Proposed Scheme & Syllabus

For

Computer Science & Engineering Department

National Institute of Technology Delhi

Proposed Curriculum

M. Tech. Programme

Computer Science and Engineering

(Analytics)

Course Structure of M.Tech. Computer Science and Engineering
(Analytics)

SEMESTER – I

S.No.	Course No.	Course Name	L	T	P	Credits
1.	CSL 501	Mandatory Course 1 (Computational Mathematics)	3	0	0	3
2.	CSL 51X	Core 1	3	0	0	3
3.	CSL 51X	Core 2	3	0	0	3
4.	CSL 52X/53X	Elective 1	3	0	0	3
5.	CSL 52X/53X	Elective 2	3	0	0	3
6.	CSP 502	Core Lab 1	0	0	4	3
Total Credits			**15**	**0**	**4**	**18**

SEMESTER II

S. No.	Course No.	Course Name	L	T	P	Credits
1	CSL 51X	Core 3	3	0	0	3
2	CSL 51X	Core 4	3	0	0	3
3	CSL 551	Mandatory Course 2 (Algorithms for Analytics)	3	0	0	3
4	CSL 52X/53X	Elective 3	3	0	0	3
5	CSL 52X/53X	Elective 4	3	0	0	3
6	CSP 552	Core Lab II	0	0	4	3
Total Credits			**15**	**0**	**4**	**18**

SEMESTER III

S. No.	Course No.	Course Name	L	T	P	Credits
1	CSP 600	Dissertation I	-	-	-	8
2	CSL 52X/53X	Elective 5	3	0	0	3
3	CSL 52X/53X	Elective 6	3	0	0	3
4	CSP 601	Independent Study & Seminar	-	-	-	2
Total Credits			**6**	**0**	**0**	**16**

SEMESTER IV

S. No.	Course No.	Course Name	L	T	P	Credits
1	CSP 650	Dissertation II	-	-	-	12
2	CSP 651	Independent Study & Seminar	-	-	-	4
Total Credits			**-**	**-**	**-**	**16**

I. Core Courses

S. No	Course No.	Course	L	T	P	Total
1	CSL 511	Quantitative Techniques	3	0	0	3
2	CSL 512	Optimization Techniques	3	0	0	3
3	CSL 513	Data Mining	3	0	0	3
4	CSL 514	Big Data Analytics	3	0	0	3
5	CSL 515	Simulation and Modeling	3	0	0	3
6	CSL 516	Data Warehousing	3	0	0	3
7	CSL 517	Information Search and Retrieval	3	0	0	3
8	CSL 518	Pattern Recognition and Rule Based Computing	3	0	0	3

II. Elective Courses

S. No	Course No.	Course	L	T	P	Total
1	CSL 521	Natural Language Processing	3	0	0	3
2	CSL 522	Machine Learning	3	0	0	3
3	CSL 523	Neural Networks	3	0	0	3
4	CSL 524	Soft Computing	3	0	0	3
5	CSL 525	Digital image & Pattern Recognition	3	0	0	3
6	CSL 526	Large Network Analysis	3	0	0	3
7	CSL 527	Knowledge Representation & Reasoning	3	0	0	3
8	CSL 528	Social Media & Online Marketing	3	0	0	3
9	CSL 529	Game Theory	3	0	0	3
10	CSL 530	Cloud Computing	3	0	0	3
11	CSL 531	Recommender Systems	3	0	0	3
12	CSL 532	Research Methodology	3	0	0	3

Syllabus

Course no: CSL 501	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Mandatory Course**			
Course Title	**Computational Mathematics**			
Course Coordinator				
Course objectives:	This course aims to cover the concepts and fundamentals of probability, Random Variables and Probability Distributions, some Special Probability Distributions, Sampling Theory, Markov process, and various Tests of Hypotheses and Significance.			
POs				

Semester	**Autumn:**		**Spring: YES**		
I	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Probability, random variables, and stochastic processes
	Author	Papoulis, Athanasios, and S. UnnikrishnaPillai.
	Publisher	Tata McGraw Hill Education
	Edition	2002
2	Title	Introduction to Probability and Statistics for Engineers and Scientists
	Author	Sheldon M Ross
	Publisher	Elsevier
	Edition	5th Edition
Reference Book:		
1.	Title	Introduction to Mathematical Statistics
	Author	Robert V Hogg, Joseph McKean, Allen T Craig
	Publisher	Pearson
	Edition	7th Edition

2.	Title	Probability and Computing: Randomized Algorithms and Probabilistic Analysis
	Author	Michael Mitzenmacher and Eli Upfal
	Publisher	Cambridge
	Edition	2005

Content

Unit 1(4 Hours)

Probability

The concept of probability, The axioms of probability, Some important theorems on Probability, Conditional Probability, Theorems on conditional probability, Independent Event's, Bayes'Theorem.

Unit 2(8 Hours)

Random Variables

Random variables, discrete probability distributions, Distribution functions for Discrete random variables, Continuous probability distribution, Distributions for Continuous random variables, joint distributions, Independent random variables.

Mathematical Expectation

Definition, Functions of random variables, some theorems on Expectation, The variance and Standard Deviation, Moments, Moment Generating Functions, Covariance, Correlation Coefficient.

Unit 3(10 Hours)

Special Probability Distributions

The Binomial Distribution, The Normal Distribution, The Poisson Distribution, Relations between different distributions, Central limit theorem, Uniform distribution, Chi square Distribution, Exponential distribution.

Sampling Theory

Population and Sample, Sampling with and without replacement, the sample mean, Sampling distribution of means, proportions, differences and sums, the sample variance, the sample distribution of variances.

Unit 4(7 Hours)

Tests of Hypotheses and Significance

Statistical Decisions, Statistical hypotheses, Null Hypotheses, Tests of hypotheses and significance, Type I and Type II errors, level of significance, Tests involving the Normal distribution, One Tailed and Two tailed tests, Special tests of significance for large and small samples.

