INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

Ver.1-(12-12-2020)

Elective Courses Syllabus – Spring 2021

Code	Course Name	Credits	Faculty
	Adv. Algorithms	3-1-0-4	Kishore Kothapalli
	Advanced Bioinformatics	3-1-0-4	Nita Parekh
	Advanced Optimization: Theory and Applications	3-1-0-4	Pawan Kumar
	Advanced Structural Analysis	3-1-0-4	Pravin Kumar Venkat Rao + Venkateshwarlu M
ECE551	Advances in Robotics & Control	3-1-0-4	Spandan Roy
HS3.301	Alternate Religious Traditions in Indian History	3-1-0-4	Nilam Kakati + Aniket Alam
	Applied Electromagnetics	3-1-0-4	K R Sarma
	Behavioral Research: Statistical Methods	3-1-0-4	Bapi Raju S + Vinoo Alluri
CSE586	Cognitive Neuroscience	3-1-0-4	Kavita Vemuri
HSS337	Comprehension of Indian Music	3-1-0-4	TK Saroja
CSE578	Computer Vision	3-1-0-4	Anoop Namboodiri
	Computer Networks (H1)	3-1-0-2	Shatrunjay Rawat
CSE441	Database Systems	3-1-0-4	Krishna Reddy
CS7.601	Deep Learning: Theory and Practices **(Max:80)**	3-1-0-4	Naresh Manwani
CEW612	Design of Hydraulic Structures	3-1-0-4	Shaik Rehana
	Design Verification and System Verilog	3-1-0-4	Ganesh Bhuthekar
IMA303	Differential Equations	3-1-0-4	Lakshmi Burra
ECE463	Digital VLSI Design	3-1-0-4	Zia Abbas
CES442	Disaster Management	3-1-0-4	Sunitha P
ICS541	Distributed Data Systems	3-1-1-4	Kamal Karlapalem
CSE431	Distributed Systems (Max:100) Prerequisite: Operating Systems. Networks desirable	3-1-0-4	Lini Thomas
CES641	Earthquake Engineering	3-1-0-4	Pradeep Kumar R
HSS317	Ethics	3-1-0-4	Don Dcruz
ECE562	Flexible Electronics	3-1-0-4	Aftab Hussain
CEG422	Green Buildings	3-1-0-4	Vishal Garg
CEG462	Hydro Informatics **(40)**	3-1-0-4	Shaik Rehana
CSE595	ICTs for Development	3-1-0-4	Nimmi Rangaswamy
CSE581	Information Security Audit and Assurance	3-1-0-4	Shatrunjay Rawat
CSE563	Internals of Application Servers	3-1-0-4	Ramesh Loganathan
	Intro to UAV Design	3-1-0-4	Harikumar Kandath
EC5.205	Introduction to Coding Theory	3-1-0-2	Lalitha V

CSE498	Introduction to Game Theory	3-1-0-4	Sujit Gujar
	Introduction to Particle Physics	3-1-0-4	Subhadip Mitra
	Introduction to Philosophy of Technology	3-1-0-4	Ashwin Jayanthi
	Linear partial differential equations and variational calculus	3-1-0-4	Samyadeb Bhattacharya
CLG452	Linguistic Data 2: Collection & Modeling	3-1-0-4	Parameswari Krishnamurthy, HCU
HSS445	Literature –American Classics	3-1-0-4	Aruna Chaluvadi
	Literature, History and Belonging in Hyderabad	3-1-0-4	Nazia Akhter
SCI477	Machine Learning for Natural Sciences **(10)**	3-1-0-4	Nita Parekh + Girish Varma + Prabhakar B
	Machine Learning for Wireless Communications	3-1-0-4	Ubaidulla
	Medical Image Analysis	3-1-0-4	Jayanthi Sivaswamy
	Molecular Modeling and Simulations (20)	3-1-0-4	Deva Priyakumar
IMA409	Multivariate Analysis	3-1-0-4	Venkateshwarlu M
CSE588	Music, Mind, and Technology **(30)**	3-1-0-4	Vinoo Alluri
	Nonlinear Dynamics	3-1-0-4	Vinod PK
CSE481	Optimization Methods	3-1-0-4	Jawahar CV
SC2.301	Physics of Soft Condensed Matter **(40)**	3-1-0-4	Marimuthu Krishnan
	Readings in Indian Literatures	3-1-0-4	Sushmita Banerjee
CEG461	Remote Sensing **(40)**	3-1-0-4	RC Prasad
	Robotics: Planning and Navigation	3-1-0-4	Madhava Krishna K
	Science, Technology and Society **(15)**	3-1-0-4	Radhika Krishnan
ECE431	Signal Detection and Estimation Theory	3-1-0-4	Praful Mankar
CS4.501	Social Computing	3-1-0-4	Vasudeva Varma
CSE461	Software Engineering	3-1-0-4	Raghu Reddy
CES617	Stability of Structures	3-1-0-4	Sunitha P
CSE471	Statistical Methods in AI	3-1-0-4	Vineet Gandhi
CSE538	System and Network Security	3-1-0-4	Ashok Kumar Das
ECE442	Time Frequency Analysis	3-1-0-4	Anil Kumar V
ECE537	Topics in Coding Theory	3-1-0-4	Prasad Krishnan
SCI761	Topics in Nanosciences **(25)**	3-1-0-4	Tapan Kumar Sau
CSE567	Usability Engineering	3-1-0-4	Priyanka Srivastava

Adv. Algorithms 3-1-0-4

Type When: Spring 2021

Faculty Name: Kishore Kothapalli

Pre-requisite: Should have taken Introduction to Algorithms or equivalent with a grade of at least B-, or Pass.

Objective:

The course is aimed at undergraduates and graduates who have done a first course in algorithms and a first course in formal languages. This course is intended to build up further on the algorithmic themes. The course can be visualized as a three-module offering with each module focussing on a different area of advanced algorithms from: Computational Geometry algorithms, Parallel and distributed algorithms, Randomized algorithms, Approximation algorithms, online algorithms, streaming algorithms, algorithms for big data, and the like. While it is infeasible to cover aspects of all these topics in depth, the recommended actionapp is to pick three of these topics and do them in sufficient depth. The particular examples to pick from the chosen topics may be chosen as broad-based as possible so that they have applications to other domains of advanced algorithms. In other words, the recommendation is to focus on fundamental ideas in advanced algorithms so that students will be able to apply these ideas to other domains.

As an example, when we choose parallel algorithms, randomized algorithms, and distributed algorithms, the three modules can be developed as follows: In the case of parallel algorithms, focus will be on algorithm design and problem solving using the PRAM model. Classical PRAM algorithm design techniques such as binary tree-based computations, accelerated cascading, divide, and conquer will be covered. Also included in the coverage are PRAM algorithms for lists, trees, and graphs.

Basic concepts in randomized algorithms including tail inequalities, independence, universal hashing, approximate counting, randomized rounding, and the like can be included in this module. The module on distributed algorithms can include topics from MIS, MDS, symmetry breaking, distributed graph algorithms, models such as LOCAL, CONGEST, MPC, and the like with applications to graph algorithms can be included.

A typical syllabus can be the following.

Syllabus:

- Module 1: Randomness in computing
    - Tail inequalities and applications, fingerprinting, proofs using randomization, randomized rounding, approximate counting,
- Module 2: Parallelism in computing
    - Models of PRAM, Basic algorithms for prefix, search, sort, merge, symmetry breaking
- Module 3: Advanced topics

Grading policy:

Left to the instructor. Emphasize on small in-class quizzes to improve understanding.

Learning Outcomes:

At the end of the course, a student shall be able to understand the implications of algorithm design and analysis to problems in various domains.

Textbooks:

• Introduction to Parallel Algorithms, J. JaJa.

• Randomized Algorithms, by R. Motwani and P. Raghavan.

• Distributed Algorithms, Gerard Tel.

Most times, these books are in limited supply, especially the first one. It is therefore recommended that students need not own a copy. Lecture material should be provided and lectures should be self-contained.

Advanced Bioinformatics **3-1-0-4**

TYPE-WHEN **:** Bouquet Course - MTech (Bioinformatics), Elective - CND

FACULTY NAME **:** Nita Parekh

PRE-REQUISITE **:** Introduction to Bioinformatics

OBJECTIVE **:** Algorithms used in genomics and proteomics

COURSE TOPICS **:**

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

Lecture Plan Week-wise:

Week – 1: Gene Prediction

Week – 2 & 3: Modeling Molecular Evolution - Phylogeny

Week – 4: Markov Models

Week – 5-6: Genome Variation Analysis

Week – 6: Clustering Algorithms - Microarray data analysis

Week – 7-8: Secondary Structure Prediction of Proteins

Week – 9-10: Protein Structure Prediction

Week – 12 & 13: Comparative Genomics and Computational Proteomics

PREFERRED TEXT BOOKS:

1. Bioinformatics Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press, 2001.

***REFERENCE BOOKS:**

2. Biological Sequence Analysis, Probabilistic Models of Proteins and Nucleic Acids, Richard Durbin, Sean R. Eddy, Anders Keoghs and G. Mitchison, Cambridge University Press 1998.

3. Computational Methods in Molecular Biology, S.I. Salzberg, D.B. Searls, and S. Kasif, editors, Elsevier,

1998.

4. Computational Genome Analysis – An Introduction, Richard C. Deonier, Simon Tavae and Michael S.

Waterman, Springer 2005.

***PROJECT: -**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	20
Mid Sem-2 Exam	20
End Sem Exam	45
Assignments	15
Project	-
Term Paper	-
Other Evaluation _____	-

OUTCOME: At the end of the course the students would have a good idea about the computational approaches in biological data analysis and also learn to implement some of these. The students will also be familiar with various resources (tools & databases) available and how to use them judiciously.

REMARKS:

Advanced Optimization: Theory and Applications 3-1-0-4

Course Code :

Note: Please use course code for previously existing course

CREDITS : 3-1-0-4
TYPE-WHEN : Spring

FACULTY NAME : Pawan Kumar

PREREQUISITE: Linear Algebra, Probability and statistics, Analysis, TAO (desirable)

OBJECTIVE: Develop problem solving skills by modelling a problem as an optimization problem, analyze the problem, and develop robust and scalable solvers.

COURSE TOPICS :

1. **Convex Optimization (quick review):** Convex sets, convex functions, conjugate, duality, unconstrained and constrained optimization models, first and second order descent methods, preconditioners, interior point methods.

   Applications: Bundle adjustment (3D reconstruction), constrained optimization in control and learning, energy-based models, etc.

2. **Non-Convex Optimization:** Non-convex projected gradient descent, alternating minimization, EM algorithm, stochastic optimization techniques.

   Applications: Extreme classification, optimization models in control and learning, Gaussian mixture models, sparse recovery, low-rank matrix recovery, robust linear regression, etc.

3. **Non-Smooth Optimization:** Subgradient method, projected subgradient method, subgradient method for constrained optimization, primal-dual subgradient method, stochastic subgradient method, mirror descent, variable metric methods, variational inequalities.

4. **Min-Max Optimization:** Two player games, gradient descent-ascent, competitive gradient descent, preconditioned gradient methods.

   Applications: Stable training of generative adversarial networks, etc.

5. ***Miscellaneous Topics (Optional):** Distributed optimization, robust optimization, optimization on matrix manifolds.

   Applications: Robust path planning, classification problems, etc.

PREFERRED TEXT BOOKS:

1. Stephen Byod, Lieven Vandenberghe, *Convex Optimization*, Cambridge University Press, 2004
2. P. Jain and P. Kar, *Non-convex Optimization for Machine Learning*. Link: https://arxiv.org/abs/1712.07897
3. *Subgradient Methods*, https://stanford.edu/class/ee364b/lectures.html
4. P. A. Absil, R. Mahony, and R. Sepulchre, *Optimization Algorithms on Matrix Manifolds*. Link: https://press.princeton.edu/absil
5. F. H. Clarke, *Optimization and Nonsmooth Analysis*, Wiley, New York, 1983
6. R.T. Rockafellar, R. Tyrrel, R.J.B. Wets, *Variational Analysis*, Springer, 1998

***REFERENCE BOOKS:**

Same as above

***PROJECT:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**5%**
Mid SemExam	**20%**
Quiz-2	**5%**
End Sem Exam	**20%**
Assignments	**20%**
Project	**30%**
Term Paper	
Other Evaluation _____	

OUTCOME: Familiarity with wide variety of advanced optimization models and solvers

REMARKS: None

Advanced Structural Analysis 3-1-0-4

TYPE-WHEN **:** Spring 2021

FACULTY NAME **:** P. Pravin Kumar Venkat Rao

PRE-REQUISITE **:** Structural Analysis-B.Tech Civil Engineering

OBJECTIVE **:** The main objective is to enable the student to have a good grasp of all the fundamental issues in these advanced topics in structural analysis, besides enjoying the learning process, and developing analytical and intuitive skills.

COURSE TOPICS **:**

Analysis of Indeterminate structures, Finite difference method - Application to thin plate theory, Centra dynamic response, Stability, accuracy, convergence and computational error, Analysis of linear & non-linear responses, Continuum modelling, Finite Element Modelling (FEM), Boundary Element Modelling (BEM), Discrete modelling, Rigid body spring model (RBSM), Discontinuous deformation analysis (DDA), Distinct Element Method (DEM), Extended Distinct Element Method (EDEM), Applied Element Method (AEM)

PREFERRED TEXT BOOKS:

REFERENCE BOOKS:

1.Dynamics of Structures: Theory and application to Earthquake Engineering by Anil K. Chopra, Printice-Hall of India Pvt. Ltd, 2002
2.Numerical Methods in Structural Mechanics by Bittnar, Z. and Sejnoha, J., Telford, London, 1996.
3.Energy Methods in Structural Engineering by Bathe, K.J., Prentice Hall, Englewood Cliffs, N.J. 1996.
4.Few journal papers…

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	25
Assignments	30
Project	20
Open book exam or 30 minute quiz	25
Other Evaluation _____	

OUTCOME: After successfully completion of this course, the students shall acquire: (1) knowledge of development of stiffness matrix for prismatic members, (2) knowledge of matrix computations, (3) ability to analyze determinate and indeterminate plane and space truss/frame system, (4) good understanding of how standard software packages (routinely used for frame analysis in design offices) operate.

REMARKS:

ECE551 **Advances in Robotics & Control** **3-1-0-4**

TYPE-WHEN : Level-2 Elective, Spring

FACULTY NAME **:** Spandan Roy

Contents

4. Controller [1+4=5] 4

A. Tracking Controller, Pure Pursuit Controller [1] 4

B. Nonlinear Model Predictive Controller [4] or, Optimal Controller 4

5. Reinforcement Learning [4] 4

A. Function approximation 4

B. Effective representations 4

C. Approximate models 4

D. Prior knowledge or information 4

6. Uncertainty [2] 4

A. Markov Decision Process (MDP) [1] 4

B. Partially Observable Markov Decision Process (POMDP) [2] 4

Kinematics of Common Robot [3]

Omnidirectional, Aerial / Quadrotor, Differential Drive RRT [1]

Trajectory Parameterization (Bezier Curves, Frenet Frames) [2]
Optimization Basics [2] Least Square, Nonlinear

Controller [1+4=5]

Tracking Controller, Pure Pursuit Controller [1]

Nonlinear Model Predictive Controller[4] or, Optimal Controller LQG

LQR

Reinforcement Learning[4]

Function approximation Effective
representations Approximate models

Prior knowledge or information
Uncertainty [2]

Markov Decision Process (MDP) [1]

Partially Observable Markov Decision Process (POMDP) [2]

GRADING:

2 Mid Semester Exams,
6 Assignments, and End Semester Exam

OUTCOME:

Students on successful completion of the course get acquainted with the control schemes applied to the field of Robotics.

REMARKS:

HS3.301 Alternate Religious Traditions in Indian History 3-1-0-4

Note: Please use course code for previously existing course

TYPE-WHEN : Spring

FACULTY NAME **:** Nilam Kakati and Dr. Aniket Alam

PRE-REQUISITE **:**

OBJECTIVE **:** The course "Alternate Religious Traditions in Indian History" intends to familiarize the students with the knowledge minor religious traditions during the pre-colonial period and the colonial period. The course deliberately excludes the themes of major religious traditions like Hinduism and Islam. The course will however also discuss slightly the two important religious movements of the former period i.e. Buddhism and Jainism. The objective is to give the student a broad overview of how different religious traditions developed in India and in what form they reached us in modern times. The course hopes to broaden the student's understanding of Indian religions and also enable him/her to appreciate the place of religion in history.

