INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

Syllabus for UG Core Courses-Spring 2021

Ver.2-(24-12-2020)

Course Code	Course Name	Credits	Faculty name
CS1.302	Automata Theory (H2)	3-1-0-2	Srinathan K
SC2.203	Biomolecular Structures (H1)	3-1-0-2	Marimuthu Krishnan
EC5.203	Communication Theory	3-1-0-4	Sachin Chaudhari
CS2.201	Computer System Organization	3-1-0-4	Deepak Gangadharan
CS6.301	Design and Analysis of Software Systems	3-1-0-4	Ramesh Loganathan
CS7.303	Digital Signal Analysis (H2)	3-1-0-2	Anil Kumar V
EC2.203	Intro to Bio Electronics (H2)	3-1-0-2	Syed Azeemuddin + Prabhakar
HS8.102	Intro to Human Sciences	3-1-0-4	NimmiRangaswamy
EC6.202	Intro to Processor Architecture (H1)	3-1-0-2	Deepak Gangadharan
CS9.301	Introduction to Brain and Cognition (H1)	3-1-0-2	Bapi Raju S + Kavita Vemuri
EC5.205	Introduction to Coding Theory (H1)	3-1-0-2	Lalitha V
CS7.302	Introduction to NLP	3-1-0-4	Manish Shrivastava
CS9.302	Introduction to Quantum Information and Computation (H2)	3-1-0-2	Indranil Chakrabarty
CL1.204	Language Typology and Universals	3-1-0-4	Dipti M Sharma
CS7.301	Machine, Data and Learning	3-1-0-4	Praveen P
SC2.202	Organic Chemistry (H2)	3-1-0-2	Bhaswar Ghosh
HS0.302	Research Methods in Human Sciences	3-1-0-4	Aniket Alam
SC1.111	Science II	3-1-0-4	Nita Parekh + Marimuthu Krishnan
HS7.301	Science, Technology and Society	3-1-0-4	Radhika Krishnan
CS3.302	Software Programming for Performance (H2)	3-1-0-2	Deepak Gangadharan
SC1.205	Statistical Mechanics (H2)	3-1-0-2	Harjinder Singh
SC1.204	Thermodynamics (H1)	3-1-0-2	Harjinder Singh
OC3.102	Value Education II	0-2-0-2	Radhika M (Coordinator)
EC2.201	VLSI Design	3-1-0-4	Syed Azeemuddin + Abhishek Srivastava

CS1.302 **Automata Theory (H2)** **3-1-0-2**

Faculty Name : Srinathan K

Type and When : UG core-Spring 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, Non determinism, Regular Expressions, Equivalence and Minimization, Non regular language sand 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.

Text Book and References

Text Book

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.

Grading (tentative)

Event	Percentage
Quiz	20
Mid	30
Final	50

Readings, Home works and Tutorials

Reading assignments will be assigned for each class. Written home works 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.)

SC2.203 **Biomolecular Structures (H1)** **3-1-0-2**

Type-When : UG2&3-CND Core, Science Elective – Spring 2021

Faculty Name : Marimuthu Krishnan

Pre-requisite :

Objective : To understand the structure, dynamics and function of biomolecules

Course Topics :

- Hierarchy of length and time scales in biological systems and processes (**1 lecture**)
- Biological macromolecules: proteins, nucleic acids, lipids, carbohydrates (**2 lectures)** (The building blocks of these biomolecules and their chemical bonding and interactions will be discussed. Following topics will be covered in this module: different amino acids, their classification, dipeptides, conformations, different nucleotides, nucleobases)
- Structure and properties of biomolecules (**2 lectures**)

(Levels of protein structure: primary, secondary, tertiary and quaternary structures, Ramachandran plot, double helical structure of DNA, RNA structures, Experimental methods and techniques for analyzing structures and interactions NMR, ESR, XRay, CD, Fluorescence etc.)

- Interactions between biomolecules (**1 lecture**)

(covalent and non-covalent interactions, base pairing, hydrogen bonding, salt bridges, hydrophobic interactions, solvation, protein-ligand, protein-protein, protein-nucleic acid interactions)

- Thermodynamics of protein folding (entropic vs enthalpic factors), energy landscape,

structural stability and mutations (1 lecture)

- Introduction to enzymes, Enzyme catalysis, Enzyme kinetics, Michaelis-Menten equation (**1 lecture)**
- Biomolecular assemblies: biomembranes, chromatin, molecular motors, cellulose, riboswitches (**1 lecture**)
- Molecular modeling and docking: concepts and techniques (**2 lectures)**
- Biomolecular databases and tools: protein data bank, nucleic acid databases (**1 lecture**)
- Dry lab: Models, visualization, calculation of structural properties (**1 lecture**)
- Extra topics to be covered in tutorials and reading assignments: Properties and functions of carbohydrates, sugar, lipids, steroids, and cholesterol

Preferred textbooks:

1. Biochemistry - Lehninger
2. Biochemistry - Stryer
3. Biochemistry - Voet, Voet and Pratt

Grading Plan:

Class quizzes	10 %;
Quiz-I	10%;
Assignments	20%;
Reading project	10%;
Mid-I exam	15%;
Final exam	35%

EC5.203 **Communication Theory** **3-1-0-4**

TYPE-WHEN **:** **Spring 2021**

FACULTY NAME **:** **Sachin Chaudhari**

PRE-REQUISITE **:** **Signals and Systems, Probability Theory**

OBJECTIVE **:** This course is a core UG course of second year and serves as a pre-requisite to many communications related courses of ECE stream. The main objective of the course is to introduce the basic concepts of communication.

COURSE TOPICS:

Representation of band pass signals and systems ; linear band pass systems, response of band pass systems to bandpass signals, representation of band pass stationary stochastic processes Analog Communication Methods: AM-DSB and SSB, PM, FM-narrowband and wideband, demodulation of AM and PM/FM, Phased locked loop (PLL); Brief view of Line Coding and PWM 3.Digital Modulation: Representation of Digitally Modulated Signals; Memoryless modulation methods: PAM, PSK, QAM, Orthogonal Multi-Dimensional Signals Random Processes: Review of Correlation, ESP and PSD; Noise Modelling, Thermal Noise, AWGN. Performance of Analog methods in the presence of AWGN. Optimum digital demodulation: Hypothesis testing, Signal Space Concepts, Performance analysis of ML reception, Bit error probability, Link budget analysis

PREFERRED TEXTBOOKS:

U. Madhow: Introduction to Communication Systems

***REFERENCE BOOKS:**

J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, Pearson Education2006S. Haykin, M. Moher, “An Introduction to Analog and Digital Communications,” Wiley, 2006B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press, 2007.

