits, credits, profit, loss, earning, lending, and a detailed dive into financial ratios. The other main modules we cover are as follows:

- Working capital decision-making,
- forecasting,
- Startup Valuation, and
- Time Value of Money (TVM)

CO-1 Demonstrate a good understanding of an organization's financial health and position through the study of financial statements**.**

CO-2 Demonstrate a good understanding of various Financial Ratios and parameters derived out of the monetary positions of an organization.

CO-3 Demonstrate the ability to understand and analyze the working capital decision-making based on the above parameters and hands-on skills in applying allocation of the working capital.

CO-4 Demonstrate the ability to understand and analyze the valuation exercise as an entrepreneur of one's startup organization and make decisions on the decision making again related to the Use Case Scenarios.

CO-5 Demonstrate the ability to determine, analyze and make decisions as per the Time Value of Money (TVM) of the assets owned in running own businesses.

Course Topics :

- Basics of Business Finance/ Corporate Finance, two sessions
- Financial statements and Ratios, three sessions
- Working capital decision-making, three sessions
- Startup Valuation and entrepreneur's view, three sessions
- Forecasting, two sessions
- Time Value of Money (TVM), three sessions
- Case Scenarios and Case studies, five sessions

Preferred Text Books :

Fundamentals of Financial Management,

Author(s): Eugene F. Brigham | Joel F. Houston

Reference Books :

- Finance: The Basics by Erik Banks. Author: Erik Banks Publisher: Routledge.
- Finance Sense: Corporate Finance For Non-Finance Executives by Chandra Author: Prasanna Chandra

If any changes in the Grading Plan, faculty will announce in the first class.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid SemExam	**20**
Quiz-2	**10**
End Sem Exam	**40**
Assignments	**20**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	1	3			
CO2	3	3	3	2	3			1
CO3	3	3	3	2	3			3

CO4	3	2	3	2	3			3
CO5				1	1			

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

I believe in inclusive teaching with involvement from the class as much as possible. I tend to keep the teaching and learning hand in hand and ensure we teach, learn and evaluate as we go. This helps students to pace the subject well and also makes them accustomed to the subject in a better way. I keep quizzes and assignments to include them in the classes as much as possible. We keep the Case studies and hands-on culture intact.

PD2.423 Organizational Operations 3-1-0-2

Faculty Name: Mayank Mathur

Name of the Program: M. Tech in Product Design and Management program

Semester, Year : **2nd Sem – Year 1 (Monsoon, 2022)**
(Ex: Spring, 2022)

Pre-Requisites : **None**

Course Objective :

Operations are the work of managing the inner workings of your business so it runs as efficiently as possible. Whether you make products, sell products, or provide services, every small business owner has to oversee the design and management of behind-the-scenes work. Organizational operations management involves converting input into efficient outputs to achieve desired results for an entrepreneur. The course contains various operations models, tools, and techniques for supply chain management, quality control systems, and streamlining workflows. You will learn how to innovate business operations to improve productivity and capacity with the resources. You will develop skills that will empower you to configure business processes to channel operations and reduce bottlenecks.

Course Outcomes :

CO-1 Understand key functional areas of operations with the type of decisions they are typically involved in to run a business efficiently.

CO-2 Identify key differences between service and manufacturing organizations and the business operations in the two sectors of the businesses.

CO-3 Understand and map each process phase to formulate an organizational strategy with actions typically performed at that phase.

CO-4 Identify and categorize different transformation characteristics of manufacturing and service operations strategies.

CO-5 Understand the concept of organizational strategy, the four-phase process for formulating this strategy, and how the strategy should be aligned with operations strategy in the manufacturing and services context.

Course Topics :

Operations Management: Basics of production systems, Planning, Scheduling, Sequencing, Workplace Layouts, Locational problems of warehouses. **Four sessions**

Basics of Lean Operations: Classification of wastes, 5S, Kaizen, Jidoka, Kanban, Kaizen, Value Stream Mapping, Total Productive Maintenance. **Three sessions**

Service Operations - Service strategy, service enterprise design, service operations, service blueprint, Capacity planning, queueing models, forecasting demand, and managing service inventory. **Three sessions**

Supply Chain Management - Measuring supply chain performance, drivers and metrics, planning and managing inventories in the supply chain, managing economies of scale, uncertainty, optimal product availability, sourcing decisions, **Three sessions**