COURSE TOPICS:

1. Introduction to Religious studies: This module will help familiarize the student with the study of religion in history, as also theology and theophany. (4 lectures)
2. Buddhism and Jainism: This module will teach the foundational ideas and practices of these two religions and how they evolved over history in the Indian sub-continent. (8 lectures)
3. Bhakti Movement: This module will cover the main Bhakti preachers, their spread, their social and cultural impact, the important commonalities, and their distinctions. (5 lectures)
4. Sufi Movement: This module will cover the emergence of Sufi ideas and practices, their spread over the sub-continent, their relation to other religious traditions and state power. (4 lectures)
5. Tantra and Tantric Practices: In this module we will unbundle the idea of Tantra from modern stereotypes by tracing its ideational and practice lineage over the past two millennia. We will also look at Tantric influences on mainstream religious thought and practice. In Tantric practices we will study forms of religion which are often clubbed under witchcraft and magic. (5 lectures)

PREFERRED TEXT BOOKS:

1. The Sacred and the Profane: The Nature of Religion by Mircea Eliade (1957)
2. Indian Buddhism by A. K. Warder (1980)
3. History of Medieval India: 800-1700 by Satish Chandra (2007)

***REFERENCE BOOKS:**

1. Buddhism: A Very Short Introduction by Keown Damien (2013)
2. Indian Buddhism: A Survey with Bibliographical Notes by H. Nakamura (1989)
3. Origin and Nature of Ancient Indian Buddhism by K.T.S. Sarao (2004)
4. Buddhist Thought in India by E. Conze (1996)

5. A Genealogy of Devotion: Bhakti, Tantra, Yoga, and Sufism in North India by Patton E. Burchett (2019)
6. History of the Tantric Religion by N. N. Bhattacharyya (2005)
7. The Power of Tantra: Religion, Sexuality and the Politics of South Asian Studies by Hugh B. Urban (2010)
8. A companion to Tantra by S.C. Banerji (2007)
9. The Tantric Tradition by Agehananda Bharati (1965)
10. Jainism: An Indian Religion of Salvation by Helmuth von Glasenapp (1999)
11. Jainism and Indian Civilization by Raj Pruthi (Ed.) (2004)
12. Faith & Philosophy of Jainism by Arun Kumar Jain (2009)
13. Medieval bhakti movement its history and philosophy by Susmita Pande (1993)
14. Bhakti Movement in Medieval India: Social and Political Perspectives by Shahabuddin Iraqi (2009)
15. For the Love of God: Women Poet Saints of the Bhakti Movement by Sandhya Mulchandani (2019)
16. The Sufi saints of the Indian subcontinent by Zahurul Hassan Sharib (2006)
17. Sufism and Society in Medieval India by Raziuddin Aquil (2010)
18. Indian Witchcraft by Rajaram Narayan Saletore
19. Ancient Indian Magic and Folklore: An Introduction by Margaret Stutley (1980)
20. Empire of Enchantment: The Story of Indian Magic by John Zubrzycki (2018)

***Articles**

1. Buddhism in Indian philosophy by Raghuramaraju (India International Centre Quarterly, Vol. 40, No. ¾ , 2013)
2. Social background of Buddhism in Gandhara (2nd C B.C. to the middle of the 4th C C.E.) by Sarita Khettry (Source: Proceedings of the Indian History Congress, Vol. 75, Platinum Jubilee 2014)
3. Jainism and Society by Peter Flügel (Bulletin of the School of Oriental and African Studies, University of London, Vol. 69, No. 1 2006)
4. Dharma in Jainism- A preliminary survey by Olle Qvarnstrom (Journal of Indian Philosophy, Vol. 32, No. 5/6 December 2004)
5. Bhakti as an Ideology : Perspectives in deconstructing the early medieval Indian Tradition by Vijay Kumar Thakur (Proceedings of the Indian History Congress, Vol. 55 1994)
6. Bhakti and the British Empire by Vijay Pinch (Past & Present, No. 179 (May, 2003)
7. Sufism in History and its Relationship with Power by Tanvir Anjum (Islamic Studies, Vol. 45, No. 2 Summer 2006)
8. The Eclectic Spirit of Sufism in India: An Appraisal by Babli Parveen (Social Scientist, Vol. 42, No. 11/12 November–December 2014)
9. Matrix of Power: Tantra, Kingship, and Sacrifice in the Worship of Mother Goddess Kāmākhyā by Hugh B. Urban (South Asia: Journal of South Asian Studies 2010)
10. Medieval Jaina Goddess Traditions by John Cort (Numen, Vol. 34, Fasc. 2 Dec.1987)
11. What Tantrism means to modern western Civilization by J. Evola (East and West, Vol. 1, No. 1 APRIL 1950)
12. Witchcraft in Ancient India by M. Winternitz (The Indian Antiquary, A Journal of Oriental Research Vol. XXVIII, 1988)

***PROJECT:**

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Mid Sem Exam	**15%**

End Sem Exam	**30%**
Short Assignments (Four)	**20%**
Term Paper	**20%**

Book Reviews (two) **15%**

OUTCOME: The course aims to develop knowledge and understanding of the histories, social conditions, practices, and cultural expressions of religious traditions which have historical roots in India but are under-studied and lesser known in public life. The students will gain foundational knowledge in the subject of religion, which will help in understanding the contemporary religious setting in the country.

REMARKS: The course will involve reading about 700 printed pages and writing about 8000 words in assignments of various sorts over the entire semester. Class participation and readings will influence the grading.

Applied Electromagnetics 3-1-0-4

TYPE-WHEN **:** Elective, Spring

FACULTY NAME **:** K R Sarma

PRE-REQUISITE **:** None

OBJECTIVE **:** Understand the fundamentals of dynamic electromagnetic fields and devices and systems used in communication, RF electronics medical security and defense applications.

COURSE TOPICS **:**

Dynamic Electromagnetic (EM) fields. Governing relationships, Maxwells equations Boundary conditions at interface of media.

Propagation of EM fields in unbounded media: Dielectrics, Conductors anisotropic media. Applications using ferrites, liquid crystals

Propagation of EM fields in bounded media in one, two and three dimensions using conductors or dielectrics as boundaries. Transmission lines, Dielectric waveguides, metallic waveguides. Applications -Fibre, coaxial cable, waveguides, resonators, inductors, capacitors, filters

Guided Radiation of EM energy in free space. Antennas: Wire antennas, apertures and reflectors arrays applications in radars, diathermy, communication: terrestrial and satellite, microwave imaging, heating, cooking, drying, biological effects

PREFERRED TEXTBOOKS:

Ulaby and Ravai0li Applied Electromagnetics 7 ed Pearson

***PROJECT:** None

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Assignments	**20**
Open book exam or 30 minute quiz	2x20
Other Evaluation - 2 hour open book exam	**40**

OUTCOME: Theory and applications of systems and components based on electromagnetic theory used in communication and electronics in RF, Microwave and Visible spectral bands

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Behavioral Research: Statistical Methods 3-1-0-4

Course Code :

Note: Please use course code for previously existing course

Type-When: Open Elective in Spring 2021 (Half-semester course)

No of Credits: 2 Credits (3-0-1-2)

Faculty: S. Bapi Raju, Vinoo Alluri

PREREQUISITES: The course is primarily aimed at Cognitive Science students and other students who have interest in analyzing behavioral data for their research. Open only for DD, MS, and PhD students. BTech and MTech students can be admitted strictly based on specific requirements and instructor permission.

OBJECTIVE:

The primary objective is to equip students with visualization and statistical analyses approaches used on data from behavioral research. The course would be useful for research students in Cognitive Science as well as other domains where experiments with human participants are conducted. This course is intended to be developed as a semester-long course as a follow-up to the one offered in the Monsoon session titled “Behavioral Research: Experimental Design (BRED)”, which focuses on behavioral experimental design, related research methods, basic data visualization and analysis approaches / techniques. Together these two courses (BRED and BRSM) are intended to form core courses for research students in Cognitive Science.

Objectives of the course are:

- To develop understanding of the basic framework for hypothesis testing and statistical inference from data collected in behavioral research experiments.
- To identify appropriate statistical approaches for analyzing data from various experimental setups and designs.
- To gain practical experience with real data sets from behavioral experiments (including surveys, physiological data, perceptual ratings, psychophysical data, neuroimaging data, etc).
- To learn scientific presentation of statistical analysis results.

TOPICS:

1. (*Self-study*) Experimental Designs, Data Taxonomy, Reliability and Validity, Descriptive and basic Inferential statistics, Confidence Intervals; Identifying statistical tests of differences and tests of association based on variable types (***Univariate Statistics***). [*A QUIZ/Mini-project will be given to be completed by the second week on these materials to assess familiarity with these topics. We advise students to go through the lecture material of BRED to prepare for this*.]
2. **Exploratory Analysis, Intrinsic Dimensionality Estimation and Data Visualization**: MDS, PCA, Factor Analysis
3. **Issues in Behavioral Analysis**: Tests for Normality, Multicollinearity, Evaluating effective degrees of freedom; Significance Testing (Permutation tests; Bootstrapping, Multiple Comparison Problem), Non-parametric statistical tests for non-normal and categorical data
4. **Bivariate Statistical Analysis**: Correlation, Regression, ANOVA, ANCOVA
5. **Multivariate Statistical Analysis**: GLM, Multiple Regression, MANOVA, MANCOVA, CCA
6. **Reporting Statistical results**

REFERENCES:

- Charles Stango (2011). *Research Methods for the Behavioral Sciences*, Fourth Edition, Wadsworth Cengage Learning, USA.
- Brian S. Everitt (2010). Multivariable Modeling and Multivariate Analysis for the Behavioral Sciences, Chapman Hall & CRC, USA
- Coolican, H. (2014). *Research Methods and Statistics in Psychology*. London: Hodder & Stoughton.

EVALUATION CRITERIA:

Project: End-semester group project where students implement the techniques on a larger dataset and present the analysis and inferences in an end-semester presentation along with a final report in Scientific format.

Type of Evaluation	**Weightage (%)**
Quizzes	NIL
Assignments + Hand-on Activities	**20% + 30%**
Term Paper	NA

Project	**40%**
Open Book Exam or 30-min Quiz	NA
Other Evaluation: Class participation and discussion	**10%**

OUTCOME: By the end of the course, it is expected that students will have a particularly good understanding of the appropriate statistical analyses to be conducted on behavioral data and have hands-on experience with actual data analysis. Scientific presentation of the results from learned techniques would enable them to draw appropriate inferences.

CSE586 **Cognitive Neuroscience** **3-1-0-4**

Type When **:** Spring 2021
Faculty Name **:** Kavita Vemuri
Joint course **:** IIITH and University of Hyderabad.

The course will examine how modern cognitive neuroscientists explore the neural Underpinnings of sensory information – vision, sound, and touch leading to visual/auditory attention, language processing, memory, empathy/emotion and other higher -order cognitive processes. Investigates the different techniques applied to uncover observations of clinical populations & non-clinical human populations and also some specimens from the insect/ animal kingdom. Data collected from powerful methods like functional magnetic resonance imaging (fMRI) and electroencephalogram (EEG) will be analyzed to examine functional brain connectivity. Equal emphasis is on understanding analytical methods and the limitations of each. The third part of the course will cover a part of computational neurosciences, which involves building computer simulation on models of neurons and dynamic neural circuits Lectures: 70%

Lab work: 30%

The lab work will cover analysis of fMRI, Difusion Tomography imaging, EEG data from research studies designed to investigate the neural responses to a visual, auditory or task stimuli.

Textbooks:

1. Cognitive Neuroscience by Gazaniga (copy available in ITH library)
2. Fundamentals of Computational Neuroscience by Thomas Trapenberg.
3. Required research papers.

Evaluation:

Assignments (6):	- 20%
Class presentation (1):	-10%
Lab work:	-30%
Mid-sem I:	-20%
Final Sem:	-20%

HSS337 **Comprehension of Indian Music** **3-1-0-4**

Faculty name **:** TK.Saroja

Type-When **:** Humanities Elective, Spring 2020

Credit **:** 3-0-0-4

Course Description: This course offers an overview of Indian music and its classicism. The two major styles Hindustani and Karnataka with their rich traditions glorify Indian music. The creative aspect which is the foremost feature of Indian music is what takes the art form to its zenith. Its huge variety contributes to the cultural heritage of the civilization. The logic, science, philosophy, history, emotions, imagination in Indian music gives the art its completeness. The course will cover conceptual base of Indian music and emphasize on informed comprehension of music.

Objectives:

1. Study of basics of both the styles (Hindustani and Karnataka) to know the characteristics of them. Importance of *nāda* in music.
2. Emphasis on the conceptual system of *rāga*-s and *tāla*-s that gives Indian music its stature.
3. Introduction to different genres of India music like the semi classical, light, folk music studying their peculiar aspects. The aspects that differentiate them from each other would be analyzed.
4. The role of language and the interwoven relationship of literature and music in musical compositions. The association of melody and rhythm that go hand in hand in the compositions with focus on the vowel elongations. Role of music in bringing out the emotions and expressions in poetry and literature.
5. The contribution of different composers who enriched the classical form of art particularly in south Indian music. A special study of the compositional style of the South Indian musical trinity Tyagaraja, Mythuswamy Dixitar and Syama Sastry.
6. The existence and the prominence of *gharānā*-s in Hindustani music and the musicians who represent the particular *gharānā*-s.
7. The indispensable place of music in other art forms like dance, theatre and also spheres like cinema, commercials etc. (medium of communication).

Course outcomes:

- Understanding the theory of Indian music which gives it the status of a *śāstra* and appreciation of the practice of classical music.
- Understanding the rational, creative and social elements of the art which makes the art an integral part of the society.
- Ability to recognize different musical forms with a systematic approach.
- Understanding the universality of music with the knowledge of Indian music.
- Understanding the importance of music and related arts in one's life as those that foster individual growth.

Reference Materials:

1. *South Indian Music* – Volumes 1 to 6 by Professor P. Sambamurthy
2. *The quest for Music Divine* by Suresh Chandra Dey
3. *The Spiritual Heritage of Tyagaraja* by C. Ramanujacharya and Prof V. Raghavan
4. *Karnataka Sangita Sastra* by A.S. Panchapakesa Ayyar
5. *Appreciating Carnatic Music* by Chitraveena N. Ravikiran

6. *Nuances of Hindustani Classical Music* by Hema Hirlekar
7. *The Hindu Speaks on Music* - compilation of 232 selective music articles by The Hindu
8. *A Southern Music (The karnatic story)* by T.M. Krishna
9. *Hindustani Music: A tradition in transition* by Deepak Raja
10. *Raga Chikitsa* by Suvarna Nalapat
11. *Sangitha Ratnakara of Sarngadeva* by Shringy RK and Premlata Sharma
12. *Matanga and his work Brhaddesi*-edited by Prem Lata sharma
13. Videos and audios of music which practically demonstrate all the concepts of the course.

Tentative lesson Plan

Lecture 1, 2 - Introduction to Indian music along with technical terms.

Lecture 3 – Nāda, the basic of music. Sound, timbre and related topics

Lecture 4 - Laya, the introduction of rhythm in general, its role in any kind of music with examples from numerous varieties of songs.

Lecture 5, 6 - The concept of tāla in both North and South Indian music.

The similarity of the theory behind tāla system with difference in the execution of it.

Lecture 7, 8, 9 - Manodharma sangeet - The improvisational music. What is manodharm sangeet with respect to Classical music and how th is plays a major role in composing different kinds of music compositions.

Lecture 10, 11, 12, 13 – Genres of Indian music like the semi classical or devotional music, light music, folk music, sufi music, popular music where different musical forms that hol d different genres of music introduced.

Lecture 14, 15, 16 - Musical forms that are strictly categorized under traditional classical music. The peculiarity of these forms to be listed as classical compositions different from all other genres of music.

Lecture 17, 18, 19 - Language and its role in Indian music where the combination of musical notes, rhythm, letters of the language, vowels together contribute in the composing of songs. Grammatical aspects of language and music are exposed.

Lecture 20 - The importance of *gharānā*-s in North Indian music and the musicians who represent particular *gharānā*-s.

Lecture 21, 22, 23 - The different composers who contributed to Indian music in its development from different time periods.

Lecture 24, 25, 26 - The blend of music with different art forms like dance, theatre and role of music in different spheres of society like different communication medium.

Grading:

Mid Sem 1 – 20%

Mid Sem 2 - 20%

Assignments-20%

Individual Project and viva- 40%

CSE578 **Computer Vision** **3-1-0-4**

TYPE-WHEN **:** Spring 2021

FACULTY NAME **:** Anoop Namboodiri

PRE-REQUISITE **:** Computer Graphics or Image processing

OBJECTIVE:

COURSE TOPICS:

Relationship between computer vision, graphics and Image processing. Camera model: Imaging process 3D to 2D projection and loss of information, calibrated and un -calibrated vision systems. Limitations of popular cameras and methods to overcome them. Multiple view geometry and imaging systems. Algebraic constraints, reconstruction, view synthesis. Recognition of objects from appearance, shape, partial view, occlusion, etc., Analysis of video, motion and recognizing dynamic activities.

PREFERRED TEXT BOOKS:

Forsytn and Ponce‘ Computer Vision: a modern approach, Pearson Education Inc.

Computer Networks 3-1-0-2

Faculty Name : Shatrunjay Rawat

PRE-REQUISITE : Operating systems

OBJECTIVE : To impart principles of information networking systems and protocols.

COURSE TOPICS :

1. Classification of Communication Networks. Standard models of communication: OSI and TCP/IP. Importance of layering and service models.

2. Application layer services and protocols. Study of SMTP, HTTP, FTP, and DNS. Socket Programming.

3. Transport layer services, principles and protocols: study of TCP and UDP. Principles of reliability: sliding window protocols, selective repeat and go-back-N. Principles of congestion control: TCP case study. Details of TCP working.

4. Network layer services, algorithms and protocols: study of OSPF, RIP, BGP, and ICMP. Study of routing algorithms. Error control and reporting at the network layer. Study of Internet router architecture. IP addressing principles: assignment and aggregation. Study of DHCP.