CS2.201 **Computer System organization** **3-1-0-4**

TYPE-WHEN : Spring 2021

FACULTY NAME : Deepak Gangadharan

PRE-REQUISITE : Digital Systems and Microprocessors
OBJECTIVE : The objective of this course is to understand the structure andorganization of a computer system starting with Instruction Set Architecture abstraction and leading to the abstractions provided by an Operating System and their design.

COURSE TOPICS:

1. Von Neumann model of computing.
2. Machine representation of data
3. Instruction Set Architecture design principles from programmer's perspective.
4. Assembly Language Programmimg. Translation of high level language abstractions to assembly code and its relation to compilers.
5. Basics of Processor Design.
6. Introduction to Operating Systems. Bootstrapping Process.
7. System Call Interface provided by Operating System and its implementation.

8. Process Control and Management
9. Virtual Memory
10. Loaders and Linkers

PREFERRED TEXT BOOKS:
1. Computer Organization and Design: A Hardwar/Software Interface (MIPS Edition) by Patterson and Hennessy
2. Computer Systems: A Programmer's Perspective by Randal Bryant and David O'Hallaron
Note: I am debating on which of the above two books can be the primary textbook for the course. I will decide by mid-December after doing a proper study.

***REFERENCE BOOKS:** None

GRADING PLAN:

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

OUTCOME:
REMARKS:

CS6.301 **Design and Analysis of Software Systems** **3-1-0-4**

Faculty Name **:** Ramesh Loganathan

CS7.303 **Digital Signal Analysis (H2)** **3-1-0-2**

TYPE-WHEN **:** Breadth Elective/CLD Core – Spring-2021.

FACULTY NAME **:** Anil KumarVuppala

PRE-REQUISITE **:** Fundamental of Mathematics (Mathematics I and II).

OBJECTIVE **:**

Introduce the fundamentals of digital signal representation and processing to undergraduate students of CLD/CS/CSD.
Introduce the advantage of a transformed domainer presentation.
Introducing to basics of speech signal processing.
Introducing other signal processing applications.

COURSETOPICS:

Fourier series and transform. (3classes)
Sampling and quantization. (1class)
Different types of discrete signals and systems (LTI systems, linear and circular convolution) (3classes)
Z Transform (2classes)
Introduction to Digital Filter Design (2classes)
Applications. (2classes)

PREFERRED TEXTBOOKS:

Digital signal processing by Alan V. Oppen heim and Ronald W.Schafer.
Digital signal processing by John G. Proakis and Dimitris K Manolakis.

***REFERENCE BOOKS:**

Course Assessment Plan for Spring 2021

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

OUTCOME: Understand the basic concepts of signal processing and their applications.

REMARKS: This course help non-ECE background ground students to work on signal processing related research issues.

EC2.203 **Intro to Bio Electronics (H2)** **3-1-0-2**

TYPE WHEN : Elective-Spring 2021,

FACULTY NAME : Syed Azeemuddin and Prabhakar Bhimalapuram

PRE-REQUISITE : Interest in relevant chemistry, biology, and electronics

OBJECTIVE :

To appreciate the biochemical interactions relevant for bio sensing Understand the principles of commonly available biosensors

COURSE TOPICS :

Biology – Basic Chemical and Biochemical Concepts, Cells and their Basic Building Blocks, Basic Biophysical Concepts and Methods, Luminescence, Chemilumine scence, Fluorescence and Phosphorescence, Types of Spectroscopy, The Beer - Lambert Law, Impedance Spectroscopy, Electrochemical Principles and Electrode Reactions, Electrochemical Impedance Spectroscopy (EIS) Biosensors-Physical and Chemical Methods, Biosensor Parameters, Amperometric Biosensors, Potentiometric Biosensors, Ion Selective Electrodes, Conductometric and Im pedimetric Biosensors, Photometric Biosensors, Glucose Sensors, Bio compatibility of Implantable Sensors, Basic Sensor Instrumentation–Transducers, Sensors and Actuators, Conductometric Biosensors, FET Based Biosensors.

PREFERRED TEXTBOOK:

1.INTRODUCTORY BIO ELECTRONICS FOR ENGINEERS AND PHYSICAL SCIENTISTS Ronald Pethig and Stewart Smith,Wiley.

***REFERENCE BOOKS:**

Principles and Applications of RF/Microwave in Healthcare and Biosensing, Changzhi Li, Mohammad-Reza Tofighi, Dominique Schreurs, Tzyy-Sheng Horng, Academic Press
Essential Cell Biology by B. Alberts

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	25
Mid SemExam	N/A
Quiz-2	N/A
End Sem Exam	40
Assignments	20
Project	15 (Reading & Presentation)
Term Paper	N/A
OtherEvaluation_____	N/A

OUTCOME: Student can expect to develop understanding of biology, biomaterial and biosensing.
REMARKS:

HS 8.102 Intro to Human Sciences 3-1-0-4

TYPE-WHEN **:** Core, Spring 2021

FACULTY NAME **:** Aniket Alam (coordinator)

PRE-REQUISITE :

OBJECTIVE **:**

This course intends to introduce the student of technology and science to the world of the human sciences, or as they are often termed, the humanities and social sciences. It will consist of six modules which will give a brief overview of each discipline and illustrate how they have enriched our understanding of the world we live in his course will give the student a broad sense of what are the human sciences, how they pursue their enquiry and what is their contribution to the world of knowledge. It is designed to enable students who have not studied any social science or humanities subject get a broad understanding of the human sciences, and develop their interest in these disciplines.

COURSE TOPICS:

The course will be divided into six modules preceded by two introductory lectures. Each module will consist of four one and a half hour lectures focused on a particular discipline. These six modules will be: Philosophy -> History -> Sociology -> Politics -> Literature/Cultural Studies -> Psychology, in that order.

Each module will be taught by a subject specialist who will use the 4 classes (6 hours) to explain: What Do We Do When We Study Our Discipline?

Philosophy:

Lecture I: Introduce the notion of philosophizing as a ‘meta-inquiry’

Lecture II: Origins of Western philosophical tradition in Greek philosophy (focusing on Plato and Aristotle)

Lecture III: Conceptions of 'rationality', 'explanation', and their changes with the onset of enlightenment modernity

Lecture IV: Elaborating the two great opposing camps of thought into which philosophy comes to be divided in modernity, namely, Rationalism and Empiricism

History:

Lecture 1: The two broad approaches to studying History: Inductive and Deductive (which mirrors the Empricism – Rationalism distinction in Philosophy.

Lecture 2: The importance of Fact; how is it verified and corroborated, relation between fact and interpretation.

Lecture 3: Development of the discipline of history in India.

Lecture 4: The main features of India's history; how India's national movement imagined a nation out of an empire.