Unit 5(7 Hours)

Markov Process

Introduction, Computation of n step Transition Probabilities, State Classification and Limiting Distributions, Distribution of times between state changes, The M/G/1 Queuing System, Discrete parameter, Birth Death processes, Finite Markov chains with absorbing states.

Course Assessment

Continuous Evaluation 25%
Mid Semester 25%
End Semester 50%

Course no:CSL 551	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Mandatory Course**			
Course Title	**Algorithms for Analytics**			
Course Coordinator				
Course objectives:	To provide a foundation in algorithms for analytics. Getting familiar with basics of Performance of algorithms, Design techniques, Data Structures and different types of algorithm analysis such as Amortized Analysis, Probabilistic analysis of Randomized algorithm, Linear Programming, Approximation Algorithms, Parallel algorithm and External Memory algorithm			
POs				

Semester	**Autumn:**		**Spring: YES**		
II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Algorithm Design
	Author	J.Kleinberg and E. Tardos
	Publisher	Addison Wesley
	Edition	2005
2	Title	Introduction to Algorithms
	Author	T H Cormen, C E Leiserson, R L Rivest and C Stein
	Publisher	MIT Press
	Edition	2001
Reference Book:		
1.	Title	The Design and Analysis of Computer Algorithms
	Author	Aho, J E Hopcroft and J. D. Ullman
	Publisher	Addison Wesley
	Edition	1974
2.	Title	Data Structures, Algorithms and Applications in C++
	Author	S Sahni
	Publisher	McGraw Hill
	Edition	2001

3		Title	Algorithm Design: Foundations, Analysis and Internet Examples
		Author	M. T. Goodrich and R. Tamassia
		Publisher	John Wiley & Sons
		Edition	2001
Content	**Unit** 1(8 Hours) Introduction: Performance of algorithms, Design techniques, Graph Algorithms. Introduction of Data Structures: Priority Queues: skip lists, heaps, binomial heaps, Fibonacci heaps, Trees: splay trees, B/B+ trees;String Algorithms: Rabin Karp Fingerprinting Algorithm, Suffix Trees,Tries etc. **Unit** 2(8 Hours) Amortized Analysis: Aggregation method, Accounting method, Potential method, The disjoint set union problem. Competitive Analysis and Online Algorithm: MTF list problem, Buy vs. rent problem, Secretary Problem, Paging algorithm. **Unit** 3(8 Hours) Probabilistic analysis of Randomized algorithm: Linearity of Expectation, Markova's inequality, Threshold phenomena in graph analysis. Linear Programming: Formulation of Problems as Linear Programs. Duality. Simplex, Interior Point, and Ellipsoid Algorithms. **Unit** 4(8 Hours) Approximation Algorithms: One Way of Coping with NP Hardness. Greedy Approximation Algorithms. Dynamic Programming and Weakly Polynomial Time Algorithms. Linear Programming Relaxations. Randomized Rounding. Vertex Cover, Wiring, and TSP. **Unit** 5(4 Hours) Parallel algorithm and External Memory algorithm: Pointer Jumping and Parallel Prefix. Tree Contraction.		
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%		

Course no:CSL 511	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Core**			
Course Title	**Quantitative Techniques**			
Course Coordinator				
Course objectives:	This course aims to cover the concepts of various quantitative approaches for data analytics. It aims to covers the knowledge of Collection and analysis of Data, Decision making and quantitative techniques, Linear programming formulation and solution, Multi criteria Decision making tools with Advance quantitative methods and application, Glimpses of Metaheuristics with Case studies & applications.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Quantitative Methods for Business
	Author	Anderson, Sweeney, Williams
	Publisher	Thomson South Western
	Edition	2002
2	Title	Quantitative Techniques Management
	Author	Vohra N.D
	Publisher	Tata McGraw Hill
	Edition	2007
3.	Title	Quantitative analysis for management
	Author	Barry Render, Ralph M Stair Jr, Michael E Hanna
	Publisher	Pearson Education
	Edition	2005
Reference Book:		
1	Title	Operation Research
	Author	KantiSwarup, P.K.Gupta, Man Mohan
	Publisher	Sultan Chand and sons
	Edition	2008

2		Title	Operations Research An Introduction
		Author	Hamdy A Taha
		Publisher	Prentice Hall of India
		Edition	2006
Content	**Unit** 1(5 Hours) An overview to quantitative Techniques An analytical scientific approach to Problem solving, quantitative analysis, Operational research models & modeling process for Managerial Decision Making. Collection and analysis of Data Statistics for Management: Measures of Central Tendency & Dispersion, Probability concepts, Bayes Theorem & Applications, Probability Distributions Binomial, Poisson, Normal & Exponential, Sampling & Sampling Distributions, Testing of Hypothesis. **Unit** 2(7 Hours) Decision making and quantitative techniques Decision Analysis: Decision Trees & Utility Theory, Decision Making under uncertainty, under risk, under certainty & under conflict. Game Theory. **Unit** 3(8 Hours) Linear programming formulation and solution Linear Programming; graphical, simplex method, dual simplex, Sensitivity Analysis & Duality. Integer Programming. Transportation, Transhipment& Assignment Models. **Unit** 4(8 Hours) Multi criteria Decision making tools Multicriteria Decision making: Linear Goal Programming, Scoring Models, Fuzzy outranking, Introduction to concepts of AHP (Analytic Hierarchy Process} & ANP (Analytic Network Process). Advance quantitative methods and application **Unit** 5(8 Hours) Glimpses of Metaheuristics(Tabu, Simulated Annealing & Genetic algorithm), Markov chains & Decision Processes, Sequencing, Dynamic Programming & Nonlinear Programming (Quadratic & Geometric Programming). Network models; shortest route, maximal flow problem .PERT, CPM, Case studies & applications.		
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%		