Basics of Information Systems and Impact on Operations - Basics of Business Analytics and Business Intelligence, Enterprise Management Systems, necessity, functions of ERP systems **Four sessions**

Modern Technology interventions - Impact of technology interventions like IoT, Blockchain, Artificial Intelligence, and Robotics on Manufacturing and service applications of the future**Four sessions**

Preferred Text Books :

Operations Management (McGraw-Hill Series in Operations and Decision Sciences) 12th Edition, by William J Stevenson

Reference Books :

- Operations Management: Processes and Supply Chains 11th Edition, by Lee Krajewski (Author), Manoj Malhotra (Author), Larry Ritzman (Author)

- Operations Management (11thEdition) by Heizer, Jay, Render, Barry

If any changes in the Grading Plan, faculty will announce in the first class.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid SemExam	**20**
Quiz-2	**10**
End Sem Exam	**40**
Assignments	**20**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not relevant).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	3	3	2	3			
CO2	3	3	2	2	3	1		1
CO3	3	2	3	3	3	2		3
CO4	3	2	3	2	3			3
CO5		2		1	1			

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

I believe in inclusive teaching with involvement from the class as much as possible. I tend to keep the teaching and learning hand in hand and ensure we teach, learn and evaluate as we go. This helps students to pace the subject well and also makes them accustomed to the subject in a better way. I keep quizzes and assignments to include them in the classes as much as possible. We keep the Case studies and hands-on culture intact.

EC1.301 **Bio Instrumentation & Devices 2** **3-1-0-4**

FACULTY NAME : Anshu Sarje

Note: Please use course code for previously existing course
TYPE-WHEN : Monsoon for 3rd and 4thyr B Tech

PRE-REQUISITE : AEC, IC circuit design, Bio instrumentation & devices 1
OBJECTIVE :Hands on experience in fabrication, fluidics & instrumentation.

COURSE TOPICS :
(please list the order in which they will be covered)
Experiments and/or order of experiments may change subject to availability of space and lab materials.

1. Lab1 (Week 1 & 2): Record your muscle electrophysiology. Design amplifier and record your muscle activity.
2. Lab2 (Week 3 & 4): Make your own fluidic channel and separate out different particles.
3. Lab3 (Week 5 & 6): Lets detect fluorescence. We will explore different ways of detecting fluorescence and record fluorescence using a camera.
4. Lab4 (Week 7&8): Photolithography. We will transfer pattern using photolithography on a substrate and develop it.
5. Lab5 Bonus: We will explore optics and its use in diagnostics.

PREFERRED TEXT BOOKS: No specific book. Notes will be provided.

***REFERENCE BOOKS:**

***PROJECT:**Students have to complete experiments which they can adapt with prior approval.

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Weekly Lab report	**30%**
Lab discipline & work	**40%**
Viva & Discussions	**30%**

OUTCOME:

After completion of this course successfully, the students will be able to..
CO-1 Describe ECG signals and muscleelectrophysiology.
CO-2 They will be able design system for picking up the electrophysiological signal and amplify it.
CO-3 Design and usemicrofluidics and soft lithographyfor .
CO-4 They will be able design and fabricate fluidic channels.
CO-5 Design and describe fluorescence detection
CO-6 Explain, perform, use photolithography for device patterning and fabrication.

REMARKS:

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	2	1	1	1	1	1	1	2	-	2	1	1	3	1
CO 2	3	3	3	1	3	3	2	1	1	2	-	3	3	3	3	3
CO 3	3	2	2	1	1	1	1	1	1	2	-	2	1	1	3	1
CO 4	3	3	3	1	3	3	2	1	1	2	-	3	3	3	3	3
CO 5	3	2	1	1	1	2	2	1	1	1	-	3	3	3	2	3
CO 6		3	3	1	3	3	2	1	1	2	-	3	3	3	3	3
…..																

EC5.410 Information Theory 3-1-0-4

Faculty Name: Lalitha Vadlamani and Arti Yardi

Name of the Program **:** B. Tech in Electronics and Communication Engg.
Semester, Year_____ **:** Monsoon 2022

(Ex: Spring, 2022)

Pre-Requisites **:** Basics course in probability is a must

Course Outcomes (COs) **:**

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

CO-1: Explain the definition and properties of various basic concepts in information theory such as entropy, relative entropy, and mutual information for discrete and continuous random variables

CO-2: Interpret and apply the concept of asymptotic equipartition property and random binning proof technique.