Sociology:

Lecture 1. Introduction to Sociological imagination, Social fact, Social Status, Social construction of reality

Lecture 2. Sociological concepts; Meta constructs - Urban, Rural, Institutions, Media; labour

Lecture 3. Study of Culture, Popular Culture forms

Lecture 4. Anthropology of Technology, Interface of Technology and Society

Politics:

Lecture 1: Definition of State, Citizen, Power.

Lecture 2: The three defining ideas of political theory – Liberty, Equality, Fraternity; the idea of the fundamental rights of human.

Lecture 3: Indian Constitution; (how the ideas of State, Citizen, Fundamental rights, and Liberty, Equality, Fraternity have been embodied in India's Constitution).

Lecture 4: Survey the politics of Independent India.

Literature/Cultural St:Lecture 1: What is Culture? Culture understood as human expressive and symbolic activities, and cultures understood as distinctive ways of life.

Lecture 2: Role of ideology, class, caste, race, ethnicity, gender, political affiliations in production of cultural artefacts

Lecture 3: English literature departments and the colonial project; regional literatures – their reach, circulation and afterlives.

Lecture 4: Pop Culture and Mass consumption – particularly cinema.

Psychology: The four classes of psychology will focus on role of culture, social norms, and group on shaping our perception, thinking, and action, as an individual as well as a social-cultural being.

Lectures 1 and 2: Focus on Psychology, Social Psychology, and Social Cognition

Lectures 3 and 4: Focus on how learning and development happens

PREFERRED TEXTBOOKS:

There is no single textbook for this course. Selections from textbooks and articles will be provided by each faculty teaching the different modules.

***REFERENCE BOOKS:** Same as above

GRADING PLAN:

Type of Evaluation	Weightage (in %)
End Sem Exam	**40%**
Term Papers (Each student will select three modules in each of which s/he will write a term paper)	**20% x 3**

OUTCOME:
The student should have an idea of what the human sciences are, how they originated in the same intellectual quest as other branches of knowledge but developed their own specific areas and ways of enquiry. S/he will have an understanding of how five of the most prominent of the human sciences are organized and have an overview of the main framing questions of each discipline. S/he should also be able to relate some of these framing questions to the context of India and the world he is living in.

REMARKS:
Each student will be expected to study three modules intensively and write 1,000 word term papers on a topic given by the teacher of those three modules. The form of this assignment and its submission will be decided by the module teacher.

EC6.202 Intro to Processor Architecture 3-1-0-2

Type When **:** Spring - 2021

Faculty Name : Deepak Gangadharan

Prerequisite **:** Digital Systems and Microcontrollers

Objective : Provide a whole stack view of a Computing System; Learn Processor Design fundamentals

Course Topics **:**

1. Instruction Set Architecture; Fetch-Decode - Execute model of computing
2. Fundamentals of Operating System: System Calls, Processes and Virtual Memory
3. Processor Design: Single Cycle and Pipelined Design of Processors

Preferred Textbooks: Computer Organization and Design: The Hardware/Software Interface by Hennesy and Patterson

Grading Plan (Tentative):

Type of Evaluation	Weightage (in %)
Quiz 1	**15%**
End Sem- Exam	**50%**

Assignments	**15%**
Project	**20%**

CS9.301 **Introduction to Brain and Cognition** **3-1-0-2**

TYPE-WHEN : Spring-2021

FACULTY NAME : Dr. S. Bapi Raju and Dr**.** Kavita Vemuri

PRE-REQUISITE:

OBJECTIVE:

This is an introductory course to familiarize students with the scope, challenges and recent research directions in Cognitive Science.

COURSE TOPICS:

Topics include the basics of brain anatomy, physiology, principles of cognition, empirical and computational methods used in Cognitive Science. There will be demonstrations of experiments, methods, and practices for empirical investigation of cognition utilizing instruments such as Eye Tracker, Motion Capture (MoCap), Physiological measurements using Bio Pac, EEG, MRI (structural and functional MRI), Music processing, VR and AR. Familiarity with the current research directions by doing rotations to different research teams in Cognitive Science Lab.

PREFERRED TEXTBOOKS: NA

Course Assessment Plan for Spring 2021

Assignments	-	30%
Quiz	-	35%
Open Book Exam/ 30 Min Quiz	-	35%

REFERENCE BOOKS:

EC5.205 **Intro to Coding Theory** **3-1-0-2**

TYPE-WHEN : Spring - 2021

FACULTY NAME : Lalitha Vadlamani

PRE-REQUISITE : **Linear Algebra**

OBJECTIVE : This course aims to introduce students to the idea that coding theory is a fundamental block of communications systems, whether in the form of real-time communication or in the form of storage. The course will be draw from applications of various current communication systems and storage systems and the error correcting codes used in those systems will be enunciated upon starting from the basics. The theory required in each will be concurrently covered to a limited extent.

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

- *Introductory Concepts*: Noisy channels, block codes, encoding and decoding, maximum-likelihood decoding, minimum-distance decoding, error detection and correction. Shannon's noisy-channel coding theorem.
- *Linear codes*: Minimum distance, generator and parity-check matrices, dual codes, standard array decoding, syndrome decoding. Repetition codes, Hamming codes.
- *Bounds on Code Parameters*: Hamming bound, Singleton bound, Gilbert-Varshamov bound, Plotkin bound.
- *Basic Finite Field Theory*: Definitions, prime fields, construction of prime power fields via irreducible polynomials, existence of primitive elements, minimal polynomials.
- *Algebraic Codes*: Bose-Choudhury-Hocquenghem (BCH) codes, Reed-Solomon codes. Applications of Reed-Solomon codes in digital communications and storage.
- ***Channel Codes in Communication Systems:*** **Cyclic Codes, Convolutional Codes, LDPC Codes**
- *State of the Art and the Future:* Codes for Data Storage Applications, Codes for Distributed Computation, DNA Data Storage

PREFERRED TEXTBOOKS:

Lectures will be based on the following reference books in addition to important technical papers.

- R. Roth, Introduction to Coding Theory, Cambridge University Press, 2007
- W.E. Ryan and S. Lin, Channel Codes: Classical and Modern, Cambridge University Press, 2009.
- S. Lin and D.J. Costello, Error Control Coding, Pearson, 2011
- R.E. Blahut, Algebraic Codes for Data Transmission, Cambridge University Press, 2003

***REFERENCE BOOKS:**

- F.J. MacWilliams and N.J.A. Sloane, The Theory of Error-Correcting Codes, North-Holland Publishing Company, 1977

- W.C. Huffman and V. Pless, Fundamentals of Error Correcting Codes, Cambridge University Press, 2003

***PROJECT:**There will be a paper implementation/presentation as part of this course, based on each student's capabilities and interests in theory/application. A list of plausible papers will be released mid way through the course, from which the students can select.