Course no:CSL 512	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Core**			
Course Title	**Optimization Techniques**			
Course Coordinator				
Course objectives:	This course aims to cover the concepts of optimizationmethods and algorithms developed forsolving various types of optimization Problems. To apply the mathematical results andnumerical techniques of optimizationtheory to various Engineering and Analytics problems			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	An Introduction to Optimization
	Author	Edwin K.P. Chong, Stanislaw H. Zak,
	Publisher	Wiley
	Edition	
Reference Book:		
1.	Title	Convex Optimization
	Author	Stephen Boyd
	Publisher	LievenVandenberghe
	Edition	
2.	Title	Modern Optimization with R (Use R)
	Author	Paulo Cortez
	Publisher	Springer
	Edition	2014

Content	**Unit** 1(5 Hours) Preliminaries:Proofs,Vector Spaces and Matrices, Linear Transformations, Eigenvalues and Eigenvectors, Orthogonal Projections, Quadratic Forms, Matrix Norms, Concepts from Geometry,Elements of Calculus **Unit** 2(7 Hours) Unconstrained Optimization: Basics of Set Constrained and Unconstrained Optimization, One Dimensional Search Methods,Golden Section Search, Fibonacci Search, Newton's Method, Secant Method, Solving Ax = b

	Unit 3(8 Hours) Linear Programming: Introduction to Linear Programming, Simplex Method, Duality **Unit** 4(8 Hours) Nonlinear Constrained Optimization: Problems with Equality Constraints, Problems with Inequality Constraints, Karush Kuhn Tucker Condition, Convex Optimization Problems, **Unit** 5(8 Hours) Algorithms for Constrained Optimization: Projections, Project gradient methods, Penalty methods.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no:CSL 513	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Core**			
Course Title	**Data Mining**			
Course Coordinator				
Course objectives:	The course aims to provide a comprehensive introduction to data mining techniques and knowledge discovery, supervised and unsupervised techniques for uncovering hidden patterns in data, Multidimensional analysis & Descriptive mining and analysis of variance.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Data mining and analysis: fundamental concepts and algorithms
	Author	Zaki, Mohammed J., and Wagner Meira Jr.
	Publisher	Cambridge University Press
	Edition	2014
2	Title	Data mining: concepts and techniques: concepts and techniques
	Author	Han, Jiawei, MichelineKamber, and Jian Pei.
	Publisher	Elsevier
	Edition	2011
3.	Title	Principles of Data Mining
	Author	Hand D., Mannila H. and Smyth P.
	Publisher	MIT Press
	Edition	2001
Reference Book:		
1.	Title	An Introduction to Support Vector Machines and Other Kernel based Learning Methods
	Author	Cristianini N. and Shawe Taylor J.
	Publisher	Cambridge University Press
	Edition	2000

2.	Title	Discovering knowledge in data: an introduction to data mining
	Author	Larose D.T.
	Publisher	Wiley Interscience
	Edition	2005
3	Title	Machine learning
	Author	Mitchell T.M.
	Publisher	McGraw Hill
	Edition	1997
4	Title	Pattern Recognition Algorithms for Data Mining
	Author	Pal S.K. and Mitra P.
	Publisher	CRC Press
	Edition	2004
5.	Title	Introduction to Data Mining
	Author	Tan P. N., Steinbach M. and Kumar V.
	Publisher	Addison Wesley
	Edition	2006
6.	Title	Statistical Pattern Recognition
	Author	Webb A.
	Publisher	Wiley
	Edition	2002

Content

Unit 1(5 Hours)
Introduction
Data Mining Concepts, Input, Instances, Attributes and Output, Knowledge Representation & Review of Graph Theory, Lattices, Probability &Statistics.
Machine learning concepts and approaches
Supervised Learning Framework, concepts & hypothesis, Training & Learning, Boolean functions and formulae, Monomials, Disjunctive Normal Form & Conjunctive Normal Form, A learning algorithm for monomials.

Unit 2(7 Hours)
Data Preparation
Data Cleaning, Data Integration & Transformation, Data Reduction.
Mining Association Rules
Associations, Maximal Frequent & Closed Frequent item sets, Covering Algorithms & Association Rules, Linear Models & Instance Based Learning, Mining Association Rules from Transactional databases, and Mining Association Rules from Relational databases & Warehouses, Correlation analysis & Constraint based Association Mining.

Unit 3(7 Hours)
Classification and Prediction
Issues regarding Classification & Prediction, Classification by Decision Tree induction, Bayesian classification, Classification by Back Propagation, k Nearest Neighbour Classifiers, Genetic algorithms, Rough Set & Fuzzy Set approaches.

Unit 4(7 Hours)
Cluster Analysis
Types of data in Clustering Analysis, Categorization of Major Clustering methods, Hierarchical methods, Density based methods, Grid based methods, Model based Clustering methods.
Mining Complex Types of Data

	Unit 5(10 Hours) Multidimensional analysis & Descriptive mining of Complex data objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time series & Sequence data, Mining Text databases, Mining World Wide Web. Data Mining Applications and Trends in Data Mining Massive Datasets/Text mining, Agent Based Mining. Variance Analysis and MLE F test, Techniques of Analysis of Variance, Analysis of Variance in two way Classification Model.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no:CSL 514	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Core**			
Course Title	**Big Data Analytics**			
Course Coordinator				
Course objectives:	This course aims to cover the Fundamentals of Business Analytics Business Intelligence with applications, Typical enterprise application architecture, Data Statistics, and Big Data Analytics. It also aims to cover the knowledge of various Big Data Analytics Tools.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Data Science and Big Data Analytics
	Publisher	Wiley
	Edition	
2.	Title	Fundamentals of Business Analytics
	Author	R.N. Prasad, SeemaAcharya
	Publisher	Wiley
	Edition	
3	Title	Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses
	Author	Michael Minelli ,Michele Chambers, AmbigaDhiraj
	Publisher	
	Edition	
Reference Book:		
1.	Title	An Introduction to Data Science
	Author	Jeffery Stanton
	Publisher	
	Edition	
2.	Title	Big Data and Analytics
	Author	SeemaAcharya, SubhashiniChellapan
	Publisher	
	Edition	

