DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SYLLABUS FOR M.Tech (CSE) PROGRAMME

CHOICE BASED CREDIT SYSTEM

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RAJIV GANDHI UNIVERSITY,

RONO HILLS, DOIMUKH

Course Structure for Master of Technology in Computer Science and Engineering w.e.f. July 2019

M.Tech Sem-I

Paper Code	Paper Title	Scheme of Studies Per Week			Credits
		L	T	P	
CSEC 411	Mathematical Foundations of Computer Science	3	1	0	4
CSEC 412	Advanced Data Structures	3	1	0	4
CSEE 413X	Elective – I	3	1	0	4
CSEE 414X	Elective – II	3	1	0	4
CSEA 415	Research Methodology and IPR	0	0	0	0
CSEL 416	Laboratory 1 (Advanced Data Structures)	0	0	2	2
CSEL 417	Laboratory 2 (Based on Electives)	0	0	2	2
				Total Credits:	20

THIRD SEMESTER

Paper Code	Title	Credit L-T-P	Mark Distribution			
			End Semester	Sessional	Practical	Total
XXXO-5XX	**Open Elective offered by other faculties**	4-0-0	80	20		100
CSEO-511	Formal Languages and Automata Theory **[Non CS/CSE students only]**	3-1-0	80	20		100
CSEE-51X	***Elective-III (Any one from the list)***	3-1-0	50	20	30	100
	CSEE-512: Speech Signal Processing					
	CSEE-513: Digital Image Processing & Computer Vision					
	CSEE-514: Pattern Recognition					
	Elective-IV (Any one from the list)	3-1-0	80	20	-	100
	CSEE–515: Wireless Communication					
	CSEE- 516:					

	Cryptography					
	CSEE-517: Machine Learning					
	CSEE-518: Embedded Systems					
CSEC-519	PROJECT – I	0-0-10	-	-	-	250
	Total Credits	**22**				

CourseCode	CSEC 411
CourseName	MathematicalFoundationof ComputerScience
Credits	3
Pre-Requisites	DiscreteMathematics

Total Number of Lectures: 42

COURSEOUTCOMES
After completionof course,studentswouldbe ableto:
• To understandthebasicnotionsof discrete andcontinuousprobability.
• To understandthe methodsof statisticalinference, and therolethatsampling
• Tobeabletoperformcorrectandmeaningfulstatisticalanalysesofsimpletomoderate

LECTUREWITHBREAKUP	**NO. OF LECTURES**
Unit 1 Probability mass, density, and cumulative distribution functions, Parametric familiesof distributions, Expectedvalue, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilisticinequalities,Markov chains	7
Unit 2 Randomsamples,samplingdistributionsofestimators**,**MethodsofMomentsand MaximumLikelihood**,**	7
Unit 3 Statistical inference**,** Introduction tomultivariatestatisticalmodels:regressionand classificationproblems,principalcomponentsanalysis**,** Theproblemofoverfitting modelassessment.	8
Unit 4 GraphTheory:Isomorphism,Planargraphs,graphcolouring,hamiltoncircuitsand eulercycles. PermutationsandCombinationswith and withoutrepetition. Specialized techniquestosolve combinatorial enumerationproblems	8
Unit 5 **Computerscienceand engineering applications**	8
Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems,Bioinformatics,Machine learning.	
Unit 6 RecentTrandsinvariousdistributionfunctionsinmathmaticalfieldofcomputer sciencefor varyingfieldslikebioinformatic,softcomputing, andcomputer vision.	4

References

1. John Vince,FoundationMathematicsfor ComputerScience,Springer.
2. K. Trivedi.Probabilityand Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. MitzenmacherandE. Upfal.Probabilityand Computing: Randomized Algorithms and ProbabilisticAnalysis.
4. AlanTucker, AppliedCombinatorics, Wiley

CourseCode	**CSEA 415**
CourseName	**ResearchMethodologyandIPR**
Credits	0
Pre-Requisites	DiscreteMathematics

Total Number of Lectures: 28

CourseOutcomes:

Attheendofthiscourse,studentswillbe ableto

- Understandresearchproblemformulation.
- Analyzeresearchrelatedinformation
- Followresearchethics
- Understand thattoday's world is controlled by Computer, Information Technology, buttomorrow worldwillberuledbyideas,concept,and creativity.
- UnderstandingthatwhenIPRwouldtakesuchimportantplaceingrowth of individuals&nation,itisneedlesstoemphasistheneedofinformationabout Intellectual PropertyRighttobepromotedamongstudentsingeneral& engineering inparticular.
- UnderstandthatIPRprotectionprovidesanincentivetoinventorsforfurther research workandinvestmentinR&D,whichleadstocreation ofnewand betterproducts,andinturnbringsabout,economicgrowth andsocial benefits.