Course Assessment Plan for Spring 2021

Assignments	-	35%
Quiz	-	20%
Term Paper	-	20%
Open Book Exam/ 30 Min Quiz	-	20%
Class Participation	-	5%

OUTCOME: At the end of the course, the student is expected to appreciate how coding theory has been and will be instrumental in applications like storage and communications. The student should also be ready to read introductory papers on research topics related to coding theory.

REMARKS:

CS7.302 **Introduction to NLP** **3-1-0-4**

FACULTYNAME : Manish Shrivastava

CS9.302 **Introduction to Quantum Information and Computation** **3-1-0-2**

TYPE-WHEN **:** Spring 2021

FACULTY NAME **:** Dr. I. Chakrabarty

PRE-REQUISITE **:** Knowledge of Advanced Linear Algebra, Quantum Mechanics, Classical information Theory.

OBJECTIVE: Quantum information and computation science is an emerging field at the crossroads of physics, mathematics, computer science, and technology. It
promises to revolutionize our abilities to compute and communicate. The basic purpose of this course is to develop the basic foundations of the field of quantum information and computation among the graduate students so that they can pursue their research in this field and can put their contributions in the development of this future technology.

COURSE TOPICS:

Introduction and Overview: Transition from Classical to Quantum(2L)
Foundations of Quantum Theory I: States, Ensembles, Qubits, Pure and Mixed states, Multi-qubit states, Tensor Products, Unitary transformations, Spectral Decomposition theorem, Singular value Decomposition, Generalized Measurement, Projective Measurement, POVM(4L)
Quantum Entropy and Entanglement: Quantum Entropy, EPR Paradox,SchmidtDecomposition.(2L)
Basic Quantum Information Processing Protocols: Teleportation, SuperDense
Coding, Entanglement Swapping. (2L)
5 Quantum Computation: Introduction to quantum computing, Pauli Gates, Hadamard Gates, Universal Gates, Quantum algorithms. (2L)

PREFERRED TEXTBOOKS:

1. **Quantum Computation and Quantum Information –M. A. Nielsen, I. L. Chuang. Cambridge University Press.**

***REFERENCE BOOKS:**

1. Quantum Computer Science: An Introduction --- N. D. Mermin, Cambridge UniversityPress.
2. Quantum Computing: From Linear Algebra to Physical Realizations---M. Nakahara,T.
Ohmi, Taylor and Franchis Group.
3. Lectures on Quantum Information (Physics Textbook)---D. Brub, G. Leuchs,WILEYVCH.

***PROJECT:** Each student has to submit a project to be decided upon by the faculty concerned. They have to submit the project before the end of the semester 25% of the total grading will come from the project.

Course Assessment Plan for Spring 2021

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

OUT COME:

REMARKS:

CL 1.204 Language Typology and Universals 3-1-0-4

CREDITS : 4-3-0-0 (credits - hours per week - tutorials - lab sessions)

TYPE-WHEN : Spring Semester 2021 FACULTY

NAME : Dipti Misra Sharma

PRE-REQUISITE : Introduction to Linguistics **(1 and 2)**

OBJECTIVE : To give a general introduction to typology of languages with a special emphasis on common characteristics and differences among South Asian languages. Students will also be familiarized with the structural and generative approaches to study of language universals.

COURSE TOPICS :

1. Introduction (3 hours)
(a) What is meant by language universals?
(b) Approaches to the study of language universals, (i) database based (typological/structural) by Greenberg and (ii) based on degree of abstractness (generative) by Chomsky.
(c) Classification of language universals, (i) formal and substantive, (ii)absolute and statistical, (iii) implicational and non implicational.
(d) Explaining language universals, (i) common genetic origin, (ii) external explantations – language contact.

2. Universals and Language Typology (6 hours)
(a) Typological parameters
(b) Morphological typology

3. Word Order Typology (3 hours)
(a) Greenberg's word order typological generalizations

4. Syntactic Constructions (7.5 hours)
(a) Case marking
(b) Subject
(c) Causatives
(d) Relative Clause
(e) Animacy

5. Language typology and Historical linguistics (6 hours)
(a) Diachronic dimensions
(b) Areal typology: South Asian language area

(a) Common areal features. Experience subject, echo formation, reduplication, retroflexion, Nominative-Accusative and Ergative-Absolutive, Complement clause, conjunctive participle

PREFERRED TEXT BOOKS:

1. Comrie, Bernard. 1981. Language Universals and Linguistic Typology. Oxford : Basil Blackwell.
2. Subbarao K.V. 2012. South Asian Languages: A Syntactic Typology. Cambridge University Press.

Chapters 1,2,5,6 and 8.

***REFERENCE BOOKS**

1. Greenberg J.H. 1966. 'Some Universals of grammar with particular reference to the order of meaningful elements'. In Greenberg Joseph (ed.) Universals of Language. Cambridge, Mass: MIT press. Reprinted in Ian Roberts (ed.) Comparative Grammar. Vol 1. New York: Routledge (pp. 41-74).
2. Typology and Universals (2nd edition) by William Croft, Cambridge University Press
3. Emeneau, Murray (1956), "India as a Linguistic Area", Language 32 (1): 3–16

***PROJECT**

The Course will have a project component.

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Quizzes	20
Assignments	20
Term paper	
Project	25
Open book exam or 30 minute quiz	25
Other Evaluation____Seminar_____	10%

OUTCOME

The students will get introduced to the notion of 'language type' and how some languages cluster with similar linguistic properties.

REMARKS

CS 7.301 Machine, Data and Learning 3-1-0-4

TYPE-WHEN : Spring 2021

FACULTY NAME : Praveen Paruchuri

PRE-REQUISITE : None

OBJECTIVE : To provide breadth of knowledge in data and learning topics

COURSE TOPICS :

(please list the order in which they will be covered) Overview of AI and ML Data and generalization Overfitting, Underfitting, Bias-variance tradeoff Techniques to avoid overfitting [Introductory level] Decision Tree Learning, Construct decision trees from examples Notion of information gain Basics of Probability and Bayes nets Utility theory How to construct formal model from data? Decision Theory - Markov Decision Process Modeling observation errors Genetic Algorithms, Local Search Application modeling or two additional topics in brief.

PREFERRED TEXT BOOKS:

Python ML by Example
AI: A Modern Approach by Russell and Norvig

***REFERENCE BOOKS:**

Course Assessment Plan for Spring 2021

Assignments	-	40%
Project	-	15%
Flexi	-	15%
Quiz	-	30%

OUTCOME: Expected to provide basics for advanced AI and ML courses

REMARKS:

SC2.202 **Organic Chemistry** **3-1-0-2**

Faculty Name **:** Bhaswar Ghosh
TYPE-WHEN **: Core for CND 2nd year students Spring-2K19**
PRE-REQUISITE **: GSC**
OBJECTIVE **: Understand principles of organic chemistry**
COURSE TOPICS :

Concepts on structures, stabilities and reactivities

1. Reactive intermediates: Formation, structure, stability and fate of various reactive intermediates (Carbanion, carbocation, carbenes, nitrenes, benzynes, free radicals) – Reactive intermediates in biology and environment
2. Concepts of aromaticity
3. Molecular symmetry and chirality, Stereoisomerism, Classification of stereoisomerism, configuration, chiral centre, Axial chirality, planar chirality, helicity, Racemization and methods of optical resolution, Determination of configuration, Conformation of acyclic and monocyclic molecules-conformation and reactivity, Prochirality and prostereoisomerism, Stereochemistry of alkene, Chirality in molecules devoid of chiral centers, Chirooptical properties.