Content	**Unit** 1(5 Hours) Fundamentals of Business Analytics-Business Intelligence (BI), Business Intelligence vs. Business Analytics, BI Framework, BI Roles & Responsibilities, BI DW Best Practices, Popular BI Tools, BI Applications **Unit** 2(8 Hours) Big Data Analytics In Memory Analytics, In Database Processing, Symmetric Multiprocessor System (SMP), Massively Parallel Processing, Shared Nothing Architecture, Parallel and Distributed Systems, CAP Theorem, NoSQL **Unit** 3(8 Hours) Typical enterprise application architecture Visualizing Relationship in Data, Probability, Estimation, Outliers and Normal Distribution, Inference, Regression, Exploratory Data Analysis (EDA), Big Data, Scaling Problems, HDFS, Design Patterns, Cluster **Unit** 4(8 Hours) Data analytic life cycle, Advance analytic theory and method: "Clustering", Advance analytic theory and method: "Association,", Advance analytic theory and method: "Classification", Advance analytic theory and method: "Regression" **Unit** 5(7 Hours) Big Data Analytics Tool Hadoop, MongoDB, Cassandra, MapReduce, Hive, Pig, Oozie
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSL 515	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Core**			
Course Title	**Simulation and Modeling**			
Course Coordinator				
Course objectives:	This course aims to cover the fundamentals of System & System Environment, various Techniques of Simulation, different Statistical Models in Simulation, Queuing Models, GenerationofRandom Numbers, Input modeling and forecasting. This course also covers various models along with application of each using appropriate software.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	System simulation and modeling
	Author	V P Singh
	Publisher	New Age International
	Edition	
2	Title	Modeling and Simulation: The Computer Science of Illusion
	Author	Stanislaw Raczynski
	Publisher	Wiley publication
	Edition	
Reference Book:		
1.	Title	Simulating Computer Systems: Techniques and Tools
	Author	Cambridge, MIT Press
	Publisher	
	Edition	
2.	Title	Simulation Modeling and Techniques
	Author	A.M. Law and W.D. Kelton
	Publisher	
	Edition	

3		Title	Network modeling and simulation a practical perspective
		Author	Mohsen Guizani, AmmarRayes, Bilal Khan, Ala Al Fuqaha
		Publisher	Wiley publication
		Edition	
Content	**Unit** 1(5 Hours) System & System Environment, Components of a System, Discrete and Continuous Systems, Model of a System and Types of Models, Discrete Event System Simulation, Advantages and Disadvantages of Simulation, Areas of Application. Techniques of Simulation: Monte Carlo Method, Types of System Simulations, Real Time Simulation, Stochastic Variables, Discrete Probability Functions. **Unit** 2(7 Hours) General Principles: Concepts in Discrete Event Simulation, Event Scheduling /Time Advance Algorithm, List Processing, Using Dynamic Allocation & Linked List. Simulation Software: History of Simulation Software, Selection of Simulation Software, Simulation in C++, GPSS, Simulations Packages, Trends in simulation Software. Statistical Models in Simulation: Useful Statistical Models, Discrete Distribution s, Continuous Distributions, Poisson Process, Empirical Distributions **Unit** 3(8 Hours) Queuing Models: Characteristics of Queuing systems, Queuing Notation, Long Run Measures of performance of Queuing Systems, Steady State Behavior of infinite Population Markovian Models, Steady State Behaviour of finite Population Models, Networks of Queues Random Number Generation: Properties of Random Numbers, Generation of Pseudo Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers, Inverse transform Techniques, Convolution Methods, and Acceptance –Rejection Techniques **Unit** 4(8 Hours) Input Modeling: Data Collection, Identifying the Distribution with Data, Parameter Estimation, Chi – Square Test, Selecting Input Models with Data Verification & Validation of simulation Modelling: Model Building, Verification & Validation, Verification of simulation Models, Calibration & Validation of Models. Forecasting: Forecasting technique/method based upon key criteria such as: Forecast time horizon Amount and relevance of historical data Data patterns (seasonality, trends), Accuracy requirements and purpose of the forecast, Assessment of the potential for forecasting – can the variable be forecasted? Understand the organizational and decision making context of forecasting **Unit** 5(8 Hours)		

	Understand the basic principles for each of the following and be able to apply each using appropriate software: Extrapolation and growth models (e.g., the Bass model) Time series models such as smoothing (Holt Winters, multiplicative and additive), ARIMA, Causal models (e.g., ordinary regression, econometric models)
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSL 516	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Core**			
Course Title	**Data Warehousing**			
Course Coordinator				
Course objectives:	The objectives of this course are : to cover the basic concepts of data warehouse and OLAP technology, to cover the knowledge of concepts such as data cleaning, data integration, large databases, Multidimensional Data Models, Query processing and various Quality models for data warehouse.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Building the Data Warehouse
	Author	Inmon W. H.
	Publisher	Wiley &Sons
	Edition	2002
2	Title	The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling
	Author	Ralph Kimball and MargyRoss
	Publisher	Wiley publication
	Edition	2nd Edition, 2002
Reference Book:		
1.	Title	Database Tuning: Principles, Experiments, and Troubleshooting Techniques
	Author	Dennis Shasha and Philippe Bonnet
	Publisher	Morgan Kaufmann
	Edition	2002
2.	Title	Database Systems: The Complete Book
	Author	H. Garcia Molina, J.D. Ullman, and J. Widom
	Publisher	Prentice Hall
	Edition	2002