5. Data link layer services and protocols. Medium access control services and protocols: CSMA, CSMA/CD, CSMA/CA, and Token ring. Link layer framing and addressing. Study of ARP. Study of Ethernet. Sharing communication medium: TDMA and FDMA. Study of wireless and mobile networks: WIFI and Cellular Internet Access.

PREFERRED TEXT BOOKS: Computer Networking –A Top-Down Approach Featuring the Internet by

James Kurose and Keith Ross, 5th ed and above. Pearson.

Reference Books: Computer Networks, by Andrew S Tanenbaum and David J Wetherall, 5th Ed and above, Prentice Hall.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem Exam	20
End Sem Exam	40
Project	20
Assignments	20

CSE441 **Database Systems** **3-1-0-4**

TYPE-WHEN **:** Second-level course in database systems

FACULTY NAME : P. Krishna Reddy

PRE-REQUISITE :

Students should have knowledge of SQL, database design and operating systems, programming language, algorithms.

OBJECTIVE :

Databases have become essential part of every business. A database system can be used to manage large amounts of data in a persistent manner. The objective of this course is to study the methods that have been evolved over several decades to build database systems or database management systems software in a focused manner which include storage management, index management, query processing, recovery management and transaction management.

COURSE TOPICS

Introduction (3 hours); Data storage (3 hours); Representing data elements (3 hours); Index structures (3 hours); Multidimensional indexes (6 hours); Query execution (6 hours); The query compiler (6 hours); Coping with system failures (3 hours); Concurrency control (6 hours); More about transaction management (6 hours).

PREFERRED TEXT BOOKS:

1. Database System Implementation, Hector Garcia-Molina, Jeffrey D. Ullman and Jennifer Widon, Pearson Education, 2003

OTHER TEXT BOOKS:

2. Elmasri & Navathe, Fundamentals of Database Systems, Pearson Education, 5th Education.
3. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, Third edition, Mc Graw Hill, 2003.
4. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database system concepts, fifth edition, Mc Graw Hill, 2006.

PROJECT:

A practical project on indexing, query optimization, and transaction management will be given. The project will be evaluated.

GRADING:

PROJECT and Assignments: 30%; MIDSEM: 30%; ENDSEM: 40%

OUTCOME:

The course will help the students in understanding the fundamental concepts of several database management systems like ORACLE, DB2, SYBASE and so on. Also, the students will understand the solutions/options to interesting problems which have been encountered by the designers of preceding DBMSs. Most important, the students will be exposed to internal design of DBMSs and able to tune the DBMSs to meet the performance demands of diverse applications.

CS7.601 Deep Learning: Theory and Practices (Max:80) 3-1-0-4

TYPE-WHEN : Spring 2021

FACULTY NAME : Dr. Naresh Manwani

PRE-REQUISITE : Good background in Linear Algebra and Probability theory, Statistical Methods in AI (Compulsory), 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 :

1. Introduction to neural network, Perceptron and its convergence proof. Feed-forward neural network, back propagation, convergence in neural networks, rates of convergence, loss surfaces, learning rates. [3 Lectures]
2. Representation power of feedforward neural network, limitations of shallow networks, why and when can deep networks avoid curse of dimensionality. [3 Lectures]
3. Optimization for deep networks: gradient descent (GD), momentum based GD, Nesterov accelerated GD, stochastic GD, AdaGrad, RMSProp, Adam [5 Lec-tures]
4. Bias variance tradeoff, L2 regularization, early stopping, dataset augmentation, parameter sharing and tying, injecting noise at input, ensemble methods, dropout. [2 Lectures]
5. Greedy layerwise pre-training, better activation functions, better weight initial-ization methods,

batch normalization [2 Lecture]

6. 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 [4 Lectures]
7. Convolutional neural networks (CNNs), backpropagation in CNNs, variations in the basic model, Alexnet, Inception, VGG [2 Lectures]
8. 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 vanish-ing gradient problem with LSTMs, Resnets [5 Lectures]

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

***REFERENCE BOOKS: Recent research papers in deep learning (papers pub-lished in ICLR, ICML and NIPS)**

***PROJECT:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	7.5
Mid Sem Exam	20
Quiz-2	7.5
End Sem Exam	20
Assignments	25
Project	15
Scribing	5

OUTCOME: By the end of the course, it is expected that students will have very good familiarity with the subject 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 much of the current literature in Deep Learning and extend their knowledge through further study (research).

Type of Evaluation

CEW612 Design of Hydraulic Structures 3-1-0-4

TYPE-WHEN : Spring-2021

FACULTY NAME : Shaik Rehana

PRE-REQUISITE : Nil

OBJECTIVE : To develop a detailed understanding about the design aspects of the hydraulic structures those are constructed for the purpose of storage, diversion, conveyance and distribution of water.

COURSE TOPICS :

- Introduction of Hydraulics: Fluid Properties and Classification, Hydrostatics, Equation of Motion, Continuity Equation, Flow Measurements
- Introduction of types of hydraulic structures: Storage, Diversion, Conveyance and Distribution structures
- Gravity Dams: Site selection, Forces, Stability analysis, Modes of Failure
- Reservoirs: Storage Capacity of a Reservoir and Design aspects, Reservoir operation and irrigation water management, hydropower potential and storage capacity
- Design of Diversion Works: Weirs and Barrages, Spillways
- Canal irrigation System; hydraulics of alluvial channels; Sediment transport and design of irrigation canals

REFERENCE BOOKS:

- *Hydraulic Structures*, P. Novak, A. I. B. Moffat, C. Nalluri and R. Narayanan, Taylor and Francis, U. K
- Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers N.D.13th ed, 1998.
- Irrigation and Water Resources Engineering by G. L. Asawa, New Age International Publishers, 2008.

Grading Policy:

Assignments =10%
Mid Sem I = 20 %
MID Sem II =20 %
Project = 20%
Final Exam =30 %

Design Verification and System Verilog 3-1-0-4

Course Code :

Note: Please use course code for previously existing course

CREDITS :

TYPE-WHEN :

FACULTY NAME : Ganesh Bhutekar

PRE-REQUISITE : Verilog, VLSI basics

OBJECTIVE **:** To make students aware of Design Verification which is very an important aspect of VLSI.

COURSE TOPICS :

1. Basic Design Verification concepts
    a. Introduction
    b. Verification components
    c. Memory modelling
    d. Bus Functional Models
    e. Verification IPs
    f. Verification documentation
2. System Verilog (SV)
    a. Introduction and data types
    b. Basic OOPS
    c. Randomization
    d. Threads and Interposes communication
    e. Writing testbench in SV
3. Introduction to verification methodology
    a. UVM Basics
        i. UVC component
        ii. Designing testbenches in UVM
4. Industry standard Interfaces
5. Case studies

PREFERRED TEXT BOOKS:

1. Writing Testbenches by Janick Bergeron (ISBN: 9780387292212)
2. System Verilog for Verification by Chris Spear (ISBN:9780387765303, 0387765301)
3. Online references for Verification methodology and UVM

***REFERENCE BOOKS:**

***PROJECT:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	15%
Assignments	15%
Term paper	30%
Project	20%
Open book exam or 30 minute quiz	20%

Other Evaluation _____	

OUTCOME:

Students will understand the important aspect of VLSI, Design Verification. This will make them think about Design Verification as career option, which is in high demand in VLSI industry.

This subject will cover the System Verilog to a good depth. OOPS fundamentals for reusability will be brushed up. Important features of SV like randomization and interposes communication will be of great help in understanding verification methodology.

Introduction to verification methodology will open many career options in Design Verification.

REMARKS:

IMA303 **Differential Equations** **3-1-0-4**

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

FACULTY NAME **:** BS Lakshmi

PRE-REQUISITE **:** Calculus

Max.Limit :

OBJECTIVE **:** To understand the basic concepts of elementary differential equations, to learn to solve certain forms of first order and second order differential equations and applications. To be able to use mathematical modeling of some physical phenomena using differential equations.

COURSE TOPICS :

1. First order ODEs
2. Second order ODEs
3. Higher order ODEs
4. Systems of equations
5. Phase-plane analysis
6. Laplace Transforms
7. Series Solutions
8. Mathematical modeling

PREFERRED TEXT BOOKS:

Boyce di-Prima, Elementary Differential Equat ions andBoundary Value Problems (John Wiley and sons, Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley

***REFERENCE BOOKS:** Differential equations, dynamical systems and an Introduction to Chaos, Hirsch,M.W., Smale and Devaney (Elsevier), Differential Equations, S.L.Ross (John Wiley and sons)
George F. Simmons, Differential Equations With Applications and Historical Notes

***PROJECT:**
GRADING:

50% for 2 Tests and
final exam 25% for assignments
25% for quizzes

OUTCOME:

Upon successful completion of the course the student must be able to

1. Solve first order differential equations using the techniques of separation of variable, integrating factors, power series and Laplace transforms. Understand the existence and uniqueness
2. Use Euler's method to approximate solutions for first order ODEs
3. Find general and particular solutions of second order linear ODEs using the techniques of undetermined coefficients, variation of parameters, power series and Laplace transforms.
4. Solve homogeneous first order systems of linear ODEs
5. Use direction fields, phase lines and phase portraits to qualitatively analyze the solutions to differential equations.
6. Understand how to model simple physical phenomena using differential equations.

ECE463 **Digital VLSI Design** **3-1-0-4**

Faculty Name : Zia Abbas

Pre-requisite : **Basic Electronics&(Digital VLSI) ECE 361**

Course Topics:

Unit 1: Introduction to digital design: Analog vs Digital, Process Technology and Design/process parameters: technology scaling, power, speed, leakage, performance. CMOS process, transistor, registers. Idea of design+fabrication process. Recap: Inverter, transmission & logic gates

Unit2: MOS transistor: operation, threshold voltage, body effect, channel length modulation, C- V characteristics, Switching and DC characteristics (noise margin), First order & Second order effects, Short channel transistors vs Long Channel, FinFET, metal gate

Unit 3: CMOS Process Technology: Silicon Semiconductor technology, Manufacturing CMOS Technology (Silicon wafer, photolithography, processing steps, well formation, self aligned process), Packaging/Assembly and Testing, Layout (Hierarchy & special layout techniques) and process steps, I/O, ESD, Pad-frame, Layout versus Schematic (LVS), Design Rule Check (DRC),Process parameters and their impact on device performance.

Unit 4: Design topics: Memory: SRAM, DRAM, Counters, Combinational and Sequential circuit. Project ideas: counters, array scanner, pulse width

Unit 5: Design & process issues:Delay, Power and Robustness. Issues: leakage (types of leakages) mechanism,, Band-to-Band Tunnelling Current, Tunnelling throughand into gate oxide, Injection of hot carriers from substrate to gate oxide, GIDL, Punch-through, Sub-threshold Leakage Current including DIBL. Latch up. Process Variation and its affect.

Recommended books:

Jan M. Rabaey, A. Chandrakasan, B. Nikolic "Digital Integrated Circuits- A Design Perspective, PHI.
Douglas A. Pucknell, K. Eshraghian, "Basic VLSI Design", 3rd Edition, Prentice Hall of India.
Neil H. E. Weste, K. Eshraghian, "Principles of CMOS VLSI Design", A Systems Perspective, 2nd Edition, Pearson Education Pvt. Ltd.

Grading Scheme:

Assignments	-	10%
Quiz (class quizzes, Mid-term);	-	5% & 10%
Mid-Semester Project (Layout):	-	25%
End-Semester Project	-	30 %
Final Exam:	-	20%

CES442 Disaster Management 3-1-0-4

Faculty Name: Sunitha P

Type-when: Spring 2021

Objective:

Facilitate awareness of disasters and their management, and help contribute holistically towards a disaster resilient community.

Course Content

1. **Disaster Management** – Disaster Management Cycle-Mitigation, Preparedness, Response, Rehabilitation, Reconstruction and Recovery- Guidelines- Capacity Building, Disaster Resilience.
2. **Institutional Arrangements in Disaster Management-** NDMA, SDMA, DDMA, FEMA-Activities.
3. **Management of Disasters**- Natural-Flood, Drought, Earthquakes, Cyclones, Tsunami, Landslides, Avalanche, Man-Made-Air Pollution, Nuclear Disaster, Chemical Disaster, Forest Fires-Case-studies.
4. **Role of Information and Communications Technologies in Disaster Management**-Mitigation, Preparedness, Response, Recovery-Early Warning Systems, Mobile Communications, Information Dissemination, Dynamic Resource Allocation, IoT, GIS Tools in DM.
5. **Disaster Risk Analysis**-Mapping, Modelling, Risk Analysis, Loss Estimation- Introduction to Risk Modelling & Analysis software- QGIS.

Grading

Assignments: 15%

Term Project: 15%- NLP, ML, AI, GA, Web-based Applications

Mid-Semester Exam: 30%

End-Semester Exam: 40%

References

1. Alexander, D., (1999), *Natural Disasters*, Kluwer Academic, London
2. Bhandani, R.K., *An Overview on Natural & Man-made Disasters and their Reduction*, CSIR, New Delhi
3. Bryant,E., (1995), *Natural Hazards*, Cambridge University Press, New York
4. Coppola, D.P., (2007), I*ntroduction to International Disaster Management*, Elsevier Science (B/H), London
5. Federal Emergency Management Agency (FEMA), *Guidelines*, FEMA, USA
6. Kanda, M., (2017), *Disaster Management in India Evolution of Institutional Arrangements and Operational Strategies*, Centre for Good Governance, Hyderabad, India
7. Malhotra, S., (2005), *Natural Disaster Management*, Avishkar Publishers, Distributors, Jaipur, India
8. National Disaster Management Authority (NDMA), *Guidelines*, NDMA, India (https://ndma.gov.in/en/ndma-guidelines.html)
9. Robinson, A., (1996), *Earth Shock*: *Hurricanes, Volcanoes, Earthquakes, Tornadoes and other Forces of Nature*, Thames and Hudson, New York
10. Sinha, P.C., (2006), *Disaster Vulnerabilities and Risks: Trends, Concepts, Classification & Approaches*, SBS Publishers & Distributors, New Delhi, India

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ICS541 **Distributed Data System** **3-1-1-4**

Note: Please use course code for the previously existing course

TYPE-WHEN **:** Elective course for CSE, Spring Semester.

FACULTY NAME **:** Kamal Karlapalem

PRE-REQUISITE **:** Data Systems I
OBJECTIVE **:** Theory and practice of distributed and cloud database systems.

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

Distributed database architecture
Distributed database design – fragmentation, allocation
Distributed query processing and optimization
Distributed transaction management, commit protocols, CAP theorem
Columnar and other stores, query processing optimization
Design considerations for cloud database systems implementations

PREFERRED TEXT BOOKS:

Fundamentals of Database Systems, Elmasri and Navathe, 7th Edition, Person, 2017
Principles of Distributed Database Systems, Ozsu, and Valduriez

***REFERENCE BOOKS:**

Distributed Databases, Ceri and Pelagatti, McGraw-Hill.

***PROJECT:**

Compulsory Components:

A group project to build a distributed database across multiple relational database sources.

GRADING PLAN:

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

ADBI – As Decided By Instructor

The instructor can be contacted for getting the assessment details.

OUTCOME:

A very good understanding of core concepts and practice distributed database and cloud database technologies.

REMARKS:

A cool distributed database system implementation course.

CSE431 Distributed Systems (Max:100) Prerequisite: Operating Systems.

Networks desirable **3-1-0-4**

FACULTY NAME **:** Lini Thomas

Pre-requisite **:** Operating Systems, Networks desirable

Foundations **:** Characterizations of Distributed Systems System Models Networking and Internetworking Inter process Communication

Logical Time:

A framework for a system of logical clocks

Scalar time, vector time and efficient implementation of vector clocks

Synchronization of physical clocks. NTP

Global state and snapshot recording algorithms:

System model and definition

Snapshot algorithms for FIFO channels

Middleware:

Distributed objects and RMI

Termination Detection:

Termination detection using distributed snapshots

A spanning-tree-based termination detection algorithms

Distributed mutual exclusion algorithms:

Lamport‘s algorithm, Ricart-Agarwala Algoritm

Sughal‘s dynamic information – Structure Algorithm

Quorum-based mutual exclusion Alogorithm

Maekawa‘s Algorithm

Deadlock detection in Distributed Systems:

Models of deadlocks, Knapp‘s classification of distributed deadlock detection algorithms.

Mitchell and Merrit‘s

algorithm for single resource model

Consensus and agreement algorithm:

Problem definition. Agreement in a failure-free system (synchronous or asynchronous).

Agreement in (messagepassing)

synchronous system with failures. Agreement in asynchronous message passing systems with failures.

The syllabus includes the following topics:

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

Grading:

Mid-1: 15%

Final: 40%

Assignment-1: 5% (Compare Google Protobuf with JSON for serialization)

Assignment-2: 10% (Gossip protocol)

Assignment-3: 30% (Lab project, groups of 2. Implement MapReduce)

Reference Books:

1) Ajay D. Kshemkalyani and Mukesh Singhal, ―Distributed CompuƟng Principles, Algorithms and System‖, Cambridge University Press 2008.

2) Sukumar Ghosh, ―Distributed Systems – An Algorithmic Approach‖, Chapman & Hall ICRC, 2007.