Some reactions and their mechanisms

4. Methods for determining structures and reaction mechanisms
5. Types of reactions and their mechanisms

- Radical substitution
- Electrophilic addition to alkenes and alkynes – stereochemical considerations – Markonikov rule
- Nucleophilic Substitution at saturated carbons (SN1, SN2 and SNi): Types, stereochemical considerations, Role of solvent
- Nucleophilic addition to the Carbonyl group
- Elimination reactions: Types (E1, E2 and E1cB) - stereochemical consideration, Role of solvent- Hofmann rules- Zaytsev Rules
- Nucleophilic substitution at the carbonyl group
- Electrophilic Aromatic Substitution: Benzene and its reaction with electrophiles- Effect of functional groups
- Nucleophilic Aromatic substitution: Diazonium compounds-benzyne mechanism
- Pericyclic reactions: Electrocyclic reactions, Cycloadditions, Sigmatropic rearrangements and Group transfer reactions
- Important name reactions involving rearrangements

Functional group wise reactions
Conversions and Identifications

PREFERRED TEXT BOOKS:

1. Michael B Smith, MARCH'S ADVANCED ORGANIC CHEMISTRY REACTIONS, MECHANISMS, AND STRUCTURE (7th Edition) Wiley (2013)
OR
M. B. Smith, J. March, Advanced Organic Chemistry: Reactions, Mechanisms and Structures, 6th Edition, Wiley Interscience, (2007)
2. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, Prentice Hall, (1992)
3. Todd_Teaching – OpenWetWare.pdf

REFERENCE BOOKS (For Projects/Term paper):

1. J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press, (2000)
2. P. Sykes, A Guidebook to Mechanism in Organic Chemistry, Addison-Wesley, (1996)
3. F. A. Carey, R. J. Sundberg Advnaced Organic Chemistry, 5th edition, Springer (2007)
4. E. L. Elilel, S. H. Wilen, L. N. Mander, Stereochemistry of Organic compounds (Wiley)

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz	**5%**
Assignments (4)	**30%**
End Sem Exam	**40%**
Project/Term Paper	**25%**

***For CND students only**

OUTCOME: Appreciation of major intricricies in Organic Chemistry reaction mechanisms.
REMARKS:

Code: **Research Methods in Human Sciences** **3-1-0-4**

TYPE-WHEN **:** 2nd Year, 2nd Semester
FACULTY NAME **:** Aniket Alam

PRE-REQUISITE **:** Thinking and Knowing in the Human Sciences 1 & 2, Classical Text Readings

OBJECTIVE **:** This course intends to explain how research is done in the Human Sciences. The tools of research, how to use them, to what effect, and with what limitations, are what this course intends to teach students. It will build on the earlier courses which taught distinct perspectives and theories within the Human Sciences, to now give them a sense of how these are embodied in actual research practice.

Rather than using the traditional qualitative – quantitative structure of research method courses, it will introduce the different types of sources that researchers draw on, and how these can be deployed to answer research questions. The course will also explain the various steps to writing and presenting research.

COURSE TOPICS **:** 1) What all does Research Methods encompass?
Explain the importance of research methods in making of a good research project. List and describe the different components of it. Introduction to Zotero (open-source reference management) and Tropy (open-source management tool for photographs of research materials).

2) Textual Sources of Research: Literary, Historical. The different categories of textual sources; how to read them in context; the distinction and similarity between literary and historical textual sources. The function of the archive and library.

3) Material Sources of Research: Artefacts, Built Environments, Nature; Pictures, Photographs, Audio sources of these. How to "read" material objects for information and evidence. Audio and Visual evidence as artefacts. Introduction to Omeka (open source CMS which allows publishing digital collections)

4) Human Sources of Research: Relationships, Social Processes, Emotions, Ideas, Visual, Oral. How to conduct ethnographic research; special emphasis on surveys and questionaires, participant observation, focus group, ethics of conducting research. Placing audio-visual material in context.

5) Data Sources of Research: Numbers; Turning textual, material and human sources into computational data. Importance of numbers and data; their limitations. The fraught relation between correlations and causation. The possibilities of using NLP tools and data analytic tools.

6) Placing Research in Space (and Time) GIS tools and their applications. Importance of space and time in building context of information/evidence. Introduction to QGIS (open source GIS application)

7) Common Errors in Research Cherry-Picking data; strong determinism; generalizing/theorizing on insufficient evidence; conceptual stretching; lack of originality, and/or following fashion; Straw-man.

8) Research Design and Presentation How to design a research project: identifying the research ap/debate, identifying methods/approach/theories, collecting evidence, analysis. Writing out the research: how to write abstract, literature review, citation and references, plagiarism, other components of writing.

PREFERRED TEXT BOOKS:

1. Anol Bhattacherjee (2012), Social Science Research: Principles, Methods, Practices, Textbook Collection 3. http://scholarcommons.usf.edu/oa_textbooks/3

2. Shawn Graham, et al (2015), Exploring Big Historical Data: The Historian's Macroscope, Imprerial College Press, http://www.themacroscope.org/2.0/

***REFERENCE BOOKS:**

1. Paul S. Gray, et al (2007), *The Research Imagination*, Cambridge University Press.

2. Peter J Carrington et al (ed) (2005), *Models and Methods in Social Network Analysis*, Cambridge University Press.

3. Mathew W Wilson, (2017), *New Lines: Critical GIS and the Trouble of the Map*, University of Minnesota Press.

4. Gabe Ignatow, Rada Mihalcea (2016), *Text Mining: A Guidebook for the Social Sciences*. Sage.

5. Andrew Piper (2020), *Can We Be Wrong? The Problem of Textual Evidence in a Time of Data*, Cambridge Elements – Digital Literary Studies, Cambridge University Press, https://www.cambridge.org/core/elements/can-we-be-wrong- the-problem-of-textual-evidence-in-a-time-of- data/86A68A9A055DE5815F29AAE66F2AFF9A

6. Johny Saldana (2016), *The Coding Manual for Qualitative Researchers*, Sage.

7. Bonita Aleaz, Partha Pratim Basu (eds) (2019), *Revisiting Qualitative Methods in Social Science Research*, Orient Blackswan.