CO-3: Discuss the basics of data compression and source codes such as Huffman codes, Lempel-ziv.

CO-4: Employ random coding ideas to prove the Shannon's source coding and channel coding theorems for some simple sources and channels

CO-5: Analyze the capacity of a communication channel through various illustrative examples

CO-6: Calculate the achievable rates of Slepian Wolf coding and MAC channels in network information theory

Course Topics **:**

Unit 1: Motivation for digital communication and information theory, Probability overview.

Unit 2: Source Coding - Entropy and its properties, Relative entropy, Mutual information, Huffman codes and optimality, Asymptotic Equipartition Property and Typical set based source coding.

Unit 3: Channel coding - Channel capacity motivation and definition, Discrete memoryless channel, Channel coding theorem for DMC- achievability and converse.

Unit 4: Gaussian channel - Differential entropy, Gaussian channel with power limitation, Gaussian channel coding theorem and converse.

Unit 5: Network Information Theory - Slepian-Wolf coding, MAC channels

Preferred Text Books :

1. "Elements of Information Theory", Thomas Cover and Joy Thomas.

Reference Books :

"Information Theory, Inference and learning algorithms", David McKay (available online)

1. "A First Course in Information Theory", Raymond Yeung.
2. "Network Information Theory" by Abbas El Gamal and Young Han Kim (available online)
3. "Principles of Digital Communications", by Robert Gallager (Lecture notes available online).

E-book Links :

If any changes in the Grading Plan, faculty will announce in the first class.

Grading Plan :

(The table is only indicative)

Type of Evaluation	**Weightage (in %)**
Quiz-1	**10%**
Mid SemExam	**20%**
Quiz-2	**10%**
End Sem Exam	**30%**
Assignments	**15%**
Project	

Term Paper	**15%**
Other Evaluation	

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant). Program outcomes are posted at https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

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

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

The course materials will be delivered through a systematic set of lectures, assignments, tutorials, and a term paper. The lectures will be highly interactive, where students will be encouraged to participate in class activities. In order to evaluate overall understanding of

students, there will be short quizzes with multiple choice questions during the lectures. There will be one tutorial session per week and periodic set of assignments consisting of practice questions throughout the semester. Students will be divided into groups (of appropriate sizes) and each group will be asked to study and present a research paper. These research papers are carefully chosen by the instructor such that they will aid students to understand and apply the concepts studied during the course duration.

==========

Note: This course description format comes into effect from Spring 2022.

PD1.411 Product Design Workshop 3-1-0-2

Faculty Name: Prakash Yalla

Name of the Program: M. Tech in Product Design and Management program

Semester, Year : **2nd Sem – Year 1 (Monsoon, 2022)**
(Ex: Spring, 2022)

Pre-Requisites : Basic principles of, Software programming, Design thinking and Product design. Basics of workshop tools and equipment operations (lathe, cnc, 3d printing ,laser cutter & pcb maker). Else tutorials need to be taken). Basics of rapid prototyping CAD software for mechanical and electronics design (else tutorial to be taken)

Course Objective & Overview:

This course module intends to equip students with tools and techniques to rapid prototype a physical product that solve real life problems. Some of the most impactful systems interact with physical world. All of these have software driven intelligence. The objective of this learning module is to empower students with tools and techniques and to design real world physical systems.

Mode: Hands on workshop and project-based delivery. The course will involve a series of micro level projects that add up-to a larger project leading to a physical system (s).

2. Course Outcomes (COs)

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

CO-1. Apply Product design & rapid prototyping tools in development of physical systems/products.

CO-2: Re-engineer/Design products based on end user needs

CO-3. Integrate and create an end to end physical system (SW, Mechanicals and Electronics).

CO-4. Deploy in live setting and capture usable information from physical world.

3. Detailed Syllabus:

#	Topics
1	Rapid Prototyping Techniques & Tools
2	Shapes, Cuts and Joints : Usage and realise using RPT tools
3	Materials and selection depend upon their applications.
4	Product aesthetics : Materials Texture, Feel, and colour.
5	Embedded Intelligence
6	System Integration & Live deployment

The course has four parts to it with each part naturally dove tailing into the other

Part 1: Understanding Physical Objects & Rapid Prototyping:

In this module students get introduced to basics of rapid prototyping and usage of equipment like 3d printers, laser cutters, CNC machines etc. The students replicate everyday objects as is using these tools (builds an understanding on the right tool for right job).