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

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

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

CES641 **Earthquake Engineering** **3-1-0-4**

TYPE-WHEN **:** Spring 2021

FACULTY NAME : Ramancharla Pradeep Kumar

PRE-REQUISITE **:** Structural Dynamics

OBJECTIVE **:**

- Knowledge of Earthquake Engineering and its application to building design
- Understanding of behavior various structural elements

COURSE TOPICS **:**

- Introduction to earthquake engineering & Seismology
  - Origin of earthquakes
  - Plate tectonics
  - Seismic waves
  - Magnitude and intensity
  - Measurement of earthquakes
- Characteristics of earthquakes
- Response of structures
- Concept of earthquake resistant design
- Seismic code Provisions for design of buildings
- Non-engineered constructions
- Post-earthquake evaluation of structures & Retrofitting

- Ductile detailing
- Special topics

PREFERRED TEXT BOOKS:

- Seismic Design of Reinforced Concrete and Masonry Buildings by T. Paulay and M.J.N. Priestley.
- Earthquakes by Bruce A. Bolt.
- Earthquake Engineering, Application to Design by Charles K. Erdey.
- Earthquake Engineering: From Seismology to Performance Based Design by Yousef Bozorgnia and Vitelmo Bertero.

***PROJECT:** Mini Project on some topics mentioned above

GRADING:

30 marks: Assignments (4) + Mini project 30 marks:
Mid-Semester Exams (2)
40 marks: End Sem exam

OUTCOME:

- Understanding of earthquake behavior of buildings
- Post-earthquake assessment of buildings
- Seismic safety assessment of buildings
- Earthquake resistant design of buildings
-

REMARKS: None

HSS317 **Ethics** **3-1-0-4**

TYPE-WHEN **:** Spring-2021

FACULTY NAME **:** Don Dcruz

PRE-REQUISITE :

OBJECTIVE :

1. Examine major theories in ethics by dividing the various approaches in ethics to normative ethics, meta-ethics and applied ethics.

2. To look into some of the possible scenarios or cases in which one would face moral dilemma in deciding what would be the (morally) right thing to do. Response to such question or moral dilemma will lead to normative approach in ethics. Thus, the objective is to see various approaches in normative ethics.

3. Examine some of the major approaches in meta-ethics to understand the nature of morality. For example, to enquire whether there is only one absolute morality or is morality relative.

4. Examine some of the actual moral issues such as abortion, animal rights, environmental issues etc.

COURSE TOPICS:

Topic 1: Normative Ethics

Consequentialism Deontology
Virtue Ethics
Social contract theory

Topic 2: Meta-Ethics

Non-naturalism
Non-cognitivism
Moral Realism and Moral relativism
Moral Skepticism and Intuitionism

Topic 3: Applied Ethics

Abortion
Duties to animals
Environmental Ethics
Engineering ethics Situated
Ethics

PREFERRED TEXT BOOKS:

Russ Shafer-Landau (ed.) 2013. *Ethical Theory: an Anthology*. Wiley-Blackwell. George Sher (ed.) 2012. *Ethics: Essential Readings in Moral Theory*. Routledge. Hugh LaFollette (ed.) 2000. *The Blackwell Guide to Ethical Theory*. Blackwell.

Peter Singer (ed.) 1991. *A Companion to Ethics* . Wiley-Blackwell.

***PROJECT:** None.

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Participation in class room discussions and interactions	20
End Sem Exam	30
Assignments	20
Term Paper and Presentation	30

OUTCOME: Students will be able to distinguish between meta-ethical, normative ethical and applied ethical concerns from each other. Students will be able to critically think and examine actual problems mentioned in the applied ethics based on the theories in normative and meta ethics.

REMARKS: This course will give more emphasis on normative and applied ethics, though the topics from meta-ethics are discussed.

ECE562 **Flexible Electronics** **3-1-0-4**

TYPE-WHEN **:** Level 2 – Spring semester

FACULTY NAME **:** Aftab M. Hussain

PRE-REQUISITE **:**

OBJECTIVE **:** To make students familiar with the different micro-machining techniques in use in semiconductor fabrication, along with knowledge of the state-of-the-art of flexible electronic systems.

COURSE TOPICS **:**

1. Unit one: a) Clean room environment, analysis of semiconductor fabrication techniques such as lithography, dry and wet etching, oxidation, thin film deposition and implantation.

   b) Silicon electronics and non-silicon electronics

   c) Need for non-silicon and flexible electronics – study of use cases and applications

2. Unit two: (Constraints on flexible electronics – material selection) a) Carbon based electronics such as graphene and CNTs

   b) 2D atomic crystal structure materials

   c) Commercial applications of novel electronic materials

3. Unit three: (Constraints on flexible electronics – process selection) a) Organic and polymer electronics

   b) Various fabrication techniques for flexible electronics such as microfabrication, inkjet printing, 3D printing etc.

   c) Large area flexible electronics (electronic fabric)

   d) Stretchable electronics

REFERENCE BOOKS:

1. “Introduction to Microfabrication”, Sami Franssila, Wiley VCH, 2010

2. “Large Area and Flexible Electronics”, Mario Caironi , Yong-Young Noh, Wiley VCH, 2015

3. “Stretchable Electronics”, Takao Someya, Wiley VCH, 2013

PROJECT:

Students will be expected to fabricate flexible electronics circuits using flexible PCBs and surface mount components (groups of two). All necessary trainings for this will be provided during the course.

GRADING PLAN: Type of	**Weightage (in %)**
Evaluation	
Mid Sem-1 Exam	**15**
Mid Sem-2 Exam	**15**
End Sem Exam	**40**
Assignments	**-**
Project	**20**
Term Paper	**-**
Class quizzes	**10**

CEG422 **Green Buildings** **3-1-0-4**

Type/ When : Spring-2021

Faculty name : Vishal Garg

Objective:

1. To understand impact of building on environment and human beings
2. To understand the concept of high performance green buildings and sustainability
3. To understand various green building rating systems such as LEED NC, LEED O&M, GRIHA,ASHRAE Standard 189.1–Standard for the Design of High Performance Green Buildings
4.To apply the learning by case study: Evaluate IIIT campus for green building design and operations

Course Topics:

- Conventional building impacts
- Introduction to Green Buildings
- Impacts of building construction, operation and disposal

- The green building process and assessment
- Ecological design
- Sustainable sites and landscaping
- Energy efficiency in buildings
- Renewable energy
- Water conservation
- Sustainable and alternative materials
- Indoor environmental quality
- Construction Operations and Building Commissioning
- Certification Systems
- Sustainable Operations
- Economic issues andfuture directions in green building

Project work: Each student will evaluate an aspect of the IIIT campus from the point of view of arating system and will submit his/her assessment and recommendations.

Site Visits:

Site visit(s) to building(s)/campus(es) in Hyderabad which aredesignedor operated in sustainablemanner. Students will have to submit their individual site visit reports.

Preferred Text Books:

1. Sustainable Construction: Green Building Design and Delivery, Second Edition, Charles Kibert,John Wiley and Sons
2. The Integrative Design Guide to Green Building: Redefining the Practice of Sustainability, BillReed, John Wiley and Sons
3. ASHRAE Standard 189.1–Standard for the Design of High Performance Green Buildings
4. 4.LEED Reference Guide forGreen Building Design and Construction
5. LEED Reference Guide for Green Building Operations and Maintenance

Reference Books:

1. The Green Studio Handbook: Environmental Strategies for Schematic Design, Alison Kwok, Walter Grondzik, Elsevier
2. Carbon-Neutral Architectural Design, Pablo M. La Roche, CRC Press
3. Green Building: A Professional's Guide to Concepts, Codes and Innovation, Anthony C. Floyd,International Code Council
4. Green Building Fundamentals (2nd Edition), Mike Montoya, Pearson Education 5.Fundamentals of Integrated Design for Sustainable Building, Marian Keeler, Bill Burke, JohnWiley and Sons

Grading:

Mid-term exams = 10%+10%

Report on Site Visit(s) =5%

Attendance in the Invited lectures/seminars = 5%

Project work and presentation=20%

End semester Exam=50%

Outcome:

Students will get an overview of green building design and operations. They will also understandvarious rating systems and will apply these to evaluate sustainability of the campus.

Remarks:

1. Course will be heavy and would need lot of reading.
2. There will be several lectures from various experts besides the regular class hours. Students are expected to attend them.

CEG462 **Hydro Informatics** **3-1-0-4**

TYPE-WHEN **:** Engg Elective - Spring 2021

FACULTY NAME **:** Shaik Rehana

PRE-REQUISITE **:** Nil

OBJECTIVE: The goal of the course is to teach the principles and operation of Hydroinformatics in water management with the application of information technology

COURSE TOPICS:

Acquisition and Processing of Hydroinformatics Data: Automated data collection, data storage, file formats and standards, web-based data distribution, access and processing, geographic information system;digital image processing, digital elevation modeling.

Technologies in Hydroinformatics: Regression, Stochastic Models, Optimization, Data Driven Models

Application of Hydroinformatics: Operation, management and decision making, development of decision support systems for water, agriculture, energy, climate, and environment

Grading Policy:

Assignments =40%
Mid Sem I = 10 %
MID Sem II =10 %
Project = 20%
Final Exam =20%

REFERENCE BOOKS:

- Introduction to Geographic Information Systems by Kang-Tsung Chang
- Geographical information systems and science by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind
- Haan, C.T., Statistical Methods in Hydrology, East West Publishers, 1998
- Remote Sensing and Image Interpretation by Lillesand, T., Kiefer, R. W., and Jonathan Chipman.
- Lo, C. P., and Albert K. W. Yeung., Concepts and techniques of geographic information systems by C P

Lo and Albert K W Yeung

CSE595 **ICTs for Development** **3-1-0-4**

TYPE-WHEN **:** Spring 2021

FACULTY NAME : Nimmi Rangaswamy

PRE-REQUISITE **:** UG 3, UG 4

OBJECTIVE:

To introduce the idea of channelling the potential of Information and Communication Technology for socio-economic development to students of Engineering and the Social Sciences To debate the notion of development as a sociological concept, with a particular focus on India, and discuss and impacts of the development process on society as and a multi -faceted phenomenon
To formulate the idea of social media, as a component of ICTs, and the role they play in shaping the contours of a digital society

COURSE TOPICS/ CONTENT/ OUTLINE

Information and Communications Technology for Development is a growing area of research and community of scholars studying the role of technology in international development. Students in this course will study contemporary debates, issues and field projects that engage with information and communication technologies [ICTs] in the service of socio -economic progress and human development. This means a range of things: it could refer to the scope of technology in alleviating poverty, in impactin g low-resource settings, in designing and engineering relevant technologies to close digital literacy gaps in specific populations. Topics that will be covered as part of the course are the following. These are broad umbrella categories which contain sub-topics

Introduction to the idea of Development:

Studying development is essentially a multidisciplinary exercise rooted in a range of technical and social-science research. By combining a variety of subject areas, the course will engage deeply with some of the complex problems associated with developing economies especially unstable infrastructures, scarce resources and social disadvantages. We will discuss A Sen, K Galbraith among others

Globalization and Development

The course will specifically look at globalization as a socio-economic disruptor having far- fetched implications for not only wealth generation for a country but also bringing cultural transformations. We will disuses several historical trajectories of globalization in specific country contexts. We will include works of J Sachs, W Easterly

Technology and Development

The course will introduce a variety of social environments across resource and economic constraints that are targets for socio -economic development either through a top down model of deploying ICTs or through a more market driven and organic social processes. These can range from building low-cost technologies to studying user-driven innovations of ICTs to fit contexts of use. We will cover certain domain areas, using relevant theore

tical models and practical outcomes, within ICTs and Development, like, education, healthcare, livelihoods, entertainment and governance. Students will develop a critical lens to evaluate the processes and impacts and gain a well-rounded and practical perspective on issues of assessment and successes of development projects. A second focus of this course will be on digital and new media technologies as products of the digital revolution and as rapidly transforming the 'everyday' life of societies and indi viduals. As emerging economies globalize and urbanize rapidly, and users in the global south become 'prosumers' or more critical consumers and creative contributors of digital content, we require a shift in approaching new media users with a more open-ended and explorative perspective. Thereby, the motivating question for our course is what are the implications and impacts of new media as leisure (entertainment/pleasure/ play) artifacts and as professional tools for social mobility especially in the contexts of developing economies and emerging markets.

Introducing Information and communication technologies as harbingers of social change

Under this topic we will debate and discuss the nature and contours of new channels of information, social networking the rise of social media and online content generation. Questions posed by these digital artifacts evaluate the inherently democratizing, process of owning, using and networking with new media technologies. With the help of case studies, with a focus on India, we will articulate the implications of new and digital media in everyday life. We will focus on the sociology of new media technologies, with a specific aim to anchor them within select theoretical debates and in specific geographic contexts.

Social Media as a Developmental tool

Research had pointed to the rich field of utilization of new media tools for leisure and social networking as well as the unique affordances they spawn in the arena of self-expression and acquiring socio-digital identities. For example, the pre-pay mobile internet made web surfing an affordable and engaging activity even in the down markets and resource poor social ecologies of urban India. The course will critically evaluate the impacts of media technologies in the development discourse of a nation. The topic will include case-studies from the global North and South centering on social segments in resource-poor and emerging market settings [for example, 'Twitter in Political campaigns, Facebook use in the urban slum…].
This class has no pre-requisite requirements and open to students from any background. Students will be continuously evaluated with periodic quizzes/short tests and a course end assignment that will gauge student ability in engaging with and comprehending the cours e readings and class room discussions.

PREFERRED TEXT BOOKS:

1. J. Timmons Roberts and Amy Bellone Hite, Eds. The Globalization and Development Reader: Perspectives on Development and Global Change, Blackwell: London, 200

***REFERENCE BOOKS:**

1. Amartya Sen, Development as Freedom, Anchor Books: New York, 1999
2. C K Prahalad, The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits, Revised and Updated 5th Anniversary Edition, Prentice Hall, New Jersey
3. Jeffrey Sachs, The End of Poverty: Economic Possibilities for Our Time, Penguin Books: New York, 2006
4. Friedman, Thomas L. 2006. The World Is Flat: A Brief History of the Twenty-first Century, Farrar, Straus and Giroux
5. Easterly, W. 2002. "The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics. MIT Press

6. Turkle, S. (1984) The second self. New York: Simon & Schuster.
7. Mizuko Ito, Daisuke Okabe, and Misa Matsuda, eds., 2005, Personal, Portable, Pedestrian: Mobile Phones in Japanese Life(Cambridge, MA: MIT Pres
8. Turkle, S. (1995). Life on the screen: Identity in the age of the Internet. New York: Simon & Schuster.
9. Castells, Manuel (2001): Internet Galaxy. Oxford University Press
10. Lessig, Lawrence. 2009. "RE, Revived" i Remix: Making Art and Commerce Thrive in the Hybrid Economy. The Penguin Press, New York
11. Lister et. al. (2008): New Media A Critical Introduction. London and New York, Routledge.

GRADING PLAN:

Type ofEvaluation	**Weightage (in %)**
Mid Sem-1 Exam	
Mid Sem-2 Exam	
End Sem Exam	**25%**
Assignments	**25%**
Project	
Term Paper (In Lieu of Mid Sem-1)	**25%**
Other Evaluation (Term Paper and Presentation)	**25%**

OUTCOME:

Students will be able to identify and apply a developmental lens in a variety of and diverse socio-economic contexts. The course will provide a strong grounding in developing a sociological perspective of digital media and their impact in the evolution of a digital society as a part of parcel of socio-economic development. One of the critical question the course will attempt to unpack is how technology seeks to address the needs and aspirations of people who are increasingly consuming technologies and services despite living in low resourced eco systems.

REMARKS:

CSE581 Information Security Audit and Assurance 3-1-0-4

TYPE-WHEN : Spring 2021

FACULTY NAME: Shatrunjay Rawat

PRE-REQUISITE: Basic understanding of Computer Networks and Operating Systems

OBJECTIVE: To learn how to evaluate and enhance information security of IT infrastructure and organizations

COURSE TOPICS:

(1) Introduction to Information Security

(2) Security weaknesses in various networking protocols – IP, TCP, UDP, SMTP, RIP, OSPF, etc.

(3) Network Security Products – Firewall, IDS/IPS, VPN Devices, Content Screening Gateways, etc.
(4) Physical Security – Access Control Systems, Video Surveillance, etc.
(5) Security Features of Operating Systems
(6) PKI
(7) Security Standards – ISO 27001, Indian IT Act, IPR Laws
(8) Security Audit procedures
(9) Developing Security Policies
(10) Disaster Recovery, Disaster Management
(11) Business Continuity Management
(12) Security considerations while developing software
The course will be primarily driven by classroom discussions and assignments.

PREFERRED TEXT BOOKS:
No single text book. Required study material will be identified as course progresses.

REFERENCE BOOKS:
RFCs; Various Acts/Laws and Standards; Security Guideline documents of Operating Systems

PROJECT: TBD

GRADING:
Based on class participation, presentations, assignments, Mid/End Sem exams, Viva, etc.

OUTCOME:
Understanding of security needs and issues of IT infrastructure. Have basic skills on security audit of networks, operating systems and application software.