8. Cliffford Geertz (1973), "Deep Play – notes on the Balinese Cockfight", Interpretation of Cultures: Selected Essays, Basic Books.

9. Clifford Geertz (1973), "Thick Description – towards an interpretive theory of culture", Interpretation of Cultures: Selected Essays, Basic Books.

10. Akhil Gupta, and James Ferguson (1997), "Discipline and Practice: 'The Field' as Site", Method, and Location in Anthropology", In Anthropological Locations: Boundaries and Grounds of a Field Science. A. Gupta, J. Ferguson, eds. Berkeley: University of California Press. Pp 1-46.

11. Carl E. Pletsch (1981) "The Three Worlds, or the Division of Social Scientific Labor, Circa 1950-1975", Comparative Studies in Society and History, 23(4), pp. 565-590.

12. D. D. Kosambi (1956), Introduction to the Study of Indian History, "Chapter 1: Scope and Methods", Popular Prakashan.

13. Carlo Ginzberg (2002), Wooden Eyes: Nine Reflections on Distance, Verso. (Chapter 1: Making it Strange – Prehistory of a Literary Device; Chapter II: Myth – Distance and Deceit; Chapter III: Representation – The World, The Idea, The Thing)

14. Jean-Claude Carriere, Umberto Eco (2012), *This is not the end of the book;* Vintage Books

15. James Hoopes (1979), *Oral History: An Introduction for Students*, University of North Carolina Press.

16. David L. Ransel (2010), "The Ability to Recognise a Good Source", *Perspectives on History*. https://www.historians.org/publications-and- directories/perspectives-on-history/october-2010/the-ability-to- recognize-a-good-source

17. Lynn Hunt (2010), "How Writing Leads to Thinking", *Perspectives on History*. https://www.historians.org/publications-and- directories/perspectives-on-history/february-2010/how-writing- leads-to-thinking

18. Giovanni Sartori (1970), "Concept Misinformation in Comparative Politics", *American Political Science Review*.

19. Stephen Kern (2004), *Cultural History of Causality : science, murder novels, and systems of thought*, Princeton University Press

20. Arthur Conon Doyle (1892), Sherlock Holmes – Silver Blaze.

21. Arthur Conon Doyle (1887), Sherlock Holmes – A Study in Scarlet.

***PROJECT:** **None**

Course Assessment Plan for Spring 2021

Assignments	-	90%
Quiz	-	10%

OUTCOME: The student will have a comprehensive, cross-disciplinary understanding of research methods, their relative strengths and limitations, and how to adapt them for the problem at hand. The student will be able to formulate a research question. S/he will become aware of the writing protocols of academic research and be able to write research articles and thesis. Each student will be able to make an informed assessment about their research goals and be ready for more discipline specific, detailed research methods which will be part of the semester long research projects from the fifth semester onwards.

REMARKS: The course will involve lectures as well as workshop mode engagements. Students will be expected to actively participate and contribute.

SC1.111 **Science II** **3-1-0-4**

TYPE WHEN **:** Spring 2021.

FACULTY NAME **:** Subhadip Mitra and Nita Parekh

PRE-REQUISITE :

OBJECTIVE :

COURSE TOPICS :

First Half: Electromagnetism

1. The mathematical background: Vector calculus, coordinates and Dirac delta function
2. Electrostatics : Coulomb's law, electric field, Gauss's law, electric potential, electro static energy, conductors, electric fields in matter: polarization, bound charges, dielectrics
3. Magneto statics: Lorentz force law, Bio-Savart law, Ampère's law, vector potential, mag-netic fields in matter: dia-/para-/ferro-magnets, bound currents
4. Electromotive force, Faraday'slaw
5. Maxwell's equations and electromagnetic waves

Second Half: Introduction to Biology

I Introduction
- Classification of Living Organisms
- Origin of Life and Evolution
- Bio molecules – Nucleotides, Amino Acids, Proteins, Enzymes

II Cell Biology
- Structure and Function - Prokaryotic and Eukaryotic Cells
- Cell Cycle – Cell division – Mitosis, Meiosis
- DNA Replication, Transition, Translation – Central dogma
- DNA amplification, sequencing, cloning, restriction enzymes

III Genetics

- Mendelian Genetics – Genetic Disorders
- Mendelian Inheritance Principles
- Non-Mendelian Inheritance
- Clinical Perspective

IV Macromolecules
- DNA, Proteins – Structure, Function, Analysis – alignment, database search, phylogeny
- Carbohydrates – Features, Structure, Metabolism, Kreb cycle

V Biological dataanalysis
- Biological Data – sequence, structure, expression,etc.
- Sequence Data Analysis •Applications

PREFERRED TEXT BOOKS:

Electromagnetism:

1. Introduction to Electrodynamics by David J Griffiths

Introduction to Biology:

1. Essential Cell Biology by Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Roberts, Walter

REMARKS:

HS7.301 Science, Technology and Society 3-1-0-4

TYPE-WHEN **:** Spring 2021

FACULTY NAME **:** Radhika Krishnan

PRE-REQUISITE : Thinking and Knowing in the Human Sciences I and II**.**

OBJECTIVE **:**

This course is designed as an introduction to the discipline of Science and Technology Studies (STS). This is a core course for CHD students, and introduces them to the various ways looking at the science-technology-society interface. It will expose students to questions that have driven STS, as well as the field's major themes, methods, theories and scholars to provide the intellectual foundation for engaging in current debates around science and technology.

COURSE TOPICS :
(please list the order in which they will be covered)
(1) Structure and functioning of the scientific community (rules, norms, values)
(2) Social construction of scientific knowledge (controversies and the problem of replication, science as a negotiated process, role of interests)
(3) Technological Visions (Jacques Ellul, Lewis Mumford)
(4) Debates around social construction and technological determinism (Michael Callon, Trevor Pinch, Wiebe Bijker, David Noble, Thomas Hughes, Langdon Winner, Robert Heilbroner, David Harvey, Nathan Rosenberg).
(5) Digital Technologies in society

The course will begin with a brief introduction to the philosophy of science, and the 'nature' of scientific enquiry and its founding principles. With this background, the course will introduce the idea of social construction of science. To do so, it will look the process of constructing scientific facts by introducing students to the Strong Programme, Sociology of Scientific Knowledge, andthe Empirical Programme of Relativism.

The course will then proceed to discuss the various theories in STS which attempt to understand the relationship between technology, society, politics and power(how technology shapes and in turn shaped by social, economic, political and cultural factors). It will cover various theories and methods under the broad rubric of the social construction of technology. Students will be encouraged to identify values embedded in technical systems, and human and non-human agency. Students will be exposed to important theorists of technology, including Michael Callon, Bruno Latour, Langdon Winner, Nathan Rosenberg, Thomas Hughes.