Content	**Unit** 1(5 Hours) Data Warehousing Basics An overview of data warehousing and OLAP technology and decision support, Data Warehouse Constructs and Components, Data cube: a relational aggregation operator generalizing group by, cross tabs and subtotals, Dimensional Modeling, **Unit** 2(7 Hours) Data Cleaning, Data Integration, Record Linkage, The Merge/Purge Problem for Large Databases. **Unit** 3(10 Hours) Multidimensional Data Models Multidimensional data modeling, Dimensional Modeling, Granularity in Data Warehouse, Dimensions, Characteristics, and hierarchies, Star schema, Snowflake schema, and Multi star schema, Technical Architecture, ETL Design, ETL Development, Physical Data Model, Logical Data Model. **Unit** 4(8 Hours) Query Processing SQL Server Query Processor Overview,Star Queries, Merge Join and Hash Join,Bitmap Indexes and Compression, Improved Query Performance, Bitmap indexes, projection indexes, and bit sliced indexes, Performance Measurements of Compressed Bitmap Indices **Unit** 5(6 Hours) Quality Factors Quality factors of data warehouse and its evaluation, supporting data mining tasks, partitioning the data, Data warehouse CRM applications, Data warehouses in practice.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSL 517	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Core**			
Course Title	**Information Search and Retrieval**			
Course Coordinator				
Course objectives:	This course aims to cover Basic information retrieval concepts, Indexing, Vector space model, Recommender systems, Decision making, Web search, link analysis, Ranking and machine learning on documents.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Introduction to Information Retrieval
	Author	Christopher D. Manning, PrabhakarRaghavan and HinrichSchtze
	Publisher	Cambridge University Press
	Edition	2008
2	Title	Modern Information Retrieval
	Author	Ricardo Baeza Yates and BerthierRibeiro Neto
	Publisher	Addison Wesley
	Edition	1st Edition, 1999
Reference Book:		
1.	Title	Mining the Web
	Author	SoumenChakrabarti
	Publisher	Morgan Kaufmann Publishers
	Edition	2002
2.	Title	Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data
	Author	Bing Liu
	Publisher	Springer
	Edition	2nd Edition, 2009

3		Title	Information Retrieval: Algorithms and Heuristics
		Author	David A. Grossman, OphirFrieder
		Publisher	Springer
		Edition	2nd Edition, 2004
4		Title	Information Retrieval Data Structures and Algorithms
		Author	William B. Frakes, Ricardo Baeza Yates
		Publisher	Prentice Hall
		Edition	1992
5		Title	Introduction to Modern Information Retrieval
		Author	G. Salton, M. J. McGill
		Publisher	McGraw –Hill
		Edition	1986
6		Title	Information Retrieval
		Author	C. J. Van Rijsbergen
		Publisher	Butterworth – Heinemann
		Edition	2nd Edition, 1979
Content	**Unit** 1(4 Hours) Basic information retrieval concepts **Unit** 2(7 Hours) Boolean retrieval Indexing **Unit** 3(8 Hours) Vector space model Text and vector space classification Evaluation in information retrieval **Unit** 4(10 Hours) Recommender systems Collaborative and Content based filtering Hybrid recommender systems Context dependent recommender systems Decision making **Unit** 5(7 Hours) Web search and link analysis Ranking and machine learning on documents		
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%		

Course no: CSL 521	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Natural Language Processing**			
Course Coordinator				
Course objectives:	To provides a broad introduction to NLP with a particular emphasis on core algorithms, data structures, and machine learning for NLP, text classification, sentiment analysis and other applications of NLP			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Speech and Language Processing
	Author	Daniel Jurafsky and James H Martin
	Publisher	Pearson Education
	Edition	2009
Reference Book:		
1.	Title	Natural language Understanding
	Author	James A
	Publisher	Pearson Education
	Edition	1994
2.	Title	Natural language processing: a Paninian perspective
	Author	Bharati A., Sangal R., Chaitanya V.
	Publisher	PHI
	Edition	2000
3	Title	Natural language processing and Information retrieval
	Author	Siddiqui T., Tiwary U. S.
	Publisher	OUP
	Edition	2008

Content	**Unit** 1(4 Hours) Introduction Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers. **Unit** 2(8 Hours)

	Linguistics resources Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Regular expressions, Finite State Automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer. N grams, smoothing, entropy, HMM, Maximum Entropy. **Unit** 3(8 Hours) Part of Speech tagging Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. Parsing Statistical Parsing, Probabilistic parsing. **Unit** 4(10 Hours) Semantics Meaning representation, semantic analysis, lexical semantics, WordNet Word Sense Disambiguation Selectional restriction, machine learning approaches, dictionary based approaches. Text Classification Sentiment Analysis **Unit** 5(6 Hours) Applications of NLP Spell checking, Summarization Information Retrieval Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no:CSL 522	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Machine Learning**			
Course Coordinator				
Course objectives:	With the increased availability of data from varied sources there has been increasing attention paid to the various data driven disciplines such as analytics and machine learning. This course aims to provide students with the knowledge of key concepts of machine learning from a mathematically well motivated perspective. The course aims to familiarize the students with the two broad categories of machine learning algorithms supervised and unsupervised.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Introduction to Machine Learning
	Author	E them ALPAYDIN
	Publisher	The MIT Press
	Edition	2004
2	Title	Pattern recognition and machine learning
	Author	Bishop, C. M.
	Publisher	New York: springer
	Edition	2007
Reference Book:		
1	Title	Machine Learning,
	Author	Tom Mitchel
	Publisher	McGraw Hill
	Edition	
2	Title	Machine learning in action.
	Author	Harrington, Peter.
	Publisher	Manning Publications Co
	Edition	2002

Content	**Unit** 1(10 Hours) Supervised Learning Machine learning basics, Artificial Neural Network, Classifying with k Nearest Neighbors, Splitting datasets one feature at a time: decision trees, Classifying with probability theory: naive Bayes, Support vector machines, Improving classification with the AdaBoost meta algorithm. **Unit** 2(6 Hours) Unsupervised Learning Grouping unlabeled items using k means clustering, Association analysis with the Apriori algorithm, Efficiently finding frequent itemsets with FP growth. **Unit** 3(8 Hours) Reinforcement learning: Markov decision process (MDP), Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR), Linear Quadratic Gaussian (LQG), Q learning, Value function approximation, Policy search, POMDPs. **Unit** 4(6 Hours) Forecasting and Learning Theory Predicting numeric values: regression, Logistic regression,Tree based regression. Bias/variance tradeoff, Union and Chernoff/Hoeffding bounds, Vapnik–Chervonenkis (VC) dimension, Worst case (online) learning, Practical advice on how to use learning algorithms. **Unit** 5(6 Hours) Additional Tools Dimensionality reduction: Feature Extraction Principal component analysis to simplify data, Simplifying data with the singular value decomposition, Feature Selection – Ranking methods, subset selection – forward and backward. Big data and MapReduce
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSL 523	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Neural networks**			
Course Coordinator				
Course objectives:	The objectives of this course are to understand different types of neural networks, neuro fuzzy systems and their applications in pattern recognition, Image processing, computer vision, control, expert systems and decision making systems, and real world computing.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Neural Networks: A Comprehensive Foundation
	Author	S. Haykin
	Publisher	Prentice Hall
	Edition	
2	Title	Neural Networks in computer intelligence
	Author	Limin Fu
	Publisher	McGraw hill Intl
	Edition	
Reference Book:		
1	Title	Fuzzy logic with Engineering applications
	Author	T Ross
	Publisher	
	Edition	
2	Title	Fuzzy sets and fuzzy logic : Theory and application
	Author	G Klir, B Yuan
	Publisher	
	Edition	