REMARKS:

CSE563 Internals of Application Servers 3-1-0-4

TYPE-WHEN : Spring 2021

FACULTY NAME : Ramesh Loganathan

PRE-REQUISITE :

OBJECTIVE :

COURSE TOPICS :

Understand essence of middlewares and distributed object technology. J2EE Technology and Architecture overview. J2EE App Server archit ecture. Lifecycle of a J2Eeapplication-deployment thru running and unemployment. Web Container internals. EJB Container internals. Essentials of Clustering architecture,Project problems Discussions

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

***PROJECT:**

GRADING:

OUTCOME:

REMARKS:

Intro to UAV Design 3-1-0-4

Course Code :

Note: Please use course code for previously existing course

CREDITS : 4

TYPE-WHEN : Elective, Spring 2021

FACULTY NAME : Harikumar Kandath

PRE-REQUISITE : NIL

OBJECTIVE : To understand the flight mechanics and design principles of unmanned aerial vehicle. To enable the student to perform a conceptual design based on design specifications.

COURSE TOPICS :
Types of UAVs--- Multi-rotors, fixed wing (FWUAV), Hybrid VTOLs

Multi-rotor design--- Concept of operation (CONOPS), design specifications, different reference frames, axis conventions, forces and moments, sizing and assembly, sensors and control.

FWUAV Flight mechanics and control--- wing, fuselage, stabilizer and control surfaces, propulsion system, forces (lift, drag, thrust, side force), moments (roll, pitch, yaw), trim conditions, longitudinal static stability, lateral and directional stability, PID control through successive loop closure.

FWUAV design--- Concept of operation (CONOPS), design specifications, preliminary sizing, airfoil selection, wing planform selection, control surface sizing, stabilizer sizing, selection of propulsion system (battery, motor/engine, propeller), stability and performance analysis, design tradeoffs.

Hybrid VTOL design--- Different configurations (tilt-rotor, tail sitter), transition dynamics, design specifications, sizing, stability and control.

**Software used as a part of the course: XFLR, ROS

PREFERRED TEXT BOOKS:

1) Aircraft Design, A Conceptual Approach, Daniel P Raymer, second edition.

***REFERENCE BOOKS:**

2) Introduction to flight, John D. Anderson, third edition.

3) Small Unmanned Aircraft: Theory and Practice, R. W. Beard and T. M. Mclain, first edition.

***PROJECT: The course will have a final project that covers the design of a UAV in detail supported by theoretical study and simulation analysis.**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	**10**
Assignments	**40**
Term paper	**10**
Project	**40**
Open book exam or 30 minute quiz	
Other Evaluation _____	

OUTCOME: The student will understand the principles of flight. The student will be able to perform a conceptual design based on the requirements set by the end user.

REMARKS:

EC5.205 Introduction to Coding Theory 3-1-0-2

Course Code **:** EC5.205

Note: Please use course code for previously existing course

CREDITS **:** 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 TEXT BOOKS:

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.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes	20%
Assignments	35%
Term paper	20%
Project	
Open book exam or 30 minute quiz	20%
Other Evaluation _____ 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:

CSE498 **Introduction to Game Theory** **3-1-0-4**

TYPE-WHEN : Spring-2020

FACULTY NAME : Sujit Gujar

PRE-REQUISITE : Basic Knowledge in Linear Algebra, Probability Theory and comfortable in basic maths

OBJECTIVE:

Game theory is a mathematical model to analyze and predict behavior of strategic agents. In the modern world, where every individual has access to the Internet and immense computing power, game theory has become an important, useful and relevant tool in day to day life to design protocols in variou s contexts, analyze negotiations or induce cooperation. The objective in this course is to introduce students to game theory and different types of games such as non -cooperative games, cooperative games, games with incomplete information. Additionally the students will be exposed to various tools and solution concepts in game theory.

COURSE TOPICS:

(a) What is game? Extensive form games vs strategic form games, two player zero sum games, mini-max theorem, dominant strategy equilibrium, Nash equilibrium and its existence. Co- operative game theory, core, imputations, Shapley value, Nash bargaining solution.

(b) Mini-max Theorem, Nash Theorem, Shapley's Theorem for core and algorithmic aspects of these theorems.

(c) Game with incomplete information, introducti on to mechanism design, revelation principle, voting schemes.

(d) Application of the above concepts will be illustrated with use cases in wireless communication, e-Commerce, social networking, crowdsourcing and, cloud management. (If time permits, advance topics such as) Arrows impossibility theorem, price of anarchy in routing games.

PREFERRED TEXT BOOKS:

"Game Theory and Mechanism Design" by Y Narahari.

***REFERENCE BOOKS:**

"Game Theory: Analysis of Conflict", by Roger B. Myerson.

***PROJECT:**

Students are expected to work in groups and develop a small software in Java to compute various solution concepts taught in the class.

GRADING PLAN:

Mid Sem-1 Exam	15
Mid Sem-2 Exam	15
End Sem Exam	20
Quizes	2.5
Homeworks	10
Scribes	5
Course Participation	2.5
Programming	10
Reading Project	10
Project	10

OUTCOME:

At the end of the course a student should be able to

(ii) Model and generate strategies for two person games.

(iii) Take a strategy decision problem and model it as appropriate game theoretic problem

(iv) Understand of different kinds of games and what kind of solutions are possible and their meaning

(v) Apply mechanism design to design games for specific outcomes.

REMARKS: The course is designed for senior undergraduate students. Postgraduate students are also welcomed.

Introduction to Particle Physics **3-1-0-4**

Introduction to Philosophy of Technology **3-1-0-4**

Course Code **:**

Note **: Please use course code for previously existing course**

CREDITS **:** 4

TYPE-WHEN **:** Spring 2021

FACULTY NAME **:** Ashwin Jayanthi

PRE-REQUISITE **:**

OBJECTIVE **:**

This course aims to introduce students to the field of philosophy of technology and acquaint them with contemporary debates by excursion through historical, conceptual, and normative investigations into the phenomenon of technology.

COURSE TOPICS **:**

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

I: What is Philosophy of Technology?

• Engineering and Humanities Philosophies of Technology
• Classical and Contemporary Philosophy of Technology

II: Encountering Technological Artefacts

• Conceptual history of ‘technology’
• What is ‘technology’? Continental and Analytic Perspectives

III: Epistemological Aspects to Technologies

• Science, Technology, and Engineering
• Philosophy of science and philosophy of technology
• Knowing-how and knowing-that

IV: Moral Status of Technologies

• Norms, Values, and Technologies
• Debates Concerning Moral Significance of Artefacts
• Role of Design in Moral Status

V: Philosophical Debates in Artificial Intelligence

• Philosophical background to Artificial Intelligence
• Philosophical and ethical issues within Artificial Intelligence

PREFERRED TEXT BOOKS:

• Hans Achterhuis (ed.), American Philosophy of Technology: The Empirical Turn, translated by Robert Crease, Indiana University Press: 2001.
• Carl Mitcham, Thinking Through Technology: The Path Between Engineering and Philosophy, The University of Chicago Press: 1994
• Robert C. Scharff and Val Dusek (eds.), The Technological Condition: An Anthology (Second Edition), John Wiley & Sons: 2014
• Peter-Paul Verbeek, What Things Do: Philosophical Reflections on Technology, Agency, and Design, translated by Robert Crease, The Pennsylvania State University Press, 2005
• Peter Kroes and Peter-Paul Verbeek (eds.), The Moral Status of Technical Artefacts, Dordrecht: Springer, 2014.
• Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach (Second Edition), Pearson, 2003
• John Searle, Mind: A Brief Introduction, Oxford University Press: 2004
• Vincent C. Muller (ed.), Philosophy and Theory of Artificial Intelligence, Springer-Verlag, 2013.

***REFERENCE BOOKS:**

• Val Dusek, Philosophy of Technology: An Introduction, Blackwell:
• Maarten J. Verkerk, Jan Hoogland, Jan van der Stoep and Marc J. de Vries, Philosophy of Technology: An Introduction for Technology and Business Students, translated by Dr M. Nelson, Routledge: 2016
• Peter-Paul Verbeek, Moralizing Technology: Understanding and Designing the Morality of Things. Chicago: University of Chicago Press, 2011.
• Franssen, Maarten, Pieter E. Vermaas, Peter Kroes, Anthonie W.M. Meijers (ed.)., Philosophy of Technology After the Empirical Turn. Switzerland: Springer, 2016.
• Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Farrar, Strauss and Giroux, 2019.
• Vincent C. Müller (ed.), Fundamental Issues of Artificial Intelligence, Springer: 2016.
• Keith Frankish and William M. Ramsey, The Cambridge Handbook of Artificial Intelligence, Cambridge University Press, 2014.

***PROJECT:**

This will involve applying the conceptual tools learnt in class to critically analyze a particular technology and present their analyses of the same. A 2000 word essay will have to be submitted and the main points presented in class.

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Short Assignments (4)	20% (5% each)
Long Essay	20%
Project	20%
Term Paper (2)	20% (10% each)
Book Review	10%
Class Participation	10%

OUTCOME:
Students would be able to comprehend and critically analyze key debates in the philosophical thinking on technology. They would be able to use the conceptual toolbox accrued herein to critically investigate into particular technologies from multiple perspectives.

REMARKS:

This course provides a selection of issues/debates/arguments and not a comprehensive survey, nor a detailed analysis, of any specific issue concerning technology. However, the course is designed to encourage students to explore these specific issues in greater detail through their assignments and projects.

Linear partial differential equations and variational calculus 3-1-0-4

Course Code :

Note: Please use course code for previously existing course

CREDITS : 4

TYPE-WHEN : Spring semester

FACULTY NAME : Samyadeb Bhattacharya

PRE-REQUISITE : Basic knowledge of ordinary differential equations.
OBJECTIVE : Getting students equipped with skills to solve practical physical problems.

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

1. Basic concepts and definitions.
2. Mathematical problems.
3. Linear operators.
4. Superposition principle.
5. First order quasi-linear equations and method of charecteristics.
6. Mathematical models: a) Vibrating strings and membranes, b) Heat conduction, c) Schroedinger equation

7. Classification of second order linear equations.
8. Method of separation of variables.
9. Introduction to eigenvalue problems.
10. Introduction to boundary value problems.
11. Variational calculus.
    a. Application: Least action principle, brachistochrone and related problems.
    b. Application:Euler-Lagrange's equation and related problems.
    c. Hamilton's principle and related problems.

PREFERRED TEXT BOOKS: K.T. Tang, Mathematical methods Engineers and scientists 3.

***REFERENCE BOOKS:** Tyn Myint-U and Lokenath Debnath, Linear partial differential equations for scientists and engineers. (other references will be given during the course)

***PROJECT:** Problems will be given to groups of students, which they have to solve and give a presentation. (Topics will be decided during course)

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid Sem Exam	**15**
Quiz-2	**10**
End Sem Exam	**25**
Assignments	**20**
Project	**20**
Term Paper	**NA**
Other Evaluation _____	

OUTCOME: Students are expected to come out of the course equipped with the tools for handling applications of linear partial differential equations.

REMARKS: Comments and suggestions are wholeheartedly welcome.

CLG452 Linguistic Data 2: Collection & Modeling 3-1-0-4

TYPE-WHEN : Spring 2021

FACULTY NAME : Parameswari Krishnamurthy, HCU

PRE-REQUISITE : Preferred Introduction to Linguistics, CL1

OBJECTIVE: The objective of Linguistic Data II course is to introduce the students to the necessary concepts and the methods for analysing linguistic data at different levels of language organization. They will also be given practical training in analyzing data, storing and modeling it for NLP applications.

COURSE TOPICS:

1. Discourse and Dialogue coherence theories

a. Discourse relations and connectives

b. Dialogue acts

c. Anaphora processing

d. Politeness theory

e. Bias in news data

2. Collection and formatting of data from various web resources

3. Developing an annotation schema

4. Annotation of collected data

GRADING: Seminar 10, Term paper 20, MidSem 30, Project 40

Reference:

Penn Discourse Tree Bank (PDTB) guidelines Rhetorical Structure Theory (RST) manual

Greene, Judith. 1986. Language Understanding: A Cognitive Approach. Open University Press. Leech, Geoffrey N. 1983. Principles of Pragmatics. London: Longman.

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

Sacks, Harvey, Emmanuel Schegloff and Gail Jefferson. 1974. A simplest systematics for the organization of turn-taking in conversation. Language, 50, 696-735.

Brown, Gillian and George Yule. 1983. Discourse Analysis. Cambridge: Cambridge University Press.

Andrew Mullen and Jeffery Klaehn. 2010. The Herman–Chomsky Propaganda Model: A Critical Approach to Analysing Mass Media Behaviour.

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.458.4091&rep=rep1&type=pdf Steven J. Allen. 2015. Article on Deception and Misdirection: 8 types of media bias. https://capitalresearch.org/article/media-bias-8-types-a-classic-kinda/

HSS445 **Literature –American Classics** **3-1-0-4**

TYPE-WHEN **:** Spring 2021

FACULTY NAME **:** Aruna Chaluvadi

PRE-REQUISITE **:** 3rd and 4th yr students

OBJECTIVE:

This course aims to introduce literature with a focus on Classic American works. It examines the ethos in which themes and sensibilities took shape and expression.

COURSE TOPICS:

1. What constitutes Literature - Introduction, Historical Survey- Romanticism, Realism, Naturalism

2. Literary Theories - Historical Survey, Moral Criticism, Dramatic Construction (~360

BC-present),Formalism, New Criticism, Neo-Aristotelian Criticism (1930spresent),Psychoanalytic Criticism, Jungian Criticism(1930s-present),Marxist Criticism (1930spresent)Reader-Response Criticism (1960s-present), Structuralism/Semiotics (1920spresent),Post-Structuralism/Deconstruction (1966-present),New Historicism/Cultural Studies

(1980s-present),Post-Colonial Criticism (1990s-present),Feminist Criticism (1960spresent)Gender/Queer Studies (1970s-present),Critical Race Theory (1970s-present)

3. Thomas Jefferson- Declaration of Independence, R W Emerson-Nature, H D Thoreau- Civil Disobedience

4.James Fenimore Cooper - The Last of the Mohicans, Edgar Allen Poe- The Tell Tale Heart and The Raven, Herman Melville- Moby-Dick, Mark Twain-Tom Sawyer, Nathaniel Hawthorne-The Scarlet Letter

5.Harriet Beecher Stowe-Uncle Tom's Cabin, W.E.B. Du Bois- The Souls of Blackfolk

6.Walt Whitman -Leaves of Grass, Emily Dickinson, Stephen Crane, Robert Frost

7.Henry James, Jack London, Upton Sinclair

8.Edith Wharton, Gertrude Stein, Willa Cather

9.T.S. Eliot, John Steinbeck

10.F. Scott Fitzgerald, Ernest Hemingway,

11. William Faulkner, Langston Hughes, Zora Neale Hurston

13.Eugene O'Neill, Tennessee Williams, Arthur Miller

14.Ralph Ellison, JD Salinger

15. Harper Lee, Toni Morrison

Selections for Reading:

Upton Sinclair: The Jungle

Willa Cather: My Antonia

Jack London: On the Road

Emily Dickinson: Selected Poems

Stephen Crane: Selected Poems

Robert Frost: Selected Poems

John Steinbeck : East of Eden

F Scott Fitzgerald: Tender is the Night

Ernest Hemingway : Old Man and the Sea

William Faulkner: The Sound and the Fury

Eugene O'Neill: Desire Under the Elms, Arther Miller : Death of a Salesman

JD Salinger: Catcher in the Rye, Franny and Zooey

Toni Morrison: The Bluest Eye, The Beloved

PREFERRED TEXT BOOKS:

https://owl.english.purdue.edu/owl/resource/722/01/

Online Material, Movies, Audio Texts (Extracts- Poetry, Short Stories, Novels, Essays)

REFERENCE BOOKS:

The Norton Anthology of American Literature, Online Material,

https://archive.org/details/outlinehistoryof00hudsuoft

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	15%
Mid Sem-2 Exam	15%
End Sem Exam	30%
Assignments	15%
Project	-
Term Paper	15%

Group Presentation of evaluation of a Text _____	10%

OUTCOME:

Students would come to be familiar with American Classics and would learn to appreciate and evaluate literature critically.

Literature, History and Belonging in Hyderabad 3-1-0-4

Course Code :

Note: Please use course code for previously existing course

CREDITS : 4

TYPE : Humanities (Elective; 300 level)

WHEN : Spring 2021

FACULTY NAME : Nazia Akhtar

PRE-REQUISITE :

OBJECTIVE : This course charts major literary themes and genres from Hyderabad. It offers a survey of poetic and prose texts in English translation. Founded in 1591, the city of Hyderabad became a prominent cultural centre in the Deccan, known for its literature, music, art, and architecture. As a result of the inclusive and plural practices of the rulers, saints, and people of this region, a distinct syncretic culture developed in and around the city, which was shared by people irrespective of linguistic, religious, or ethnic affiliation.

This course offers students the opportunity to study Hyderabad through prominent themes in literary texts and examine the social, historical, and political processes that went into the creation of its unique culture. Culture and cultural productions say a lot about who we are, where we have come from, and where we might be headed. The course will give students the chance to think about and discuss larger questions of identity, citizenship, and belonging. They will also be encouraged to investigate the ways in which literature itself participates in creating and contesting these concepts. In the process, they will be able to isolate and understand the precise ways in which words and images work in literature to create certain narratives. These discussions will empower students to develop their analytical and interpretive skills in relation to the study of culture, so that they can develop a well-rounded perspective on the world in which we all live.