SyllabusContents:

Unit1: Meaningofresearch problem,Sourcesofresearch problem,Criteria Characteristics ofagoodresearchproblem,Errorsinselectingaresearch problem,Scopeandobjectivesofresearchproblem.

Approachesofinvestigation ofsolutionsforresearchproblem,datacollection, analysis,interpretation,Necessaryinstrumentations

Unit2: Effectiveliterature studiesapproaches,analysis

Plagiarism,Researchethics,

Unit3: Effectivetechnicalwriting,howto writereport,Paper

DevelopingaResearchProposal,Formatofresearchproposal,apresentationand assessmentbyareviewcommittee

Unit4: NatureofIntellectual Property:Patents,Designs,TradeandCopyright. ProcessofPatentingandDevelopment: technologicalresearch,innovation, patenting,development. InternationalScenario:Internationalcooperationon IntellectualProperty.Procedure forgrantsofpatents,PatentingunderPCT.

Unit5: PatentRights:Scope of PatentRights.Licensingandtransferof technology.Patentinformationand databases.GeographicalIndications.

Unit6: NewDevelopmentsinIPR:AdministrationofPatentSystem.New developmentsinIPR;IPRofBiologicalSystems,ComputerSoftwareetc. TraditionalknowledgeCaseStudies,IPRandIITs.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introductionforscience&engineeringstudents'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- RanjitKumar,2ndEdition,"ResearchMethodology:AStepbyStepGuide forbeginners"
- Halbert,"ResistingIntellectualProperty",Taylor& FrancisLtd,2007.
- Mayall,"IndustrialDesign",McGrawHill,1992.
- Niebel,"ProductDesign",McGrawHill,1974.
- Asimov,"IntroductiontoDesign",PrenticeHall, 1962.
- RobertP.Merges,PeterS.Menell,MarkA.Lemley,"IntellectualProperty inNewTechnologicalAge",2016.
- T.Ramappa, "IntellectualPropertyRightsUnderWTO",S.Chand,2008

CourseCode	CSEC-412
CourseName	AdvancedDataStructures
Credits	3
Pre-Requisites	UGlevelcoursein DataStructures

Total Number of Lectures:42

COURSEOUTCOMES
After completionof course,studentswouldbe ableto:
• Understandtheimplementationof symboltableusinghashingtechniques.
• Developandanalyzealgorithmsfor red-blacktrees,B-treesandSplaytrees.
• Developalgorithmsfor text processingapplications.
• Identifysuitabledatastructuresanddevelopalgorithmsfor

LECTUREWITHBREAKUP	**NO. OF LECTURES**
Unit 1 **Dictionaries:** Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** ReviewofHashing,HashFunction,CollisionResolutionTechniquesin Hashing, Separate Chaining, OpenAddressing, LinearProbing, QuadraticProbing, DoubleHashing,Rehashing, ExtendibleHashing.	6
Unit 2 **SkipLists:**Need forRandomizingDataStructuresand Algorithms,Search and UpdateOperationson SkipLists,ProbabilisticAnalysisof SkipLists,Deterministic SkipLists	5
Unit 3 **Trees:**BinarySearchTrees,AVLTrees,RedBlackTrees,2-3Trees,B-Trees,Splay Trees	9
Unit 4	1
Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, TheKnuth-Morris-PrattAlgorithm, StandardTries, Compressed Tries, SuffixTries, The HuffmanCodingAlgorithm, The LongestCommon SubsequenceProblem(LCS),ApplyingDynamicProgrammingtotheLCSProblem.	
Unit 5 **Computational Geometry:**OneDimensionalRangeSearching,TwoDimensional Range Searching, Constructinga Priority Search Tree, Searchinga Priority Search Tree,PriorityRange Trees,Quadtrees,k-D Trees.	8
Unit 6 RecentTrands inHashing,Trees, andvariouscomputationalgeometrymethodsfor effecientlysolvingthenewevolvingproblem	4

References:

1. MarkAllenWeiss, DataStructuresand AlgorithmAnalysis inC++, 2ndEdition,Pearson, 2004.
2. MTGoodrich,RobertoTamassia,Algorithm Design,JohnWiley, 2002.