PREFERRED TEXT BOOKS:
Harry M Collins and Trevor Pinch, *The Golem: What You Should Know About Science* (Cambridge: Cambridge University Press, 1998 [2nd edition]).

Langdon Winner, *Autonomous Technology: Technics-out-of-control as a Theme in Political Thought* (Cambridge, Massachusetts and London: MIT Press, 1978).

Wiebe Bijker and Trevor Pinch, *The Social Construction of Technological Systems* (Cambridge, Massachusetts and London: MIT Press, 2012).

***REFERENCE BOOKS:**
Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network Theory* (London: Oxford University Press, 2005).

David F. Noble: *Forces of Production: A Social History of Industrial Automation* (London: Oxford University Press: 1986).

David Harvey, *A Companion to Marx's Capital* (London: Verso, 2010).

Evgeny Morozov,*The Net Delusion: The Dark Side of Internet Freedom* (New York: PublicAffairs, 2012).

Jacques Ellul, *The Technological Society* (London: Vintage Books, 1954).

Lewis Mumford, *Myth of the Machine: Technics and Human Development* (London: Harcourt Brace Jovanovich, 1967).

Lewis Mumford, *Pentagon of Power* (London: Harcourt Brace Jovanovich, 1970).

Lewis Mumford, *Technics and Civilization* (London: Routledge, 1934).

Manuel Castells, *The Rise of Network Society* (London: Wiley, 2009).

Merritt Roe Smith and Leo Marx (eds.),*Does Technology Drive History: The Dilemma of Technological Determinism* (Cambridge, Massachusetts and London: MIT Press, 1994).

Nathan Rosenberg, *Inside the Black Box: Technology and Economics* (Cambridge: Cambridge University Press, 2010).

Robert Merton, *The Sociology of Science* (London: The University of Chicago Press, 1973).

Thomas Kuhn, *The Structure of Scientific Revolutions- 50th Anniversary Edition* (Chicago: University of Chicago Press, 1999).

Sergio Sismondi, *An Introduction to Science and Technology Studies* (Sussex: Wiley –Blackwell, 2009).

Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (New York: Hachette Book Group, 2018).

Nick Couldry and Ulises A Mejias, *The Costs of Connection: How Data is Colonizing Human Life and Appropriating it for Capitalism* (California, Stanford University Press, 2019).

Note: More books will be announced in class, depending on the project chosen by the student.

***PROJECT:**
This course involves 2 projects. The first one will deal with sociology of science, and the second one will involve studying digital technologies using theories and methods in STS.

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Quizzes	**0%**
Assignments	**4 Assignments (4 * 12.5%)**
Term paper	**0%**
Project	**2 projects (2 x 25%)**
Open book exam or 30 minute quiz	**0%**
Other Evaluation _____	**0%**

OUTCOME: This course is designed as an introduction to science and technology studies. It is meant to introduce CHD students to the tools, methods and theories that will help them analyse the technology-science interface. There are two broad expected outcomes from this course:

A) Students, through 2 projects conducted during a 1.5month long duration each will learn to apply the methods they are introduced to. The idea is to bring together theory and practice. These projects will be presented in class by each student.

B) The course is meant to help CHD students decide their future research focus. They will get a sense of the 'field', and will be able to think more deeply about confluence between the social sciences and the computing on which the CHD programme is based.

REMARKS : This course will give students an hands-on experience of analyzing technology and its interaction with society. It is hoped that the course will lay a strong research foundation on which future research can be, and will be built.

CS3.302 **Software Programming for performance** **3-1-0-2**

TYPE-WHEN **:** **Spring-2021**

FACULTYNAME **:** Deepak Gangadharan

PRE-REQUISITE **:** Basics of Algorithm Analysis, Computer Architecture

OBJECTIVE **:** Motivate the student understanding towards performance engineering of large software systems

COURSETOPICS **:**

1. Optimizing a program using Compiler Optimization options
2. Memory Hierarchy (Cache, DRAM, Disk) aware Optimizations
3. Roof Line Analysis to identify performance bottlenecks and identify optimization opportunities
4. Using performance counters and other profiling tools to identify hotspots and bottle necks
5. Using SIMD units on a sequential core
6. Programming Multi-cores [Use Open MP]
7. Accelerating Software Systems using Hardware Accelerators (GPU,FPGA)
8. Programming GPUs [Basic Intro, Use Open CL/Open ACC/...]

PREFERRED TEXT BOOKS:
No Text book as such, but the material would be taken from different books like:
1. Cormen, Thomas H., et al. *Introduction to algorithms*.
2. Hennessy, John L., and David A. Patterson. *Computer architecture: a quantitative approach*.
3. GCC Manual:https://gcc.gnu.org/onlinedocs/gcc/index.html

***REFERENCE BOOKS:**

***PROJECT:**

1. One final project towards optimizing a large software system

Course Assessment Plan for Spring 2021

Assignments	-	50%
Quiz	-	50%

OUT COME:
REMARKS:

SC1.205 **Statistical Mechanics (H2)** **3-1-0-2**

TYPE-WHEN : Spring - 2021

FACULTY NAME **:** Harjinder Singh

PRE-REQUISITE **:** Thermodynamics

OBJECTIVE **: Fundamentals of Statistical Thermodynamics**
COURSE TOPICS **: (1L: 90 mins)**

1. The purpose of statistics: Bridging the micro and the macro, random walk, binomial distribution and the Gaussian limit: 1L
2. Ensemble, micro-canonical, canonical and grand canonical; Partition function, Lagrange multiplier technique to obtain the Boltzmann distribution: 2L
3. Statistical expressions for thermodynamic functions for monatomic, diatomic and polyatomic perfect gases, equilibrium constant using partition function: 2L
4. Classical statistical mechanics, Liouville equation, Equipartition of energy: 1L
5. Identical particles, Quantum statistics - Fermi-Dirac and Bose-Einstein statistics: 2L
5. Special topics (Real gases, Liquids, Lattice dynamics, Ising spins, etc.): 3L
Additional work required for MS/PhD students: term paper

PREFERRED TEXT BOOKS:

1) Physical Chemistry, by P. W. Atkins.
2) Statistical Thermodynamics (or Statistical Mecahnics) by D. A. McQuarrie
3) Fundamentals of Statistical and thermal Physics, by F Reif (Berkeley Physics, vol. 5)
*REFERENCE BOOKS: (1) 10 copies; (2) 5 copies; (3) 4 copies

Course Assessment Plan (Spring 2021)

Quiz	- 20%
Assignments	- 40%
End Exam	- 40%

*for MS/PhD students only

OUTCOME: Expertise in statistical thermodynamics
REMARKS: -

SC1.204 Thermodynamics 3-1-0-2

TYPE-WHEN : Spring - 2021

FACULTYNAME : Harjinder Singh

PRE-REQUISITE : None

OBJECTIVE **:** Fundamentals of Thermodynamics

COURSETOPICS : (1L: 90mins)