COURSE TOPICS :

1. **The People's Poetry: The Plural Traditions of Dakhni** – Dakhni is a link language that draws from many regional and non-regional languages in the Deccan. We will read and discuss Dakhni poetry in translation and study the ways in which it represents the lives, experiences, and perspectives of

common people in this region. These poems will also allow us to see how Dakhni poets imagined the Deccan and the Indian subcontinent and articulated a sense of belonging in relation to these geopolitical entities. In this context, we will discuss contemporary and subsequent assessments of their work and milieu through ideas and concepts such as syncretism, pluralism, and patriotism.

2. **Literature and Culture at the Asaf Jahi Court (1724-1948)** – This module will offer a glimpse into the thriving literary culture at the court of the Nizams of Hyderabad, where men and women of different ethnic, religious, and professional backgrounds produced rich ghazal poetry. We will study the themes and concerns of their work and examine the role this ghazal tradition played in imagining and legitimizing Asaf Jahi rule in Hyderabad, both through disruption and engagement with literary precedents.

3. **Revolution, Partition, Independence in Hyderabad** – Hyderabad boasts a well-known tradition of Progressive writing that speaks truth to power. We will read poetry and prose by some of the most important poets and writers of the twentieth century and see how they represented the critical years (1940s) of the transfer of power in Hyderabad. Their work offers vital critiques of older socio-economic and political structures of Hyderabad and demonstrates a radical shift in how the society, people, and landscape of Hyderabad came to be envisaged and represented.

4. **Hyderabadi Pasts: History, Memory, and Culture in Personal Narratives** –This theme will involve the study of excerpts from the personal narratives penned by Hyderabadi women and men in the last two centuries. Life-writing, i.e. memoirs and autobiographies, offers vital glimpses into how people perceive themselves and their role in a larger socio-cultural and historical background. In the process, these writings by Hyderabadis also participate in the narrative construction of Hyderabad along certain lines. We will explore these narrative claims, some of which have hegemonic implications about the way Hyderabad continues to be represented and perceived.

5. **Inverting the Terms of Reference: Women Writing in Hyderabad** – Hyderabadi women have been prolific writers since the late nineteenth century. We will read and discuss the short stories and essays written by some of them and evaluate their relevance to our society today. This unit will also feature a guest lecture by Telugu writer Volga about her work. Our analysis of the genres and concerns chosen by women writers will throw light on how women's perspectives and interventions frequently shaped and influenced the course of history, society, and culture in Hyderabad.

6. **Writing from the Margins** – In this module, we will see how writers from Hyderabad have represented the social and material realities of class, caste, and minority. Two of these writers will also speak to the class about the prominent concerns that emerge in their writing. We will also contemplate in this module the very category of "Hyderabadi" and other related local and national identities and investigate their meaning with reference to the question of marginalization.

7. **"Every City is a Story": New Narratives of Globalization** – This module will bring together the strands of all the previous modules and also add to them through readings of poetry, a graphic novel, and non-fiction essays. We will touch briefly on food writing and the popular trend of heritage walks. The aim will be to review the ways in which Hyderabadis have defined themselves and their city in

recent decades, especially in view of dramatic transformations as a result of globalization. Jai Undurti will deliver the guest lecture to conclude this module.

PREFERRED TEXT BOOKS: Chapters and excerpts from the following books will form the textbook for this course.

1. Translations by Shagufta Shaheen and Sajjad Shahid of poems by Dakhni poets. In Kousar J. Azam (Ed.), *Languages and literary cultures in Hyderabad* (2017)
2. Scott Kugle – *When Sun Meets Moon* (2016)
3. Makhdoom Mohiuddin – *The Red Dawn* (1944; poems)
4. Jeelani Bano – *A Hail of Stones* (1984; novel); excerpt from *The Palace of Ghazal* (1976; novel)
5. Ashokamitran – *The Eighteenth Parallel* (1977; novel)
6. Letters by Sarojini Naidu. In Makarand Paranjape (Ed.), *Sarojini Naidu: Selected Letters, 1890s-1940s* (1996)
7. Huma R. Kidwai – *The Hussaini Alam House* (2012; novel)
8. Venkatesh Kulkarni – *Naked in Deccan* (1983; novel)
9. Skybaaba – *Vegetarians Only: Stories of Telugu Muslims* (2016; short stories)
10. G. Shyamala – selections from *Father May Be an Elephant and Mother Only a Small Basket But …* (2012; short stories)
11. Sarojini Naidu – *The Bird of Time* (1912; poems)
12. Jai Undurti and Harsho Mohan Chattoraj – *Hyderabad Graphic Novel* (2014; graphic novel)
13. Essays by various contributors from Syeda Imam (Ed.), *The Untold Charminar: Writings on Hyderabad* (2008)

***REFERENCE BOOKS:** Articles and chapters/excerpts from books will be assigned for each module. A list for further reading will be provided to help students work on their final projects as well as read further on topics of particular interest.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Assignments	30%
Project	30%
Term Paper	40%
Other Evaluation _____	

OUTCOME: On successful completion of the course, students will be equipped with a good knowledge of Hyderabad's literary history and an appreciation of the role of literature in the creation and contestation of memory and history. They will also have a broad understanding of Hyderabad's history, society, and culture. Besides literary and ethnographic dimensions, the course will give students the chance to develop an informed understanding of larger questions of identity, citizenship, and belonging. Along with a solid grasp over literary

terms and concepts, they will possess a foundation in important techniques of textual analysis and will have experience in writing an argumentative essay or position paper. In the process, they will have developed a thoughtful and informed critical voice that will enable them to meaningfully situate culture and cultural productions in the world around them.

REMARKS:

1. Each module will be prefaced by an introductory lecture. This will be followed by classroom interactions in the form of combined discussions, lectures, and activities associated with the readings. Some modules will also have guest lectures.
2. While some of the texts covered in this course were written in English, most were originally published in Urdu and Telugu and will be made available to students in English translation (original language texts can also be made available to students who are interested). Additionally, these primary texts will be situated in our analysis through selected critical texts or secondary sources.

3. This course will entail active participation of students in class discussions. Students will choose two topics from the course and analyze them in greater depth for the project and term paper respectively.

SCI477 Machine Learning for Natural Sciences 3-1-0-4

TYPE-WHEN : Science/CNS elective – Spring 2021

FACULTY NAME : Nita Parekh + Girish Varma + Prabhakar B

PREREQUISITE : Statistical methods in AI (additionally Science-I and Science-II for nonCND students)

OBJECTIVE : This course will attempt to enable students along with faculty mentors to review the emerging utility of machine learning in natural sciences, and to apply state-of-the-art machine learning methods to solve problems in natural sciences.

COURSE TOPICS :

Application of machine learning in the following broad areas:

● Materials discovery

● Molecular design in chemistry and biology

● Higher-dimensional molecular potential energy surfaces

● Molecular simulations

● Bioinformatics

Additionally, lectures by scientists from academia and industry working in these areas.

PREFERRED TEXT BOOKS:

Review papers in the broad areas listed above published during the last three years; recent research articles related to the chosen project. Material will be provided from time to time.

***REFERENCE BOOKS:**

1. Introduction to Computational Chemistry by Frank Jensen

2. Modern Quantum Chemistry by Attila Szabo and Neil Ostlund

***PROJECT:** Major component of this course is a project during the last two-thirds of the semester. Students will form teams of two or three (one from CNS + one from CSE + one from TIFR Hyderabad) to do projects. Each faculty member involved in the course will guide one or two teams with weekly meetings for discussions and assessment of the progress of the projects.

GRADING PLAN:

Grading will be based on literature review and project.

Type of Evaluation	Weightage (%)
(A) Literature review (30%)	
Class participation	10%
Presentation & term paper	20%
(B) Project (70%) - after Midsem-I	
Weekly progress (as assessed by faculty mentor)	20%
Intermediate presentations (once in two weeks)	20%
Final presentation	20%
Final Scientific report	10%

OUTCOME: An understanding of how AI/ML is applied for solving problems in natural sciences, and hand-on experience in problem solving.

REMARKS: This course is being offered on an experimental basis and will be continued to be offered based on the experience after suitable modifications. It is proposed that a limited number of students (6 CSD/CSE Honors + 6 CND + up to 6 early-PhD students from TIFR) will be interviewed and selected for this course.

Machine Learning for Wireless Communications 3-1-0-4

TYPE-WHEN **:** Spring 2021

FACULTYNAME **:** Ubaidulla

Medical Image Analysis 3-1-0-4

TYPE-WHEN **:** Spring 2021

FACULTYNAME **:** Jayanthi Sivaswamy

PRE-REQUISITE **:** Digital image processing (preferred)

OBJECTIVE **:** Medical images are a vital and widely used source of diagnostic information. From simple X-rays to SPECT and FMRI such images provide a window into the functioning of human bodies and other organisms. Processing of medical images is needed for various purposes ranging from providing high quality information for visual inspection and guidance for surgeries, to extracting higher order information about the condition of different issues/organs/structures. This course will provide an hands-on introduction to the exciting area of medical image processing, an area of focus for several major international conferences.

COURSE TOPICS :

1. Physics of medical imaging Optical,X-ray, acoustic, magnetic and nuclear

2. Fundamentals Types of images, data formats, tools for medical image processing (ITK, VTK)

3. 3D and nD image processing

4. Problems in med IP Image conditioning illumination/geometric correction, denoisingSegmentation Geometric and other methods Rigid and non-rigid image registration and Fusion Reconstruction

5. Validation of results Signal detection theoretic issues

PREFERRED TEXT BOOKS:

*REFERENCE BOOKS:Fundamentals of medical imaging by Paul Seutens, Cambridge University Press.

Handbook of Medical Imaging, Vol 2: Medical image processing and analysis, by Jacob Beutel and Milan Sonka. Geometric methods in medical image processing by Ravikanth Malladi. Medical image processing-reconstruction and restoration by Jiri Jan. Medical Imaging Systems, by Albert Macouski, Prentice Hall, New Jersey.

***PROJECT:**

GRADING:

2 midsem exams (40%) + 1 final project (30%)+ assignments using ITK (National Library of

Medicine Insight Toolkit) an open source software library (30%).

OUTCOME:

REMARKS

Molecular Modeling and Simulations 3-1-0-4

TYPE-WHEN : Bouquet core & Open elective, Spring 2021

FACULTY NAME : Prabhakar B + Deva PriyaKumar

PRE-REQUISITE : None

OBJECTIVE :

To introduce the fundamental concepts of molecular modeling and simulation to students (mainly for computational natural sciences and bioinformatics students) and motivate/train them to apply these concepts/techniques to solve interesting research problems.

COURSE TOPICS:

1 Basic Maths: coordinate systems, vector algebra, differential equations, matrices, Taylor expansion (1 lecture)

2 Molecular Mechanics: Molecular force fields, energy minimization (2 lectures)

(3) Molecular Dynamics: Equations of motion, phase space distribution functions, sampling, integrators, boundary conditions, electrostatics, molecular constraints (5 lectures)

(4) Free energy calculations: Umbrella sampling, thermodynamic integration, replica exchange method (2 lectures)

(5) Monte Carlo methods: Pi-value computation, important sampling, Metropolis algorithm, applications

(1 lecture)

(6) Non-equilibrium molecular dynamics: Jarzynski equality, steered molecular dynamics, shear flow (2 lectures)

(7) solvent models: Implicit models, explicit models (1 lectures)

(8) Quantum Chemistry: Operators, wavefunctions, postulates, probability density, timedependent Schrodinger equation (2 lectures)

(9) Translational, rotational, vibrational dynamics of simple quantum systems, hydrogen atom

(3 lectures)

(10) Molecular quantum mechanics: Born-Oppenheimer approximation, LCAO, Variation

theorem, perturbation theory, Huckel theory, HF, semi-empirical methods, electron correlation,

CI (4 lectures)

(11) DFT (1 lecture)

(12) Force field parameterization using quantum mechanical methods (1 lecture)

(13) Students presentations (3 lectures)

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

1. Computer Simulation of Liquids, by M.P. Allen and D.J. Tildesley

2. Understanding Molecular Simulation: From Algorithms to Applications, by D. Frenkel and B. Smit

3. Molecular Quantum Mechanics by Atkins

***PROJECT:**

GRADING: Will be decided later after discussing with students

OUTCOME:

REMARKS:

IMA409 **Multivariate Analysis** **3-1-0-4**

TYPE-WHEN **:** Spring

FACULTY NAME **:** M. Venkateswarlu

PRE-REQUISITE **:** Statistics

OBJECTIVE **:** The course aims at the coverage of statistical methods that infer information from the datasets that are obtained by measurements on several variables and to look at the underlying probability model.

COURSE TOPICS :

1. Preliminaries: Organization of data, Statistical distance, Geometry of the sample, Random samples, expected values of the sample mean and covariance matrix, Generalized variance, Matrix operations for sample mean, covariance, and correlation, Linear combination of variables.

2. Matrix Algebra and Random Vectors: Positive definite matrices, Quadratic forms, Spectral decomposition of a matrix, Square-root matrix, Random vectors and matrices, Mean vectors and covariant matrices, Matrix inequalities and maximization

3. Multivariate Normal Distribution: Multivariate normal density, Sampling from a multivariate normal distribution, Maximum likelihood estimation, Sampling distributions, Large-sample behavior, Assessing the assumption of normality.

4. Inferences About a Mean Vector: Testing a multivariate mean vector, Likelihood ratio tests, Confidence regions, Simultaneous comparison of component means, Large sample inferences about a population mean vector.

5. Comparison of Several Multivariable Means: Paired comparisons, Repeated measures design for comparing treatments, comparing mean vectors from two populations, A review of univariate analysis of variance (ANOVA), Comparing several multivariate population means (One-Way MANOVA), Simultaneous confidence intervals for treatment effects, Testing for equality of covariance matrices, A review of univariate two-way analysis of variance, Two-way multivariate analysis of variance, Profile analysis.

6. Inferences for Regression: Review of the classical linear regression model and Inferences about the regression model, Inferences from estimated regression function, Model checking, Multivariate Multiple Regression

PREFERRED TEXT BOOKS: Applied Multivariate Statistical Analysis, Richard A Johnson and Dean W Wichern.

***REFERENCE BOOKS:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	20
Mid Sem-2 Exam	20
End Sem Exam	40
Assignments	20

OUTCOME: Testing of specific statistical hypotheses, formulated in terms of the parameters of multivariate populations; Comparisons among mean vectors using multivariate analysis of variance; Data reduction and Interpretation.

REMARKS:

CSE588 Music, Mind, and Technology (30) 3-1-0-4

TYPE-WHEN : Spring 2021

FACULTY NAME : Vinoo Alluri

PRE-REQUISITES :

None (Interest in Music, Open mind, Enthusiasm and Motivation! No dislike for DSP helps! Basic MATLAB programming)

DESCRIPTION:

The objective of the course is to give an appreciation of the main concepts of the field of Music Cognition and Technology. You will learn about topics in music psychology (from perception to cognition), familiarize yourselves with music signal analysis and music information retrieval (MIR), ending with the interdisciplinary field of cognitive neurosciences of music (with a focus on functional magnetic resonance imaging (fMRI) studies).

Apart from this, the course provides an overview of main areas of contemporary research of music perception and cognition such as musical preferences and personality, music and movement, music and emotion, music and mental well-being, and music processing in the brain.

As part of the course requirements, students are required to do three projects:

1) requires conducting experiments on human subjects to study any one of the topics covered in the class (perceptual study)
2) design solutions to problems using signal processing and pattern classification (focusing on the field of MIR)
3) music and neuroscience based project (data will be provided by the instructor)

COURSE TOPICS:

Music Psychology: Introduction, Origins and functions of music, effect of music listening and training on cognitive skills, music in everyday life, Music and Movement, Music and Personality and Preferences.

Psychoacoustics of Music/Music Perception: Auditory system, pitch, timbre, rhythm

Music Information Retrieval: Audio/Musical Signal analysis (with a focus on the MIRToolbox), Acoustic Feature Extraction, Similarity and Classification, General overview of Digital Filters used in Musical Signal Processing

Music Cognition and Neuroscience:

Musical moods and emotions, Music and mental well-being, Music processing in the brain.

REFERENCE BOOKS:

(PDF copies of material from the following will be made available for reading)

- Cook, P. (Ed.) (1999). Music, cognition, and computerized sound. MIT Press: Cambridge, MA. (Chs. 1, 2, 6, 7, 8, 10, 13, 14, 17)
- W. F. Thompson (2009). Music, thought, and feeling. Understanding the psychology of music. OUP: New York.
- P. N Juslin & J. A. Sloboda (Eds.) (2001), Music and Emotion: Theory and Research. New York: Oxford University Press
- S. Hallam, I. Cross, M. Thaut (2017), The Oxford Handbook of Music Psychology (2 ed.) 10.1093/oxfordhb/9780198722946.001.0001

***REFERENCE CONFERENCES AND JOURNALS:**

Relevant conference proceedings and journal articles will be suggested when needed.