Content	**Unit** 1 (5 Hours) Introduction to neural networks: Biological and Artificial neurons, Learning in ANNs, Perceptrons – classification and linear separability, XOR problem, Network architechtures, Multilayer feed forward networks and recurrent networks, Generalized delta rule.

	Unit 2 (10 Hours) Multilayer networks: Back propagation (BP) network, BP training algorithm, Radial basis function (RBF) networks, Applications of BP and RBF networks. Recurrent networks and unsupervised learning, Hopfiled network energy; stability; capacity; Application to optimization problems, Counter back propagation network, Boltzman machine, Kohonen'sself organizing feature maps, Adaptive resonance theory. **Unit** 3 (7 Hours) Associative memory: Matrix associative memory, Auto associative memories, hetero associative memories, Bi directional associative memory, applications of associative memories. **Unit** 4 (7 Hours) Fuzzy Systems and Neuro fuzzy systems: Relevance of Integration between fuzzy sets and neural network, Fuzzy neural network, Neuro fuzzy systems, Fuzzy associative memories. **Unit** 5 (7 Hours) Application of Fuzzy sets and Neural networks: Application in pattern recognition, Image processing and computer vision, Application in control: Fuzzy controllers, neuro controllers and fuzzy neuro controllers, applications in expert systems and decision making systems, application in real world computing.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSL 524	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Soft Computing**			
Course Coordinator				
Course objectives:	The main objective of the course is to understand the ideas and concepts of fuzzy logic, Neural networks, and Genetic algorithm and their applications.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Neural Networks Fuzzy Logic, and Genetic Algorithms
	Author	S. Rajasekaran and G.A.VijaylakshmiPai.
	Publisher	Prentice Hall of India
	Edition	
2	Title	First Course on Fuzzy Theory and Applications
	Author	K.H.Lee.
	Publisher	Springer Verlag
	Edition	
Reference Book:		
1.	Title	Fuzzy Logic, Intelligence, Control and Information
	Author	J. Yen and R. Langari.
	Publisher	Pearson Education
	Edition	
2.	Title	Neuro Fuzzy & Soft Computing
	Author	J. S.R.Jang, C. T.Sun, E.mizutani
	Publisher	Pearson Education
	Edition	

Content	**Unit** 1 (5 Hours) Crisp set and Fuzzy set, Basic concepts of fuzzy sets, membership functions. Basic operations on fuzzy sets, Properties of fuzzy sets, Fuzzy relations. **Unit** 2 (7 Hours) Propositional logic and Predicate logic, fuzzy If – Then rules, fuzzy mapping

	rules and fuzzy implication functions, Applications. **Unit** 3 (8 Hours) Neural Networks: Basic concepts of neural networks, Neural network architectures, Learning methods, Architecture of a back propagation network, Applications. **Unit** 4 (8 Hours) Fuzzy neural networks and chaos in neural networks Applications : Optimization; Control systems; Speech systems; Image processing; Natural language processing and decision making **Unit** 5 (8 Hours) Genetic Algorithms: Basic concepts of genetic algorithms, encoding, geneticmodelling.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no:CSL 525	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Digital Image & Pattern Recognition**			
Course Coordinator				
Course objectives:	The course aims to cover techniques for digital image processing, image transformation in spatial and frequency domains. It introduces image analysis techniques in the form of image enhancement, image segmentation, image compression, and processing of colored images. This course also aims to cover various pattern recognition techniques for digital image applications			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Digital Image Processing
	Author	R. Gonzalez and R. E. Wood
	Publisher	Prentice Hall of India
	Edition	
2	Title	Introductory Computer Vision and Image Procession
	Author	Andrian Low
	Publisher	McGraw Hill Co.
	Edition	
Reference Book:		
1.	Title	Pattern Recognition Statistical, Structural and Neural Approach
	Author	Robert Scholkoff
	Publisher	John Willey & Sons.
	Edition	
2.	Title	Digital Image Processing
	Author	W.K. Pratt
	Publisher	McGraw Hill
	Edition	