1. Thermodynamic space, system and surroundings, variable, function, Thermodynamic process and energy transaction: Work, Heat; Walls: Dia thermal, Adiabatic, (im) permeable1L
2. Properties of Gases: Perfect and real :1L
3. Zeroth law and temperature, first law and internal energy, enthalpy, thermo chemistry, Hess's law :1L
4. Expansion Work, Isothermal and Adiabatic Changes, Heat capacity:1L

5. Second law and equivalence of different ways of stating it, Clausius in equality. The Joule-Thomson Effect, Entropy, Heat Engine, Refrigerator, Carnot Cycle :2L

6. Helmholtz And Gibbs Free Energies, thermodynamic equation of state, criteria for spontaneity, chemical potential, variation with temperature and pressure, Maxwell relations:2L

7. Fugacity and activity:1L

8. Thermodynamics of mixing, Phase Diagrams and Phase Transitions :2L

9. Chemical equilibrium, Equilibrium constant and standard free energy:1L Additional work required for MS/PhD students: term paper

PREFERRED TEXT BOOKS:

1) Physical Chemistry, by P. W.Atkins.
2) Physical chemistry: a molecular approach by Donald Allan Mc Quarrie and John Douglas Simon.
3) Physical Chemistry, by G. W. Castellan.
4) Heat and Thermodynamics by M W Zemansky and R H Dittmna

***REFERENCE BOOKS: (1) 10 copies; (2) 4 copies; (3) 1 copy; (4) 1 copy**

Course Assessment Plan (Spring 2021)

Quiz	- 20%
Assignments	- 40%
End Exam	- 40%

***for MS/PhD students only**

OUTCOME:
Remarks:

OC3.102 **ValueEducation-II** **0-2-0-2**

TYPE WHEN : SPRING 2021.

Faculty Name : Dipti Mishra Sharma (Coordinator)

Objective: The course is aimed at furthering the understanding of human values gained in HumanValues-1course; and putting it in to action at the level of self and local organization. It will help in developing correct perception of human life and human happiness; further in understanding of framework of universal human values; practical methods for inculcating values; applying them to self and to local organization.

Course Topics: The classes in the course will run asaseries of discussions in small groups as well as activities. It is expected there would be activities and discussion so alternate weeks. Some topics covered in the earlier Human Values course which will be continued for discussion are given below.

Relationships:

1.Applying concepts to relationships with friends, with teachers, with family members, with others.
2. Activity: Applying the above to deal with conflict situations with friends etc.
Respect –do you respect yourself? Do you respect others?
3.Inner self as a source of our strength. Is yourself-respect dependent on the other? Confidence and initiative. Keyto happiness. Activity: Apply it in the context of Felicity (IIIT cultural festival).
4. Role of values in Society. Following rules and norms.
Social behavior. Legality versus morality
5.I and Nature: How to build mutually enriching relationship with nature? Activity: Tree plantation and caring for the tree. How to conserve?

Activity: Further sensitization of right utilization of physical facilities, i.e., water, electricity, food, labs., internet, personal items. Applying it to self as well as local organization level.

There would be no formal lectures in the course. For the above topics, scenarios would be created, and used to initiate discussion. Activities, as mentioned above, would pertain to applying Jeevan Vidya in day today life, dealing with relationships, handling conflicts; to nature, tree plantation and nourishing the planted tree, cleaning the campus, cultural programme depicting values; managing them essoro there hostel affairs.

Course Assessment Plan for Spring 2021

Assignments	-	40%
Term Paper	-	20%
Classroom reflections and participation	-	40%

Outcome: At the end of the course, students are expected to start applying the ideas learnt from the course to their own life, and to local organization around them.

Remarks:

EC2.201 VLSI DESIGN 3-1-0-4

TYPE-WHEN **:** Spring 2021
FACULTY NAME **:** Abhishek Srivastava and Syed Azeemuddin
PRE-REQUISITE **:** Digital electronics, Linear Electronic Circuits, Network theory
OBJECTIVE **:** To introduce VLSI design to students and expose them to SPICE and HDL

COURSE TOPICS :

Introduction to VLSI design: 1) Introduction to VLSI design (top-bottom approach) - flow, applica- tions, technologies, 2) MOSFET, FinFET transistors – Geometry and model, 3) Introduction to basic building blocks - SPICE, HDL, layout, 4) Moore's law, technology scaling, current trends (5)

CMOS Inverter: 1) Static characteristics- VTC, switching threshold, Noise margin, 2) Dynamic char- acteristics – rise time, fall time, delay, power, 3) Why CMOS Inverter, 4) CMOS inverter design flow- problem of achieving higher speeds (solution/technique discussed in the following unit), 5) From in- verters to other logic - pull-up, pull-down networks, tristate inverter, Gates, Mux, Latches, Flip-flops, set-up hold time, clocked CMOS and true single phase clocked (TSPC) latches (7)

Multistage Logic Design and Optimization: 1) Parasitics in layout causing performance degradation – field transistor, active MOS, gate-drain overlap, latch-up, 2) Method of logical effort- fan-out, Stage effort, electrical effort, device sizing, design examples **(5)**

Other Logic Styles: Pseudo nMOS, pass transistor logic, Cascode Voltage Switch Logic (CVSL), Dynamic logic **(3)**

Introduction to System Design using HDL: Finite state machines – Mealy, Moore, Intro to RTL, Data path, Control unit, combinational and sequential circuit design examples **(6)**

Tutorials:

1. SPICE – NGSPICE (open source)
2. Verilog HDL – Xilinx ISE or ICARUS (open source)
3. Layout – Magic (open source)

PREFERRED TEXTBOOKS:

1. Neil H. E. Weste, K. Eshraghian, "Principles of CMOS VLSI Design- A Systems Perspective", 2nd

Edition, Pearson Education Pvt. Ltd.

2. J. M. Rabaey, A. Chandrakasan, B. Nikolic, “Digital Integrated Circuits - A Design Perspec- tive”, 2nd Edition, Prentice Hall of India.
3. Stephen Brown and Z. Vranesic, “Fundamentals of Digital Logic with Verilog Design”, Tata McGraw-Hill Edition 2002.
4. Samir Palnitkar, “Verilog HDL – A Guide to Digital Design and Synthesis”, Second edition, Pearson, 2003.
5. J. Bhaskar, “Verilog HDL Synthesis- A Practical Primer”, Star Galaxy Pub; 1st edition, 2001.

Course Assessment Plan for Spring 2021

Assignments	-	30%
Project	-	30%
Quiz	-	40%

Sd/ Dean (Academics)