Part 2: Problem Solving – understanding user need, usage scenario and re-imagining:

In this module students are given design problems that makes one re-imagine know systems based on user needs e.g. How could the everyday object manifest in the context of say r a Parkinson's patient.

Part 3: Embedding Intelligence:

In this module students are taught how to capture physical world information and how to embed smarts in a seamless manner into the physical system. This module brings into focus the behavior of software systems while engaging with real world parameters.

Part4: Putting it all Together: Final project

This part of the course assembles all the learning in the form of a end to end system/object that students showcase. The end semester exam for this is an end use feedback: the usability, the aesthetics , the functionality, the smarts etc.

4. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific

Outcomes (PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	3	3	2	2	2	2	3	3	3	3	3
CO 2	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 3	3	3	2	2	3	3	2	2	3	3	3	3	3	3
CO 4	3	3	2	2	3	3	3	3	2	3	3	3	3	3

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

5. Teaching-Learning Strategies in brief:

The course is experiential in nature. It is workshops and discussions-based methodology to discover solutions to problems and projects that enables students to see their designs work in real world.

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing 4 mini-projects & one major project in laboratory by the students

If any changes in the assessment method, faculty will announce in the first class.

6. Assessment methods and weightages in brief :

In-class activities and Quizzes	20%
Weekly Lab assignments	30 %
Main Project	40 %
End Semester Exam	10 %

EC5.412 Speech Analysis and Linguistics (SAL) 3-1-0-4

Faculty Name: Chiranjeevi Yarra

Name of the Program : CLD/CSD/ECD/ECE/CSE

Semester, Year : Monsoon 2022
(Ex: Spring, 2022)

Pre-Requisites : No

Course Outcomes :
(list about 5 to 6 outcomes for a full 4 credit course)

CO-1: Explaining the basics of speech and linguistic.
CO-2: Analyzing the linguistics in the state-of-the-art speech applications.
CO-3: Applying computationallinguisticsfoundations for speech analysis.
CO-4: Analyzing the speech applications using phonemic, prosodic and text modelling.
CO-5: Explaining the basics of phonemic, prosodic and text analysis.
CO-6: Designing the algorithms for phonemic, prosodic and text modelling.

Course Topics :
(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

Unit-1: Speech and linguistic basics -- Description of frames, phonemes, syllables, words, phrases, sentences and its use in speech-based feature computation.
Unit-2: Linguistics in speech analysis -- Overview of speech applications (such as ASR, TTS, Speech pathology etc..), use of phonemes, graphemes, prosody and text.
Unit-3: Phonemic analysis -- Phonemes and its accents, visual phonetics (Spectrogram, articulatory videos), pronunciation variations and modelling, grapheme to phoneme conversion, phoneme accent variations and identification.
Unit-4: Prosodic analysis -- Prosodic structure, word and syllable prominence, prominence detection and its applications, Intonation and its modelling (such as ToBI etc..), pitch and prominence variations, intonation identification, pauses, disfluencies and its detection, speech rhythm and speaking rate.
Unit-5: Text analysis -- language modelling, neural language models, metrics, text normalization, character-based speech analysis.

Preferred Text Books :
Speech and Language Processing, Daniel Jurafsky& James H. Martin (2000), Pearson Education/Prentice Hall.
Prosody in Speech Understanding Systems, Ralf Kompe, Springer, 1997.
The Music of Everyday Speech: Prosody and Discourse Analysis, Ann Wennerstrom, Oxford University Press, 2001

If any changes in the assessment method, faculty will announce in the first class.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**15%**

Seminar	**20%**
End Evaluation	**15%**
Assignments	**15%**
Project	**25%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	2	3	1	1	1	1	1	1	2	1	1	2	2	3	-	1
CO2	3	2	2	1	1	1	3	1	2	1	1	2	2	3	-	1
CO3	3	3	3	3	2	1	2	1	3	1	1	3	2	3	-	2
CO 4	3	2	3	1	1	2	3	1	2	1	1	2	2	3	-	2
CO5	2	3	1	2	1	2	2	1	2	1	1	2	2	3	-	2
CO6	3	3	3	3	3	2	3	1	3	2	2	3	2	3	-	2

Teaching-Learning Strategies in brief (4-5 sentences):
Lectures are given by integrating ICT into classroom teaching. Regular software-oriented assignments are given to understand the concepts. Along with assignments, course projects are considered to encourage the students to learn the concepts by doing and the problem-solving ability. As a part of course, seminars are conducted to create awareness of the recent trends in the course research area.