Content	**Unit** 1 (5 Hours) Introduction Digital image representation, Fundamental steps in image processing, Components of Digital Image processing systems, Elements of visual perception, Image Formation model, Sampling and quantization, Relationship between pixels, imaging geometry. **Unit** 2 (7 Hours) Image Enhancement Enhancement by point processing, Sample intensity transformation, Histogram processing, Image subtraction, Image averaging, Spatial filtering, Smoothing Spatial filters, Sharpening Spatial filters, Frequency domain: Fourier Transform, Low Pass, High Pass, Homomorphic filtering. **Unit** 3 (10 Hours) Image Segmentation Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation, Use of motion in segmentation: Spatial techniques, Frequency domain techniques. Wavelets and Multiresolution Processing Image pyramids, Subband coding, Haar transform, Series expansion, Scaling functions, Wavelet functions, Discrete wavelet transforms in one dimensions, Fast wavelet transform, Wavelet transforms in two dimensions Spatial Operations and Transformations Spatially dependent transform template and convolution, Window operations, 2 Dimensional geometric transformations. **Unit** 4 (7 Hours) Color Image Processing Color Models, Color Transforms, Image Segmentation Based on color. Image Compression Coding redundancy, Inter pixel redundancy, fidelity criteria, Image compression models, Error free compression, Variable length coding, Bit plane coding, Loss less predicative coding, Lossy compression, Image compression standards, Real Time image transmission, JPEG and MPEG. Pattern Recognition **Unit** 5 (7 Hours) Patterns and Pattern classes, Classification and description, Structure of a pattern recognition system, feature extraction, Classifiers, Decision regions and boundaries, discriminant functions, Supervised and Unsupervised learning, PR Approaches: statistics, syntactic and neural networks.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no:CSL 526	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Large Network Analysis**			
Course Coordinator				
Course objectives:	Students who successfully complete this course will gain: a broad conceptual introduction to the modern theory and applications of complex networks, experience critiquing scientific papers, experience working with large, complex data sets, experience with technical writing and in class presentations.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Networks: An Introduction
	Author	Mark Newman
	Publisher	Oxford University Press
	Edition	
Reference Book:		
1.	Title	Networks, Crowds, and Markets
	Author	Easley and Kleinberg
	Publisher	
	Edition	
2.	Title	Introduction to social network methods
	Author	Hanneman, Robert A. and Mark Riddle
	Publisher	
	Edition	

Content	**Unit** 1 (4 Hours) Introduction Basic Network Properties: nodes, edges, adjacency matrix, node degree, connected components, giant component, average shortest path, diameter. **Unit** 2 (10 Hours) Large Network models:Erdos Renyi, Watts Strogatz and Barabasi Albert model. The Small World Phenomena and Decentralized search in small world , Configuration Model.

	Social Network Analysis tools Network X, UCINET, Gephi, Pajek, Graphviz Network centrality: Betweenness, closeness, eigenvector centrality, **Unit** 3 (7 Hours) Network Algorithms: Algorithms for degrees and degree distributions, Clustering Coefficients, Shortest Path in network with varying edge lengths. Strength of weak ties and Community structure in networks. **Unit** 4 (8 Hours) Network community detection: Modularity optimization and Spectral Clustering, Community Detection Algorithms, Overlapping communities in networks. **Unit** 5 (7 Hours) Information retrieval: Link Analysis: HITS and Page Rank. Percolation and Network Resilience. Epidemic models over networks: SI, SIS, SIR, SIRS models.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no:CSL 527	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Knowledge representation & reasoning**			
Course Coordinator				
Course objectives:	This course aims to provide students with the knowledge of First order Logic, logical foundations of knowledge representation. The course also covers Principles of Logic Programming, Automated inference techniques, Formalisms for representation of various aspects of knowledge, representation languages and tools and Semantic web applications.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Readings in Qualitative Reasoning about Physical Systems
	Author	Daniel S. Weld
	Publisher	Morgan Kaufmann
	Edition	1990
Reference Book:		
1.	Title	Representations of Commonsense Knowledge
	Author	Ernest Davis
	Publisher	Morgan Kaufmann
	Edition	1990

Content	
	Unit 1 (5 Hours) Review of First order Logic: Expressing knowledge, Resolution. Horn clauses.Procedural representations. Production systems. **Unit** 2 (7 Hours) Review of logical foundations of knowledge representation including key properties of formal systems (such as soundness, completeness, expressiveness and tractability). **Unit** 3 (8 Hours) Principles of Logic Programming. Representing and reasoning about time and actions and physical changes (e.g.,

	interval calculus, event calculus). Representing space and physical situations (topology, orientation, physical objects). **Unit** 4 (8 Hours) Automated inference techniques (e.g., refinements of resolution, relational composition, nonmonotonic reasoning). **Unit** 5 (8 Hours) Formalisms for representing other aspects of knowledge e.g., vagueness, uncertainty, belief, desire. Description logics. Defaults. Probabilities. Explanation and diagnosis; Ontology representation languages and tools.Semantic web applications.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no:CSL 528	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Social Media And Online Marketing**			
Course Coordinator				
Course objectives:	This course aims to provide the basics of different scientific perspectives in understanding networks and behavior. It covers fundamentals of networks and social media, game theory, Auctions and Matching Markets, Network Models of Markets with Intermediaries and Health Care & Financial Web Analysis			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1.	Title	Networks, Crowds, and Markets: Reasoning About a Highly Connected World
	Author	D. Easlay and J. Klienberg
	Publisher	Cambridge University Press
	Edition	2010

Content

Unit 1 (4 Hours)
Introduction
Basic Definitions, The Strength of Weak Ties, Tie Strength and Network Structure in Large Scale Data, Tie Strength, Social Media, and Passive Engagement, Closure, Structural Holes, and Social Capital.

Unit 2 (8 Hours)
Game Theory
What is a Game?, Reasoning about Behavior in a Game, Best Responses and Dominant Strategies, Nash Equilibrium, Multiple Equilibrium: Coordination Games, Multiple Equilibrium: The Hawk Dove Game, Mixed Strategies, Mixed Strategies: Examples and Empirical Analysis, Pareto Optimality and Social Optimality, Advanced Material: Dominated Strategies and Dynamic Games, Fitness as a Result of Interaction, Evolutionarily Stable Strategies, A General Description of Evolutionarily Stable Strategies, Relationship Between Evolutionary and Nash Equilibrium, Evolutionarily Stable Mixed Strategies.