- Proceedings of following Conferences: **ICMPC, ESCOM, & ISMIR**
- Journals: Music Perception, Psychology of Music, Journal of New Music Research, Psychomusicology, Mind and Brain, Neuroimage, Human Brain Mapping

GRADING (indicative only):

Mid-term Exam (1): 10%

Final Exam: N/A
Project 1: 20%
Project 2: 20%
Project 3: 30%
Quizzes/ Assignments: 15%
Class Attendance and Participation: 5%

OUTCOME:

At the end of the course, students will have an appreciation for the interdisciplinary field of Music Perception & Cognition and MIR. It is expected that students would acquire both the knowledge of the state-of-the-art in the same and also practical experience and appreciation of how empirical studies are conducted to investigate human behavior in relation to music. One of the purposes of the projects is to provide means for the students to address a research question in the broader framework of music research with the hope of eventually leading to a conference submission or subsequent journal article. Furthermore, this course would enable the students to carve out a long-term interdisciplinary research / development project in fields such as Cognitive Science, Signal and Speech processing, Computer Vision and Music Information Retrieval.

Nonlinear Dynamics 3-1-0-4

TYPE-WHEN **:** SPRING

FACULTY NAME **:** Dr. Vinod P.K.

COURSE DESCRIPTION **:**

This subject deals with mathematics of how systems evolve in time. It is used to analyse whether system in question settles down to equilibrium, keeps repeating in cycles or does something more complicated. The course focuses on nonlinear dynamics with applications in science and engineering. The emphasis will be on geometric thinking, computational and analytical methods.

COURSE TOPICS:

1. Overview

Capsule history of Dynamics, A dynamical view of world

2. One-Dimensional flows

Flows on the line, Bifurcations, Flows on the circle

3. Two-Dimensional Flows

Linear System, Phase Plane, Limit Cycles, Bifurcations

4. Chaos

Lorenz Equations, One-Dimensional Maps

PREFERRED TEXT BOOKS:

1. Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry and

Engineering by Steven Strogatz

2. Understanding Nonlinear Dynamics by Daniel Kaplan and Leon Glass

3. Simulating, Analyzing and Animating Dynamical Systems: A Guide to XPPAUT for

Researchers and Students by Bard Ermentrout

GRADING:

Mid semester exam 1 – 20%

Mid semester exam 2 – 20%

End semester exam – 40%

Assignments – 20%

CSE481 **Optimization Methods** **3-1-0-4**

TYPE-WHEN **:** Spring, 4XXX level

FACULTY NAME **:** CV Jawahar

PRE-REQUISITE **:** Strict Prerequisites: NIL

Expected Background:

To follow this course, some level of familiarity with linear algebra (specially, vectors and matrices) is expected. In addition, student is expected to know the fundamentals of algorithms and some of the popular problems (eg. shortest path.)

OBJECTIVE:

1. To enable students to formulate and solve problems in an optimization framework.
2. To expose a set of powerful tools and techniques to the students. To demonstrate how these tools (i.e. optimization methods) can be used in practice.
3. To visualize the optimization algorithms and know the numerical and practical issues in their implementation.
4. To relate the optimization methods to applications in diverse areas.

COURSE TOPICS :

Linear Equations, Solutions based Matrix Factorization, Singular Value Decomposition, Linear Least squares, Numerical algorithms, Convergence, Applications. Nonlinear equations,

Unconstrained minimization, Gradient, Hessian, Conjugate gradient , Newton's method, Applications and Computational Issues. Linear Programming, Geometric Interpretation, Simplex Method, Duality, primal dual method,

Interior point methods, Ellipsoidal methods, Computational Issues. Integer programming, LP relaxation, Examples from combinatorial optimization. Shortest paths, network flows and matchings.

Additional topics (if time permits) related to

(i) Specific Algorithms (eg. Cutting plane algorithms, Stochastic gradients)
(ii) Applications in Approximate Algorithms
(iii) Computational issues in large scale optimization
(iv) Heuristic methods for optimization

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

1. M T Heath, ``Scientific Computing", TMH (Most of First six chapters)
2. C H Papadimitriou and K Steiglitz, _Combinatorial Optimization: Algorithms and Complexity" (Most of First seven chapters), Dover
3. S. Boyd and L Vandenberghe, ``Convex Optimization", Cambridge University Press (Online Copy available at: http://www.st anford.edu/~boyd/cvxbook/)
4. L Vandenberghe, Lecture Notes for Applied Numerical Computing, (Online available at: http://www.ee.ucla.edu/~vandenbe/103/reader.pdf)
5. D Bertisimas and J N Tsitsiklis, ``Introduction to Linear Optimization", Athena Scientif ic
6. J Matousek and B. Gartner, ``Understanding and Using Linear Programming", Springer, 2007

GRADING:

Evaluation will be more or less as follows:
Mid Semester Exams (2) - 30
Final Exam - 25
Quizes - 10
Assignments - 25
TermPaper/Project – 10

OUTCOME:
This course will help in sharpen the problem solving skills of students. Students will have experience informally stating problems with the associated constraints, and solving them with computer friendly algorithms.

SC2.301 Physics of Soft Condensed Matter 3-1-0-4

TYPE-WHEN **:** Spring 2021

FACULTY NAME **:** Marimuthu Krishnan

PRE-REQUISITE **:** Science-I/II courses (for non-CND students) and none for CND students.

OBJECTIVE: This course will focus on basic concepts and recent advances in soft condensed matter physics, with particular emphasis on the equilibrium and non-equilibrium properties of simple liquids, biopolymers, and macromolecular assemblies. We will first introduce theoretical tools needed to understand many-body systems followed by some discussion on experimental techniques commonly used to probe soft condensed matter.

COURSE TOPICS:

(1) Introduction to soft condensedmatter
(2) Phase space probability density functions (PDFs)
(3) Time evolution ofPDFs
(4) Liouville equation and Liouville theorem
(5) Particle densities and distribution functions
(6) Radial distribution function and pair correlation functions
(7) Statistical properties of liquids: thermodynamics and structure
(8) Static and dynamic structure factor
(9) density fluctuations and fluctuation -dissipation theorem
(10) Fluctuation theorems
(11) Mechanics of biomembranes
(12) Molecular transport through nanopores
(13) Single-molecule kinetics

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

(1) Theory of Simple Liquids: With Applications to Soft Matter by I. R. McDonald and J. P. Hansen
(2) Principles of Condensed Matter Physics by P. M. Chaikin and T. C. Lubensky
(3) For non-equilibrium systems, relevant research articles will be provided

***PROJECT:** Reading assignments and mini projects will be given

Grading Plan: The grading plan will be decided later

Type of Evaluation	**Weightage**
Quiz-1	
Quiz-2	
Mid Sem	20%
End Sem	30%
Project	30%
Assignment	20%
Other Evaluation	__

OUTCOME: It is anticipated that the students will use the modern theoretical tools and experimental techniques covered in this course for their research projects.
REMARKS: The maximum number of non-CND students permitted to take this course is 3

Readings in Indian Literatures **3-1-0-4**

Course Code :

CREDITS **:** 4

TYPE-WHEN :

FACULTY NAME **:** Sushmita Banerjee

PRE-REQUISITE **:** None

OBJECTIVE **:** This is a readings course that engages in the pleasure and challenge of the close reading of literary texts. We will look at modern Indian literatures in translation to see how individuals imagine their own, particular lives and create a sense of a shared past and a shared culture. We will explore, among other issues, how the self is constructed through reading and writing, the relationship between memory and identity, the claims of authenticity or truth, the oscillation between interior and exterior life, and the peculiarities of individual voice.

COURSE TOPICS **:**

Unit 1: Individual and Society

Unit 2: Histories in the making

Unit 3: Troubled corners of our making

PREFERRED TEXT BOOKS:

Students will be required to purchase/have available a selection of novels and poetry anthologies for the class. The texts to be read for the class are (not limited to):

Curfewed Night (Basharat Peer, 2009)

Raag Darbari (Shrilal Shukla)

Agnisakshi: Fire, My Witness (Lalithambika Antharjanam, Trans. 2015)

Herbert (Nabarun Bhattacharya, Trans.2019)

Ghachar Ghochar (Vivek Shanbaugh)

A Country Without a Post Office (Agha Shahid Ali, 2013)

REFERENCE BOOKS:

Ahmad, Aijaz. *In Theory: Classes, Nations, Literatures*. London: Verso, 1992.

Bennet, Tony and John Frow, eds. *The Sage Handbook of Cultural Analysis.* London: Sage Publications, 2008.

Grassman, Edith. Ed. *Why Translation Matters,* Orient Blackswan. New Delhi.2011

Nandy, Ashish. *The Intimate Enemy: Loss and Recovery of Self under Colonialism*. OUP, Delhi.1983

Tiwari, Shubha. Ed. *Indian Fiction in English Translation*. New Delhi, Atlantic, 2005

GRADING PLAN:

Type of Evaluation	Weightage (in %)
In-class Quiz x 2	**10% x 2 = 20%**
Term Paper 1	**20%**
Term Paper 2	**20%**
Term Paper 3	**20%**
Term Paper 4	**20%**

OUTCOME: Students will learn to critically engage with literary texts, and read popular texts in nuanced and informed ways.

REMARKS: Students are expected to read up to 8 books in the course of the semester, watch any video lectures made available, and view films 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.

CEG461 **Remote Sensing** **3-1-0-4**

TYPE-WHEN **:** Open / Engineering Elective

FACULTY NAME **:** RC Prasad

PRE-REQUISITE **:** Open to PG, UG-4 & UG-3

OBJECTIVE **:**

Remote sensing techniques are widely used as a primary source of information in a range of applications including natural resource management and mitigating disasters. The objective of the course is to impart knowledge on various techniques of remote sensing, data acquisition, processing, product generation and its utility for modeling and management purposes.

COURSE TOPICS:

1. Introduction to Remote sensing
2. Physics of Electro Magnetic Radiation (EMR)
3. Earth Observation Satellites and Platforms

4. EMR interaction with Atmosphere and Earth materials
5. Sensors and its characteristics
6. Optical Remote sensing

(Data acquisition Geo-registration and Map projections, Image processing techniques, Image Interpretation (visual), Digital image classification

7. Object based classification
8. Image arithmetic, Change detection
9. DEM –Creation and Application
10. Thermal Remote sensing
11. Hyper-spectral Imaging
12. Microwave Remote sensing
13. Lidar Remote sensing
14. Major applications of Remote sensing in

a. Vegetation / Terrestrial ecology/wildlife
b. Hydrology/Land use / Land cover /Agriculture
c. Disaster management

In addition, there will be a hands-on (lab tutorials) introduction to one or two RS software and tools at relevant times during the course.

PREFERRED TEXT BOOKS:

1. Introduction to Remote Sensing by James B. Campbell
2. Remote Sensing and Image Interpretation by Thomas.M.Lillesand
3. Remote sensing Digital Image Analysis by J.A Richards and Xiuping Tia

REFERENCE BOOKS

1. Fundamental of Remote Sensing by CCRS (Online)
2. Principles of Remote sensing by ITC (online)

GRADING:

1. Assignments (max. of 4)	15%
2. Project	25%
3. Quiz (2)	20%
4. End-Semester Exam (1)	30%

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

OUTCOME:

Students after finishing this course are expected to be well versed with the techniques and approaches that are used to understand and process satellite imagery and extract meaningful earth/terrestrial surface or sub-surface parameters. Also, they are expected to get a feel of the application gaps and limitations of the current satellite imageries & their processing or information extraction techniques with respect to multiple application domains like urban mapping, agriculture, forestry, water resources, defense, and disaster management.

Robotics: Planning and Navigation 3-1-0-4

Course Code :

CREDITS : 4

TYPE-WHEN **:** Elective, Spring

FACULTY NAME **:** K Madhava Krishna

PRE-REQUISITE **:** None

OBJECTIVE **:** The course aims to introduce students to state of the art algorithms in the broad area of robot navigation. These algorithms span across AI methods, Kinematic and Dynamics based approaches as well as control theoretic formulations thereby giving the student a ringside view of the main algorithms in this area. These approaches are applicable to both ground robots and aerial vehicles.

COURSE TOPICS **:**

1. AI Based Planning Methods – Grid Based Approaches, Cell Based Approaches and Configuration Space Approaches
2. Introduction to Kinematics of Wheeled and Aerial Robots
3. Kinematic Planners: Sampling Based Planners, Roadmap Approaches
4. Planning in Dynamic Environments: Velocity Obstacles, Collision Cones
5. Trajectory Optimization Frameworks
6. Model Predictive Control
7. State Estimation
8. Tracking Controllers

PREFERRED TEXT BOOKS: Probabilistic Robotics by Sebastain Thrun, Wolfram Burgard and Dieter Fox (some portions of it)

***REFERENCE BOOKS:** Trajectory Planning in Complex Environments By David Batuista

***PROJECT:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quizzes - 1	**10%**
Assignments - 3	**60%**
Other Evaluation: Take Home End Sem	**30%**

OUTCOME: At the end of the course the students are expected to code planning and control algorithms in complex scenes and are comfortable to take on real world problems encountered in these domains.

Science, Technology and Society **3-1-0-4**

TYPE-WHEN **:** Core course, CHD 2nd year, Spring semester (UG4)

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, and the 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 1.5 month 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.

ECE431 **Signal Detection and Estimation Theory** **3-1-0-4**

Faculty : Praful Mankar
Prerequisites **:** ECE 230 AND ECE 335 OR INSTRUCTOR'S CONSENT

TOPIC OUTLINE (APPROX):

1. Introduction to Decision making under uncertainty, Minimax, Bayes ian, Maximum likelihood approaches.
2. Clasical Binary Hypothesis testing, LRTs, suficient statistic, Detection Performance, Neyman - Pearson approach, Uniformly Most Powerful tests, Generalized LRT.
3. M-ary Hypothesis Testing, Performance
4. General Gausian Detection problems, Performance Bounds
5. Parameter estimation: MSE, MAP, MLE; Cramer-Rao Performance bounds
6. Karhunen-Loeve representation of Random signals
7. Detection of Known signals in additive white Gausian noise, Optimum receivers, Performance.
8. Detection of Known signals in additive colored Gausian noise, Optimum receivers, Performance, Signal design considerations.
9. Estimation of signals with unknown parameters in additive white gausian noise, estimation error performance
10. Detection of Signals with unwanted parameters, Performance

1. Estimation of continuous waveforms in modulation systems with/without memory
12. Linear estimation: Wiener Filtering, Prediction and smoothing
13. Kalman-Bucy Filtering, Prediction and smoothing

TEXTS AND REFERENCE BOOKS:

1. H.L. Vantrees : Detection, Estimation and Modulation Theory, Part I, Wiley, 1968
2. Srinath, M.D, Rajasekaran, P.K, Viswanathan, R: Introduction to Statistical Signal Processing with Applications, Prentice-Hal, 1999
3. Sage, A.P and Melsa, J.L : Estimation Theory with Applications to Communications and Control, McGraw-Hil, 1971
4. McGarty, T.P : Stochastic Systems and State Estimation, Wiley, 1971
5. Mood, A.N, Graybil, F.A, and Boes, D.C : Introduction to the Theory of Statistics, McGraw -Hil, 1974

Examination:

First Mid-Semester (20),
Second Mid-Semester (20),
Term-Paper (20),
End-Semester (40)
* FORMER COURSE NUMBER: ET4105

CS4.501 Social Computing 3-1-0-4

TYPE-WHEN : CS/CLD/CHD elective - Spring 2021

FACULTY NAME : Vasudeva Varma (Guest lectures by Manish Gupta and Nimmi Rangaswamy)

LTP Structure: 3-0-3-4

PREREQUISITE (Recommended but not mandatory): Statistical methods in AI, Information Retrieval and Extraction

Maximum Students: 30

OBJECTIVE: Exposure to the trans-disciplinary area of Social Computing with hands-on exploration to computing on online social networks, leveraging user generated data.

COURSE TOPICS:

Social Computing

- • Motivation - why should we study Online Social Networks (OSN)?
- • Characteristics, Complexity and challenges of OSN
- • Taxonomy, Ontology and Knowledge Graph (KG)
- • Wiki Data and other KGs
- • Building and Using KGs

Human computation

- • Crowdsourcing and Incentive mechanisms
- • Wikipedia cases study
- • Gamification

Social monitoring - OSN Network analysis

- • Basic structures
- • Measures
- • Propagation models
- • Crawling the OSN
- • Link prediction, recommendation systems, Link farming

Social Listening - Content analysis

- • Characteristics of OSN content
- • NLP for OSN content - language identification, text normalization, POS tagging
- • Sentiment analysis
- • Opinion mining
- • Entity identification, and linking
- • Relation Identification

Social Intelligence - Applications

- • Community detection
- • Social media analytics in Healthcare domain
- • Social commerce

TEXT BOOKS: None

Several research papers will be given and discussed

REFERENCE BOOK: Analyzing the Structure of Social Web by Jennifer Golbeck

Grading Plan:

Class participation	**10%**
Project Several Subcomponents of the project	**90%**
Phase 1: Literature survey	**20%**
Phase 2: Problem outline, defining expected outcome	**20%**
Phase 3: Solution outline - mid term	**20%**
Phase 4: Solution outline – final	**20%**
Phase 5: Final report and presentation	**10%**

CSE461 **Software Engineering** **3-1-0-4**

TYPE-WHEN **:** Elective-Spring

FACULTY NAME **:** Raghu Reddy

Amrut Joshi (Amrut)
{linkedin.com/in/joshiamrut/}

Venkataramanan Subramanian (Venks)
{linkedin.com/in/venkataramanansubramanian} Jayaram Valliyur (Jay)

{linkedin.com/in/jayaram-valliyur-65ba401/} Yalla Veera Prakash

PRE-REQUISITE **: None**

OBJECTIVE **:**

- This is a hands-on learning course on software engineering. This course has two parts. The first part is theory covering - software engineering processes, software architecture and design, coding, unit testing, distributed system concepts and cloud infrastructure basics. The second part is project work. The project is a highly scalable distributed software that would deployed on a cloud infrastructure and made available exter nally through an open source license. The course is taught by experts from the industry who have good experience building large scale distributed software that many of us use.