==========
Note: This course description format comes into effect from Monsoon 2022.

SC2.401 Topics in Nanosciences 3-1-0-4

Name of the Faculy: Tapan K. Sau

Name of the Academic Program: CND

Title of the Course: Topics in Nanosciences

1. Prerequisite Course / Knowledge:
Science I/II
2. Course Outcomes (COs) :

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

CO-1. Define terminology used in the fields of nanoscience and nanotechnology.
CO-2. Explain the nanoscale confinement effects on various material properties.
CO-3. Discuss various methods of synthesis of nanoparticles.
CO-4. Identify the factors that need control for the preparation of stable and controlled sized and shaped nanoparticles.
CO-5. Explain the determination of the particle size and shape.
CO-6. Identify and formulate appropriate methods and experimental techniques that can be used to study various nanoscale materials and phenomena.
CO-7. Analyze the size- and shape-dependent physical/chemical properties of nanoparticles.
CO-8. Identify various applications of nanoparticles and their future potential.
CO-9. Describe the advantages and limitations of nanostructured materials.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															2
CO2	3															2
CO3	3															2
CO4		2														2
CO5	3															3
CO6			3													3
CO7	3															3
CO8				2												2
CO9	3															3

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1. Introduction to Nanoscience. (3L)
Nanomaterials: Definitions and Scopes.
Length Scales: Size Scales, Surface and Interface, Surface Energy, Coordination Numbers.
Classification of nanomaterials: Clusters and Magic Numbers, Nanoparticles, and Colloids. Metal, Semiconductor, and Bio Nanomaterials.

Unit 2. Properties of Nanomaterials. (9L)
Electrons in Nanostructures. Discrete states vs. band structure: Effects of dimensionality and symmetry in nanostructures. Metal-to-nonmetal transition.
Thermodynamics and Kinetics of Small-Sized Systems. Capillarity, Liquid droplets, Lotus effect. Self-assembly principles. Adsorption, Electrostatic and Steric Stabilization. Classical nucleation theory. Size and shape control in nanoparticle formation.

Magnetic (Super paramagnetism), *Electrical* (quantized conduction and Coulomb Staircase), *Optical* (size and shape effects), *Thermal* (melting and conduction), *Mechanical and Catalytic properties.*

Unit 3. Making Nanostructures. (3L)
Top-down and bottom-up methods.

Unit 4. Tools for Nanosystems. Microstructure/Chemistry/Defects and Structure. (5L)
AFM, SEM, TEM, XRD, SAXS, Nanoindentation.

Unit 5. Applications of Nanomaterials. (4L)
Catalysis, Band Gap Engineered Quantum Devices, Sensors, Field Effect Transistor (FET), Photoelectrochemical Cells, Photonic Crystals and Waveguides, Theragnostics (Magnetothermal Therapy), food and agriculture industries, automobile, textile, water treatment and civil applications, use in energy, space, and defense.

Unit 6. Concerns and Challenges of Nanotechnology. (2L)
Environmental, ecological and health hazards of nanoparticles. Nanotoxicology and its effect.

Reference Books:

1. S. M. Lindsay (2010), *Introduction to Nanoscience*, 1st Edition, Oxford University Press, New York.
2. E. Roduner (2006), *Nanoscopic Materials: Size-dependent Phenomena*, 1st Edition, RSC Publishing, Cambridge.
3. B. S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday (2013), *Textbook of Nanoscience Nanotechnology*, 1st Edition, Universities Press (India) Private Limited, Bangalore.
4. G.A. Ozin, A. C. Arsenault, and L. Cademartiri (2009), *Nanochemistry*, 2nd Edition, RSC Publishing, Cambridge.
5. M. Kohler and W. Fritzsche (2004), *Nanotechnology*, 1st Edition, Wiley-VCH, Weinheim.