	Unit 3 (8 Hours) Auctions and Matching Markets Types of Auctions, When are Auction Appropriate? Relationships between Different Auction Formats, Second Price Auctions, First Price Auctions and Other Formats, Common Values and The Winner's Curse, Advanced Material: Bidding Strategies in First Price and All Pay Auctions, Bipartite Graphs and Perfect Matching, Valuations and Optimal Assignments, Prices and the Market Clearing Property, Constructing a Set of Market Clearing Prices, How Does this Relate to Single Item Auctions?, Advanced Material: A Proof of the Matching Theorem. **Unit** 4 (8 Hours) Network Models of Markets with Intermediaries Price Setting in Markets, A Model of Trade on Networks, Equilibria in Trading Networks, Further Equilibrium Phenomena: Auctions and Ripple Effects, Social Welfare in Trading Networks, Trader Profits, Reflections on Trade with Intermediaries. **Unit** 5 (8 Hours) Health Care & Financial Analytic Web Analysis Understand managerial issues related to web analytics: Leveraging benchmarks and goals for web analytics to create executive dashboards. Being cognizant of legal, ethical and privacy issues in the use of web trails. Understand and employ different types of data used in web analytics, e.g., server logs, visitor's data, search engine data. Understand and explain the issues related to click stream data quality and the implications for applications. Understand key terms and terminology as well as different types of web data based metrics that can be tracked, e.g., visitors, session, page views, hits, session summary, referrals, most popular search engine, search terms by engine, keyword searches, top entrance pages, top exit pages, bounce rate, length and depth of session. Perform both internal site search analytics and search engine optimization (SEO). Employ web analytics for: Personalization and recommender systems. Competitive intelligence. Become familiar with the capabilities and limitations of currently available web analytics tools.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSL 529	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Game Theory**			
Course Coordinator				
Course objectives:	Game theory offers an important tool to model, analyze, and solve problems involving multiple autonomous agents strategically interacting in a rational and intelligent way.The objective of this course is to provide a foundation of game theory to help students apply game theory to solve various problems. The course aims to cover important game theoretic concepts such as Nash Equilibrium, Prisoner's dilemma, BargainingIncentives and Pricing in Communications Networks.			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Algorithmic Game Theory
	Author	Noam Nisan, Tim Roughgarden, Eva Tardos, and Vijay V. Vazirani.
	Publisher	Cambridge University Press
	Edition	2007
2	Title	An introduction to game theory
	Author	Osborne, M. J.
	Publisher	Oxford Univ. Press
	Edition	
Reference Book:		
1.	Title	Game Theory for Applied Economists
	Author	Robert Gibbons
	Publisher	Princeton University Press
	Edition	1992
2.	Title	A course in game theory
	Author	Osborne, M. J. & Rubinstein, A.
	Publisher	MIT Press
	Edition	1994

3		Title	
		Author	
		Publisher	
		Edition	
Content	**Unit** 1 (4 Hours) Introduction: What is game theory , The theory of rational choice, interacting decision makers **Unit** 2 (10 Hours) Nash Equilibrium: Theory Strategic games; the Prisoner's Dilemma, Bach or Stravinsky?, Brass Paradox, Matching Pennies, The stag Hunt, Nash Equilibrium, Best response functions, Dominated actions, Equilibrium in single population. Mixed Strategy Equilibrium Introduction, Mixed strategy Nash equilibrium, The formation of players' beliefs, finding all mixed strategy Nash equilibria, games in which each player has a continuum of actions **Unit** 3 (8 Hours) Extensive Games with Perfect Information Introduction, Strategies and outcomes, Nash equilibrium, Subgame perfect equilibrium, Finding subgame perfect equilibria of finite horizon games, Stackelberg's model of duopoly Repeated Games:The Prisoner’s Dilemma, General Result **Unit** 4 (8 Hours) Bargaining Bargaining as an extensive game, Illustration: trade in a market, Nash's axiomatic model, Relation between strategic and axiomatic models **Unit** 5 (6 Hours) Incentives and Pricing in Communications Networks: Large Networks, Pricing and Resource Allocation, Alternative Pricing and Incentive Approaches		
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%		

Course no: CSL 530	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**Cloud Computing**			
Course Coordinator				
Course objectives:	To impart basic concepts in the area of cloud computing. Bring in depth understanding on architectures and models for Cloud Computing, Cloud Programming and software, Virtualization Technology. To impart knowledge in web based applications of cloud computing			
POs				

Semester	**Autumn: Yes**		**Spring: Yes**		
I/II/III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Cloud Computing, Principal and Paradigms
	Author	Edited By Raj Kumar Buyya, JemesBroberg, A. Goscinski
	Publisher	Wiley
	Edition	
2	Title	Distributed and Cloud Computing
	Author	Kai Hawang, Geofrey C Fox, Jack J. Dongarra
	Publisher	Elsevier
	Edition	
Reference Book:		
1.	Title	Cloud Computing: Web Based Applications That Change the Way You Work and Collaborate Online
	Author	Robert Gibbons
	Publisher	Que Publishing
	Edition	August 2008
2.	Title	Cloud Computing – Insights into New Era Infrastructure
	Author	Kumar Saurabh
	Publisher	Wiley Indian
	Edition	2011

3		Title	Cloud Computing Best Practices for Managing and Measuring Processes for On demand Computing
		Author	Haley Beard
		Publisher	Emereo Pty Limited
		Edition	July 2008
4		Title	Cloud Computing A Practical Approach
		Author	Anthony T. Velte, Robert, Elsen Peter
		Publisher	TMH
		Edition	
Content	**Unit** 1 (5 Hours) Introduction Cloud Computing: Feature Characteristics and components of Cloud Computing. Challenges, Risks and Approaches of Migration into Cloud. Evaluating the Cloud's Business Impact and economics, Future of the cloud computing. Networking Support for Cloud Computing. Ubiquitous Cloud and the Internet of Things. **Unit** 2 (7 Hours) Cloud Computing Architecture: Cloud Reference Model, Layer and Types of Clouds, Services models, Data center Design and interconnection Network, Architectural design of Computer and Storage Clouds. **Unit** 3 (8 Hours) Cloud Programming and Software: Fractures of cloud programming, parallel and distributed programming paradigms, High level Language for Cloud. Introduction to Map Reduce, GFS, HDFS, Hadoop Framework. **Unit** 4 (10 Hours) Virtualization Technology: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor, VMware, KVM, Xen. Virtualization of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of data center. **Unit** 5 (6 Hours) Web Based Application, Pros and Cons of Cloud Service Development, Types of Cloud Service Development, Software as a Service, Platform as a Service, Web Services, On Demand Computing, Discovering Cloud Services, Development Services and Tools, Amazon Ec2, GoogleApp Engine, IBM Clouds.		
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%		