COURSE TOPICS:

- Software Engineering Processes (Agile, Scrum, Kanban, Waterfall, Working Backwards etc.)
- Software Design (High Level Design, Service Oriented Architecture, Micro Service Architecture, Serverless Architecture, Message Passing Architecture etc.)
- Programming Paradigms (Imperative, Declarative, Functional, OOP)
- OO Design (Cohesion, Coupling, SOLID, Multilayer design, DI etc.)
- OO Design patterns (Factory, Builder etc.)
- Code Reading (Optional in Java 8 and Guava)
- Clean Code (Code reviews, readability, maintainability)
- Clean Code (Unit Testing, Integration Testing etc.)
- Operational Excellence (Full CD, Metrics, Logging etc.)
- Distributed systems basics
- Cloud infrastructure Basics
- Project Work – PRFAQ, Design, Coding and Final Demo

PREFERRED TEXT BOOKS: None

***REFERENCE BOOKS:** Most reference materials are available online and will be shared at the end of each class.

***PROJECT: GRADING PLAN:**

Type of Evaluation	Weightage (in %)

Mid SemExam	**20%**
PRFAQ Review	**10%**
Design Review	**10%**
Final Project Demo (Working Code)	**40%**
Class interaction/Quiz	**20%**

OUTCOME: Learn software engineering concepts bybuilding a highly scalable software application deployed to the cloud.

CES617 Stability of Structures 3-1-0-4

Type-when: Spring 2021

Course Faculty: Sunitha Palissery

Pre-requisite: Design of Steel Structures (Undergraduate Course)

Objective: To facilitate understanding of the concepts of structural stability, key factors influencing the stability of structures, buckling, and mathematically formulate structural stability applications.

Course Contents

1. **Basic Concepts of Stability**—Bifurcation Buckling- Methods of Stability Analysis-Post-buckling Behaviour-Large Deflection Analysis.
2. **Buckling of Columns**—Differential Equations using Equilibrium, Large Deformation Theory, Effects of Imperfections, Inelastic Buckling – Tangent and Reduced Modulus Concepts, Shanley's theory of Inelastic Column Behaviour,

Effects of Residual Stresses-Beam Columns.

3. **Buckling of Frames**—Modes of Buckling- Frame Stability Analysis-Non-sway and Sway Frames- Critical Load Estimation using Slope Deflection Equations.
4. **Torsional and Flexural-Torsional Buckling**—Columns-Beams-Beam Columns.
5. **Approximate Methods of Stability Analysis & Buckling of Plates**—Rayleigh- Ritz Method, Galerkin's Method, Newmark's Method-Introduction to Plate Buckling-Governing Differential Equations for Plate Buckling, Plates Subjected to various Loading Actions, Post-buckling Behaviour.

Grading

Homework,Tutorial,

Assignments: 20%

Term Project: 15%

One Quiz: 10 %

Mid-Semester Exam: 15%

End-Semester Exam: 40%

References

1. Alexander, C., *Principles of Structural Stability Theory*, Prentice-Hall Inc, New Jersy
2. Chen, W.F., and Lui,E.M., (1987), *Structural Stability: Theory and Implementation*, Elsevier Science Publishing Co., New York
3. *Guide to Stability Design Criteria for Metal Structures*, Edited by Ziemian, R.D.,(2010)
4. Timoshenko,S.P., and Gere,J.M., (1985), *Theory of Elastic Stability*, McGraw Hill International Book Company
5. Galambos,T.V., and Surovek,A.E., (2008), *Structural Stability of Steel: Concepts and Applications for Structural Engineers*, John Wiley & Sons, New Jersy
6. Bažant,Z.P., and Cedolin,L., (2010), *Stability of Structures- Elastic, Inelastic, Fracture and Damage Theories*, World Scientific Publishing Co. Pvt. Ltd., Singapore
7. Gambhir,M.L., (2004), *Stability Analysis and Design of Structures*, Springer, New York
8. Kumar,A., (1998), *Stability of Structures*, Allied Publishers Limited, Mumbai

Expected Course Outcome

Demonstrate and apply understanding of buckling and stability analysis methods, to address practical structural design problems.

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

TYPE-WHEN : Spring 2021
FACULTY NAME : Vineet Gandhi

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

COURSE TOPICS :

Introduction, Linear Discriminant Functions, Perceptron Learning, Minimum Squared Error Procedures, Linear Classifiers: Class Test, Neural Networks: Nonlinearity, Neural Networks: Backpropagation, Improving NN Training, Random Variable, Probability Densities, Multivariate Densities, Bayesian Decision Theory, Maximum Likelihood Estimation (MLE), Principal Component Analysis (PCA), Eigen Faces, Linear Discriminant Analysis & Fischer Faces, Max- Margin Classification (SVM), SVM variants, Kernalization, Data Clustering, Kmeans (EM) and variants, Spectral Clustering, Decision Trees, Graphical Models, Combining Classifiers.

PREFERRED TEXT BOOKS: "Pattern Classification" by Duda, Hart & Stork

*** REFERENCE BOOKS:**

"Machine Learning - A Probabilistic Perspective" by Kevin Murphy (free ebook available online), Other Material: Online Courses/Tutorials and Research Papers

Course Website : http://courses.iiit.ac.in

GRADING:

27% Project + 18%
Assignments + 30%
Midsem + 25%
Final Exam

OUTCOME:
This course will enable students to understand pattern recognition techniques namely, classificationandclusteringindetail includingboththeoreticalandpracticalaspects.

CSE538 System and Network Security 3-1-0-4

TYPE-WHEN :

FACULTY NAME : Ashok Kumar Das

PRE-REQUISITE:

programming languages (C/C++, Python), operating systems + architecture (basis), POIS (CSE418) (have taken earlier or enrolled this semester).

OBJECTIVE :

This course is intended to introduce students the exciting world of information security research. The main focus of this course would be on non-cryptographic security research (as cryptographic security is covered in detail in CSE418) i.e. topics related to software vulnerabilities, malware, intrusion detection/prevention systems. The course is divided into two major parts. The first part is about "offensive computing" which is based on the premise "Know your enemy first". This part covers techniques that are used for attacking systems, including low-level vulnerabilities like buffer-overflow, cross-site scripting, format strings. These techniques are used by hackers and malwares to invade systems (thus know your enemy first). The second part is about "defensive computing", which covers techniques/technologies to defend against above mentioned attacks, including cryptographic protocols, intrusion detection systems, firewalls. At the end of the course, the students should:

1. understand the various issues in software security;

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

3. understand the majority of the attacks that hamper the security of the networks, e.g. bug

exploitation (aka hacking);

4. learn basics of malware analysis and defensive techniques;

5. learn the use of cryptographic primitives for securing networks

6. Understand that security is a layered approach.

COURSE TOPICS :

PART I- Offensive Computing

A. Introduction to Software vulnerabilities:

Non-web software vulnerabilities (low level bug, e.g., buffer overflow, use-after-free etc.)

How to find such vulnerabilities and then attack/hack?

Web specific vulnerabilities and their analysis (e.g. XSS, CSRF, SQLinjection etc.)

B. Malware Analysis:

Introduction to Malwares

Analysis techniques

Android malwares

PART II – Defensive Computing

C. Operating system and application level defense

Stack overflow prevention

Address space layout randomization

Input sanitization

D. Firewalls – first layer of defense

Introduction to Firewalls and type of firewalls

E. Intrusion Detection System:

Introduction to IDS/IPS

Types of IDS

F. Network Security with Cryptography IPSec SSL

PREFERRED TEXT BOOKS:

Text book: to be announced

***REFERENCE BOOKS:**

Assembly book for x86

Practical malware analysis, by Sikorski and Honig

GRADING:

10%: Class attendance and discussion/participation

25%: Hands-on assignments (4-6)

25%: mid term (2)

40%: End exam

ECE442 **Time Frequency Analysis** **3-1-0-4**

Type-When : Spring - 2021
Faculty Name : Anil Kumar Vuppala

Pre-Requisite:

COURSE TOPICS:

I. Introduction to the course Vector Space, Basis Functions, Basis, Frames, Signal Expansion.
II. Linear time frequency representation–Fourier and Gabor Review of Fourier Transform and Fourier Series Localisation problem Time - Frequency distributions, general concepts Short - Time Fourier Transform Gabor Transform Instantaneous Frequency.
III. Linear time frequency representation–Wavelets Nested subspaces Multiresolution formulation Continuous wavelet transform discrete wavelet transform.
IV. Quadratic time frequency representation Energy distributions Wigner distribution.
V. Applications in signal and image processing
VI.

***REFERENCE BOOKS:**

Time - Frequency Analysis, L. Cohen, Prentice Hall.
A wavelet tour of signal processing, S. Mallat, Academic Press

GRADING:

Assignments 20%
2 mid sem exams 30%
1 project 15%
End sem exam 35%

ECE537 **Topics in Coding Theory** **3-1-0-4**

Course Code **:** ECE537

Note: Please use course code for previously existing course

CREDITS **:** 3-1-0-4

TYPE-WHEN : Spring 2021

FACULTY NAME **:** Prasad Krishnan

PRE-REQUISITE **:** (Student should have **at least one of the below** prerequisites)

1. Necessity and meaning of Channel Coding (Error correcting codes), and encoding technique of least one of the codes discussed in syllabus should be *familiar* (studied few semesters back is OK) to student. (this course covers focusses on decoding mainly)
2. Alternatively, the student should be good with Communication Theory (AWGN channels, Digital Modulation schemes, Channel Coding Idea).

OBJECTIVE :

An introductory course in Coding theory typically focuses on the design of error correcting codes. This course will mainly focus on the decoding algorithms of codes that are extremely important in theory and practice, after very briefly discussing their design. The fact that these decoding algorithms (or some of their variants) are used in many practical applications is the main motivation for this course.

The goal of the course is to make the student very familiar with modern codes and their decoding techniques.

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

1. Decoding Reed Solomon Codes – Fast Algorithms that decode upto Half Minimum Distance
2. List Decoding of RS codes - decoding beyond half of minimum distance
3. Decoding LDPC Codes (Belief Propagation Decoding)
4. Polar Codes - Encoding and Decoding (Successive Cancellation Decoding + SC List Decoding)
5. Reed Muller Codes - Decoding techniques old and new.

PREFERRED TEXT BOOKS:
No specific text books. Material required (including book-excerpts, papers, course notes, etc) will be informed during the course. Student can refer to similar recent courses offered by others in the below links.

6. http://people.seas.harvard.edu/~madhusudan/courses/Spring2020/ - Madhu Sudan
7. https://user.eng.umd.edu/~abarg/ECC/ - Alexander Barg
8. https://ece.iisc.ac.in/~nkashyap/E2_205/ - Navin Kashyap, P Vijay Kumar

***REFERENCE BOOKS:**

***PROJECT:**

GRADING PLAN: Since the course is mainly about decoding algorithms, it will involve many programming assignments. Python will be preferred, Matlab is also permitted. There will be a term paper (on a particular topic the student is expected to read some papers, write a report and deliver a presentation). Short quizzes will be covering the remaining marks. There will not be any written exams.

Type of Evaluation	Weightage (in %)
Quizzes	
Assignments (PROGRAMMING in Python or Matlab)	**50 (3-4 assignments)**
Term paper	**30 marks**

Project	
Open book exam or 30 minute quiz	**20 marks**
Other Evaluation _____	

OUTCOME: At the end of the course the student is expected to feel confident about reading current literature on the topics discussed in this course, and also in designing decoding algorithm of codes used in practical applications to a reasonable extent. Research aptitude will be naturally developed if the student does well in the course, as the course runs through many important and recent academic research contributions in the field of Channel Coding.

REMARKS: Maximum number of registrations in this course will be 10 *(If more than 10 sign up then preference will be given based on verification of prerequisite knowledge or requirement for research).*

SCI761 **Topics in Nanosciences** **3-1-0-4**

TYPE **:** Elective

FACULTY NAME **:** Tapan Kumar Sau

No of STUDENTS **:** Max. 40 students (preference to CND/M.Tech. Bioinfo)

OBJECTIVE **:** To introduce the students to the rapidly developing fields of science and technology at the nanometer scales.

COURSE TOPICS:

1. **Introduction to Nanoscience.**
- Nanomaterials: Definitions.Size Scales.Surface and Interface. Magic Numbers and Coordination Numbers.
- Classification of nanomaterials: Clusters, Nanoparticles and Colloids.
- Scope of nanomaterials

2. **Making Nanostructures.** Top-down and bottom-up methods.
3. **Tools for Nanosystems. Microstructure/Chemistry/Defects and Structure.**AFM, SEM, TEM,XRD, SAXS**,N**anoindentation.
4. Properties of Nanomaterials

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. Classical nucleation theory. Size and shape control in nanoparticle formation. Self- assembly principles. Adsorption. Melting behaviour of metal nanoparticles.

Mechanical,Magnetic, Electrical, Optical, and Thermal properties.

5. **Applications of Nanomaterials.**Catalysis,Nano-electronic devices and sensors, medical, food and agriculture industries, automobile, textile, water treatment and civil applications, strategic use in energy, space and defense

6. **Concerns and Challengesof Nanotechnology.**Environmental, ecological and health hazards of nanoparticles. Nanotoxicology and its effect

PREFERRED TEXT BOOKS:

1. Introduction to Nanoscience, by S. M. Lindsay, Oxford University Press.
2. Nanoscopic Materials: Size-dependent Phenomena, by E. Roduner, RSC Publishing.
3. Textbook ofandNanoscienceNanotechnology:B. S.Murty, P. Shankar, B. Raj, B. B.Rathand J.Murday,Universities Press (India) Private Limited.

REFERENCE BOOKS:

1. Nanochemistry by G.A. Ozin and A. C. Arsenault, RSC Publishing.
2. Nanotechnology by M. Kohler and W. Fritzsche, Wiley-VCH.

GRADING

Student assessment will be on the basis of:

1. Class Performance/Quiz/Assignment/Research Paper Study	20%
2. Mid-Term Exams(2 x 20%)	40%
3. End-Semester Exam	40%

OUTCOME

Students after finishing this course are expected to develop a better understanding of the principles and techniques of nanoscience, real world applications and scopes.

CSE567 **Usability Engineering** **3-1-0-4**

TYPE-WHEN : Spring 2021

FACULTY NAME **:** Priyanka Srivastava

PRE-REQUISITE **:** None

OBJECTIVE **:**

The focus of this course is on role of cognitive and non-cognitive perspectives in ergonomic and user-friendly designs. Ergonomics deals with design factors required for equipment designs for theworkplace to maximize the productivity and minimize the fatigue error and discomfort. User-friendly or Usability, deals with the ease, efficiency and effectiveness of any system/ design interface. Since, any human activity entails physiological and mental/ cognitive processing, which understanding would play an important role in ergonomics and user-friendly design. The course will highlight the competencies and limitations of the human being in general (such as perception, memory, attention and time-sharing, mental-workload, stress, decision making and problem solving), to make better technologies for society and science. Upon completion of course students will be able to identify/ recognize the cognitive and non-cognitive perspective in designing more effective and better machines such as automated machines and assistive technologies.

COURSE TOPICS :

1. Introduction to Ergonomics, Neuroergonomics, and Usability
2. History of Human Factors
3. Psychology of Everyday Actions
4. To Err is Human: Design challenges and User-centered design
5. Differently abled people, easy and complex designs
6. Identifying Mental Model and its relations with design
7. Generation of User Interface
8. Human factors in augmented and virtual reality
9. Design and Evaluation Methods

PREFERRED TEXT BOOKS:

1. Norman, D. (2013). The Design of Everyday Things: Revised and Expanded Edition
2. Proctor, R.W., & Zandt, T.V. (2008). Human Factors in Simple and Complex Systems, Second Edition. 24

***REFERENCE BOOKS:**

1. Hale, K.S., & Stanney, K.M. (2014). Handbook of virtual environments: design, implementation, and Applications, Second Edition (Human Factors and Ergonomics)

***PROJECT:**

Each team of 2 will conceptualize, design, the study and highlight the implications.

GRADING:

Exams – 60
Quizzes – 10
Assignments – 10
Exams – Mid semester II and
Final Term – 40
Project – 40

OUTCOME:

The course aims to introduce various emerging issues in ergonomics and usability research. The student will realizethe issues related to cognitive and non-cognitive processing and its implication through conducting psychophysical experiments.

REMARKS:

The course requires reading, field and lab work and further designing a small study, highlighting the various issues of ergonomics and usability in design interface and submitting at the end. Students will be encouraged to use various tools available in Cognitive Science lab to address their research problems. The students will be allowed to work at any time for experiments and studies during the ideas development and conducting studies.

Sd/ Dean (Academics)