5. Teaching-Learning Strategies in brief (4 to 5 sentences):
The course involves lectures, quizzes, laboratory demonstrations, assignments, and finding and reading relevant scientific literature.

If any changes in the assessment method, faculty will announce in the first class.

6. Assessment methods and weightages in brief (4 to 5 sentences):
The student assessment in the course involves written tests/quizzes/assignments to determine their learning proficiency in the course and their grades. Grading is done as follows:

1. Assignments	20%	
2. Quizzes (2*10)		20%
3. Mid-Term Exam	20%	
4. End-Semester Exam (whole syllabus)		40%

Cs9.438 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 emphasisto digital, boardand physical games.

COURSE TOPICS:
This course is designed to introduce the critical aspects of games design and development. Studentswillgo throughastructuredprocessinvolvingtheoryandpractical 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. Themaingoal is togetcreatepatentableideas. Thetheoryclasses willcover 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. Ingameplay,basics likegame engine(digital) andgamelogic models willalsocovered.Expertsfromindustrywillcoveranimationandcertaintopicsinm arketing.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 gameand actually solder, cut, fabricateandpaint….

Syllabus (theory classes)

1. What is agame?
- Games Overview - A Theory of Fun; History of Games.
- History of ComputerGames

2. What are the elements of a game?
In this part, we covertheelementsofagame, withemphasisonthefourmajorones. 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 GameDesign:
-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 theplayer?
- Game Genre andplayer
- Cutting through the noise from player (likes, dislikes...)

4. Whatisplayer'sexperience?
- measuring player's experience
- Cognitive behavior measurementtechniques

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 analyzeeachofthetechniqueandthevalueadditionofeach.Someexperimenta lworkwillbe requiredusing tools like simple EEG, ECG/GSR and eyetracking.

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

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

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

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

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

10. Marketing thegame

11. Ethics, Culture, Violence in Games and Responsibilities

PREFERRED TEXT BOOKS:

1. The Art of Game Design, JesseSchell, 2008.2.Challengesfor Game Designers, Brenda Brathwaite

***REFERENCE BOOKS:**

1. Characteristics of Games, Elias, Garfield, and Gutschera, 2012, MITPress
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 andprototypeaboard game that explains aconcept. This canbetrading, 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: whichcanhelp people exercisetheir lower back (a major issue with people who sit for long hours)? Materials for the virtual game caninclude Kinnectorjoysticks.Interfacesneedbeassembled.Forthelive-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.

If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2020)

Assignments	-	20%
Project	-	55%
Term Paper	-	15%
Quiz	-	10%

OUTCOME:

Atleastcoupleofdesignpatents. Selectedgamesideastotheannual GameDeveloper Conference, transfer/license and most importantly connecting theory to practice/realproduct

REMARKS:
Thecourserequiresalotlabtypeofwork.Consideringthatanimationexpertsanda

nimators are not available, some creativity is encouraged to create avatars, characters for the digital games and layouts for the physical games. Half of the classhours will be in a lab room or work space. This space will be kept open throughout the semesterforstudentsto workatanytime.

CS1.407 Entropy and Information 3-1-0-4

Faculty Name: Indranil Chakrabarthy

Note: Please use course code for previously

existing course TYPE-WHEN : Monsoon 2020
PRE-REQUISITE : The Basic Probability Theory

OBJECTIVE :

COURSE TOPICS :

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

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:**

If any changes in the Grading Plan, faculty will announce in the first class.

GRADING PLAN:

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

OUTCOME:

REMARKS:

HS3.303 Theories and Pratices of Nationalism 3-1-0-4

Faculty Name: AniketAlam

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 World*

Javeed Alam: *India- Living With Modernity*

Sumit Sarkar: *Modern India*.

Bipan Chandra: *India's Struggle for Independence*.

***REFERENCE BOOKS:**

M.K. Gandhi: *Hind Swaraj*.

I. D. Savarkar: *Hindutva*.

Rabindranath Tagore: *Nationalism*.

M. S. Golwalkar: *We or Our Nationhood Defined*. Jawaharlal Nehru: *Discovery of India*.

Bankim Chandra Chattopadhyay: *Anandamath.*

If any changes in the Grading Plan, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2020)

Assignments	-	40%
Term Paper	-	30%
Quiz	-	30%

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.