CourseCode	CSEE-4131
CourseName	DataScience
Credits	3
Pre-Requisites	

TotalNumber ofLectures:42

COURSEOUTCOMES
Oncompletionofthecourse thestudentshouldbeableto
• Explainhow datais collected,managedand storedfordatascience;
• Understandthekeyconceptsindatascience,includingtheirreal-worldapplicationsand
• ImplementdatacollectionandmanagementscriptsusingMongoDB

LECTUREWITH BREAKUP	**NO. OF LECTURES**
Unit1: Introductiontocoreconceptsandtechnologies:Introduction,Terminology, datascienceprocess, datascience toolkit, Typesofdata,Example applications.	6
Unit2: Datacollectionandmanagement:Introduction,Sourcesofdata,Data collectionandAPIs,Exploringandfixingdata,Datastorageandmanagement, Usingmultiple data sources	6
Unit3: Dataanalysis: Introduction,Terminologyand concepts,Introductionto statistics,Centraltendenciesanddistributions,Variance,Distributionproperties andarithmetic,Samples/CLT,Basicmachinelearning algorithms,Linear regression,SVM,Naive Bayes.	8
Unit4: Data visualisation:Introduction, Types of data visualisation,Data for visualisation:Datatypes,Dataencodings,Retinalvariables,Mappingvariables toencodings,Visualencodings.	8
Unit 5: ApplicationsofDataScience,Technologiesforvisualisation, Bokeh(Python)	7
Unit 6: Recenttrendsinvariousdatacollectionandanalysistechniques,various visualizationtechniques,applicationdevelopmentmethodsofused indata science.	7

References:

1. CathyO'Neiland RachelSchutt.DoingDataScience,StraightTalkFromTheFrontline. O'Reilly.

2. JureLeskovek,AnandRajaramanand JeffreyUllman. MiningofMassive Datasets.v2.1, Cambridge UniversityPress.

CourseCode	CSEE-4142
CourseName	Machinelearning
Credits	3
Pre-Requisites	

TotalNumber ofLectures:42

COURSEOUTCOMES
Aftercompletionofcourse,studentswouldbeableto:
• Extractfeaturesthatcanbeusedforaparticularmachinelearning approachinvariousIOT applications.
• Tocompare and contrastprosandconsofvarious machinelearning techniques and
• Tomathematicallyanalyse variousmachinelearningapproachesand paradigms.

LECTUREWITH BREAKUP	**NO.OF LECTURES**
Unit1: **Supervised Learning(Regression/Classification)**	8
• Basicmethods: Distance-based methods,Nearest-Neighbours,Decision Trees,NaveBayes • Linearmodels:LinearRegression, LogisticRegression, Generalized LinearModels • SupportVector Machines,NonlinearityandKernelMethods • BeyondBinaryClassification: Multi-class/StructuredOutputs,Ranking	
Unit2: **UnsupervisedLearning** • Clustering:K-means/Kernel K-means • DimensionalityReduction:PCAand kernelPCA • MatrixFactorizationand MatrixCompletion • GenerativeModels(mixturemodelsandlatentfactormodels)	6
Unit3 EvaluatingMachineLearningalgorithmsandModelSelection, Introductionto StatisticalLearningTheory,EnsembleMethods(Boosting,Bagging,Random Forests)	6
Unit4 SparseModelingandEstimation,ModelingSequence/Time-SeriesData,Deep Learning and Feature RepresentationLearning	8
Unit5 ScalableMachineLearning (Online and Distributed Learning) Aselectionfromsomeotheradvancedtopics,e.g.,Semi-supervisedLearning, Active Learning, Reinforcement Learning, Inference in Graphical Models, IntroductiontoBayesianLearning and Inference	8
Unit6: Recent trends in various learning techniques of machine learning and classificationmethods for IOT applications. Various models for IOT applications.	6

References:

1. KevinMurphy,MachineLearning:AProbabilisticPerspective,MITPress,2012
2. TrevorHastie,Robert Tibshirani,Jerome Friedman,TheElementsofStatistical Learning, Springer2009(freelyavailableonline)
3. ChristopherBishop,PatternRecognitionandMachineLearning,Springer,2007.

THIRD SEMESTER

CSEO-511: FORMAL LANGUAGES AND AUTOMATA THEORY

Unit I: Automata Theory: formal proof techiques, Finite Automata, DFA and NFA.

Unit II:FA and Regular Expressions, closure properties, equivalence and minimization of automata, non-regular languages.

Unit III: Context Free Grammars and Languages: Parse Trees, ambiguity, PDA, DPDA, equivalence of CFG and PDA.

Unit IV: Properties of Context-Free Languages: Normal forms, Pumping Lemma for CFL, Closure Properties, Turing Machines, TM programming.

Unit V: Undecidability: Non-RE problems, undecidable problems about Turing Machine, Post's Correspondence Problem, The classes P and NP.

Books/References:

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory,Languages and Computations", Pearson Education
2. H.R. Lewis and C.H. Papadimitriou, "Elements of the theory of Computation", Pearson Education.
3. Michael Sipser, "Introduction of the Theory and Computation", ThomsonBrokecole.
4. J. Martin, "Introduction to Languages and the Theory of computation", Tata Mc Graw Hill.

CSEE-512: SPEECH SIGNAL PROCESSING (3-1-0)

Unit I: Basic Concepts: Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production;

Review of Digital Signal Processing concepts; Short - Time Fourier Transform, Filter -Bank and LPC Methods.

Unit II: Speech Analysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Unit III: Speech Modeling: Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum -Welch Parameter Re-estimation, Implementation issues.

Unit IV: Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

Unit V: Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status

Books/References:

1. Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, Pearson Education.
2. Daniel Jurafsky and James H Martin, Speech and Language Processing, Pearson Education
3. T.E.Quatieri, Speech Signal Processing, Pearson Education
4. Ben Gold , Nelson Morgan and Dan Ellis, Speech and Audio Signal Processing: Processing and Perception of Speech and Music, WILEY Publication
5. John G. Proakis, Dimitris K Manolakis, Digital Signal Processing, Pearson Education

CSEE-513: DIGITAL IMAGE PROCESSING & COMPUTER VISION (3-1-0)

Unit I: Introduction to Image Processing & Computer Vision, Image processing system components, image sensing & Acquisition, sampling & Quantization. Neighbors of a pixel adjacency connectivity, regions & boundaries, Distance Measures, stereo vision. Image Formation: Monocular imaging system, Orthographic & Perspective Projection, Camera model and Camera calibration, stereo and multi view geometry, Binocular imaging systems.

Unit II: Image Enhancement & Restoration: Spatial filtering: Intensity transformations – piece-wise linear transformations, bit plane slicing, histogram equalization, smoothing filtering masks, sharpening filters – gradient operators and Laplacian filters. Frequency domain filtering: Image sampling, 2D Discrete Fourier Transform, lowpass filteringideal and Gaussian, highpass filtering- ideal, Gaussian, Laplacian. Noise Models. Mean, median and min-max filters. Minimum mean square error filter.

Unit III: Colour Image Processing: Colour models, pseudocolour, image processing, colour transformation, segmentation.Wavelets and Multi resolution Processing: Image pyramids,

subband coding, Harr transform, multi resolution expansions, discrete and continuous wavelet transforms

Unit IV: Image Compression: Fundamentals, Basic compression methods – Huffman, Arithmetic, LZW, run length coding schemes, Error free & Lossy compression, Standards: JPEG, JBIG. Edge and Boundary Detection: Edge detection, boundary detection, edge detection performance, boundary detection performance.

Unit V: Morphological Image Processing: Erosion and dilation, opening and closing, boundary extraction, hole filling. Motion Estimation, Detection & Tracking: Regularization theory, optical computation, Motion estimation, Structure from motion.Shape Representation & Reconstruction: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multiresolution analysis.

Books/References:

1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson Education.
2. D.Forsyth, J Ponce, Computer Vision – A Modern Approach, Prentice Hall, India
3. Anil K Jain, Fundamentals of Digital Image Processing, Prentice Hall India
4. E.Trucco, A Verri, Introductory Techniques for 3-D Computer Vision, Prentice Hall.

CSEE-514: PATTERN RECOGNITION (3-1-0)

Unit I: Bayes Decision Rules for two Class problem, Bayes maximum likelihood rule, minimum distance classifier, error probabilities for classifier, Mahalanobis distance, Bound for error probabilities, Estimation of parameters, Learning.

Unit II: Single layer perceptron, Clustering, Minimum within cluster distance criterion, k-means algorithm, single linkage, complete linkage and average linkage algorithms, Isodata algorithm etc.

Unit III: Feature Selection: Algorithms for feature selection such as Branch and Bound, Sequential forward and backward selections, GSFS and GSBS, (L, R) algorithm, Criterion function: Probabilistic Separability criterion, error probability based criterion, entropy based criterion, minimum within class distance based criterion, probabilistic independence, Principal Component Analysis

Unit IV: Fuzzy Set-theoretic Pattern Recognition:Usual Fuzzy set theoretic operations – union, intersection etc., Multitvalued Logic: Zade Compositional Rule of inference, Fuzzy C-means algorithm, Supervised Classification: Multitvalued Recognition System, Fuzzy set theoretic based feature selection criteria.

Books/References:

1. Duda and Hart, "Pattern Classification ad Scene Analysis", John Willey.
2. P.A. Devijver and J. Kittler, "Pattern Recognition: A Statistical Approach".
3. K. Fukunga, "Introduction to Statistical Pattern Recognition", Academic Press
4. S.K. Pal and Dutta Mazumdar, "Fuzzy Set Theroetic Methods for Patern Recognition", John Willey.

CSEE – 515: WIRELESS COMMUNICATION (3-1-0)

Unit I: Wireless transmission fundamentals: Electromagnetic spectrum, radiation patterns, Power Density, intensity, beamwidth, directivity and gain, isotropic and omni-directional antenna, Friis transmission equation. free space propagation, free space propagation model, introduction to large-scale path-loss models, fast and slow fading and distributions.

Unit II: Modulation Techniques for Mobile radio: FM and AM, digital modulation overview, BPSK, QPSK and variants, Gram-schmidt orthogonalization procedure. Spread-spectrum modulation techniques, DSSS and FHSS and their performance.
Unit III:mobile cellular communication: frequency reuse, cluster size; cellular system architecture, channel assignment strategies, call splitting, sectoring, Introduction to GSM architecture, channel types, call setup, mobility in cellular networks and handoff. introduction to CDMA

Unit IV: Introduction to WiFi networks and ad-hoc networks, Routing protocols in ad-hoc networks, specialized sensor networks. Emerging trends in wireless networking.

Books/References:

1. Rappaport, Wireless Communications: Principles and Practice, PEARSON
2. Andreas F. Molisch, Wireless Communications, Wiley India Pvt Ltd
3. W. Stallings, Wireless Communications and Networks, Pearson education publishing

CSEE- 516: CRYPTOGRAPHY (3-1-0)

Unit I: Introduction to Cryptography, Mathematical Foundation of Cryptography : Information Theory, Complexity Theory, Number Theory, Probability Theory;

Unit II: Secret Key Cryptosystem : Stream and Block Ciphers; Pseudo-random pattern generators, LFSR based stream ciphers, other stream ciphers; Correlation attacks and other relevant attacks for steam ciphers; DES and Its Security, other Block Ciphers; Differential Cryptanalysis, Attacks on Block Ciphers;

Unit III: One-Way Hash Functions and Data Integrity: Snefru, MD4, MD5, SHA, HAVAL; Cryptanalysis of hash functions;Public Key Cryptography: Mathematical Foundation, RSA, Security Analysis of RSA

Unit IV: Key Establishment Protocols: Symmetric key based and Asymmetric Key based protocols, KERBEROS, EKE, DH-EKE, PAKE, etc; Secret Sharing;Digital Signature Schemes: RSA and other related signature schemes, Possible Attacks, DSA and other related signature schemes;

Books/References:

1. Manezes, Oorschot and Vanstone, Handbook of Applied Cryptography, CRC Press
2. B Schnier, Applied Cryptography, PHI

CSEE-517: MACHINE LEARNING(3-1-0)

Unit I: Overview of Machine Learning, Concept of Learning and the General – to – specific ordering,

Unit II: Decision tree learning, Neural Network, Evaluation Hypothesis, Bayesian Leaning, Computational Learning Theory, Instance Based Learning,

Unit III: Generic algorithms, Learning sets and rules, Analytical learning, combining Inductive and Analytical learning, Reinforcement learning

Books/References:

1. Tom Mitchell, "Machine Learning", McGraw.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press.

CSEE-518: EMBEDDED SYSTEMS (3-1-0)

Unit I: Introduction to Embedded systems, hardware/softwarecode sign, Embedded micro controller cores,
embedded memories, Examples of embedded systems, sensors and interfacing techniques,

Unit II: RTOS, scheduling paradigms, blocking, unpredictability, interrupts, caching.
Unit III: Case studies of OSs for embedded systems, programming languages, system support for embedded systems,
Unit IV: Case studies of embedded system-based applications, software development methodology

Books/References:

1. D. Gajski, F. Vahid, S. Narayan, and J. Gong, "Specification and Design of Embedded Systems", PEARSON Education
2. Syaunstrup and W. Wolf,"Hardware Software Co-design: Principles and Practice", Kluwer Academic Publishers