SIR PADAMPAT SINGHANIA UNIVERSITY

Udaipur

SCHOOL OF ENGINEERING

Course Curriculum of 2-Year M. Tech. Degree Programme in Computer Science & Engineering (Specialization in Data Mining) (Batch- 2020-22)

Credit Structure

M. Tech. Core	
Category	**Credits**
Departmental Core Subjects	60
Total	60

Distribution of Total Credits & Contact Hours in all Semesters

S. No.	Semester Number	Credits/Semester	Contact hours/week
1	I	17	19
2	II	16	17
3	III	15	21
4	IV	12	18
	Total	60	--

Course Structure: M. Tech. 2020-2022

Semester - I

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CS-551	Advanced Algorithms	3	0	1	4
2	CS-552	Probability & Statistics for Computer Science	3	0	0	3
3	CS-553	Cryptography & Network Security	3	0	1	4
4	CS-554	Database Engineering	3	0	0	3
5	CS-555	Advanced Computer Architecture	3	0	0	3
					Total Credits	17
					Total Contact hours/week	19

Semester - II

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CS-556	Machine Learning: Theory & Methods	3	0	0	3
2	CS-557	Advances in Operating System Design	3	0	0	3
3	CS-558	Digital Image Processing	3	0	1	4
4	CS-571	Data Mining	3	0	0	3
5	CS-572	Statistical Simulation & Data Analysis	3	0	0	3
					Total Credits	16
					Total Contact hours/week	17

Semester - III

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CS-573	Information Retrieval	3	0	1	4
2	CS-574	Pattern Recognition	3	0	0	3
3	CS-575	Emerging Trends in Data Mining	3	0	0	3
4	CS-580A	Dissertation – I	0	0	5	5
					Total Credits	15
					Total Contact hours/week	21

Semester - IV

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CS-580B	Dissertation – II	0	0	9	9
2	CS-580C	Dissertation Viva Voce	-	-	-	3
					Total Credits	12
					Total Contact hours/week	18

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Semester - I

(Departmental Core Subject)

CS-551 L-T-P-C
Advanced Algorithms 3-0-1-4

Objective: *The goal of this course is to develop the appropriate background, foundation & experience for advanced study in Computer Science. Students will develop the necessary skills from both a theoretical perspective as well as applying their knowledge on various problem sets.*

Course Content

NP-completeness; Advanced complexity classes; Incremental & Decremental Algorithms; Geometric algorithms: Point location, Convex hulls & closest pair; Graph algorithms: Matching & Flows; Approximation algorithms: local search heuristics; Randomized algorithms; Online algorithms; Parameterized algorithms; Internet search algorithms.

List of Experiments

1. Experiments related to various types of graphs
2. Experiments related to various algorithms on graphs
3. Experiments related to geometric algorithms
4. Experiments related to randomized algorithms
5. Experiments related to online algorithms
6. Experiments related to parameterized algorithms
7. Experiments related to approximation algorithms

Text/Reference Books

1. Introduction to Algorithms. Cormen T. H., Lieserson C. E., Rivest R. L. & Stein C. 3rd Ed. MIT Press/McGraw-Hill. 2011.
2. Algorithm Design. Kleinberg J. & Tardos E. Pearson. 2005.
3. Computational Complexity: A Modern Approach. Arora S. & Barak B. 1st Ed. Cambridge University Press. 2009.
4. Randomized Algorithms. Motwani R. & Raghavan O. Cambridge University Press. 1995.

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Semester - I

(Departmental Core Subject)

CS-552 L-T-P-C
Probability & Statistics for Computer Science 3-0-0-3

Objective: *Probability theory is the branch of mathematics that deals with modelling uncertainty. It is important because of its direct application in areas such as genetics, finance & telecommunications. It also forms the fundamental basis for many other areas in the mathematical sciences including statistics, modern optimization methods & risk modelling.*

Course Content

Review of probability basics. Discrete & continuous distributions, common distributions (Poisson, exponential, Gaussian, etc.), functions of random variables. Multivariate Distributions, joint & marginal distributions, covariance & correlation, sums of random variables, sampling theory. Estimators, confidence intervals, hypothesis testing & P-values, design of experiments. Miscellaneous topics: Markov Chains, Queuing Theory.

Text/Reference Books

1. Probability and Statistics for Computer Scientists. Baron M. 1st Ed. Chapman & Hall Publication. 2006.
2. A First Course in Probability and Statistics. Rao N. D. V. P. Cambridge University Press. 2013.
3. Probability Statistics and Reliability for Engineers and Scientists. McCuen H. R. & Ayyub B. M. 3rd Ed. CRC Press. 2011.

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Semester - I

(Departmental Core Subject)

CS-553 L-T-P-C
Cryptography & Network Security 3-0-1-4

Objective: *The course provides an extensive coverage of the techniques & methods needed for the proper functioning of the ciphers, one way functions & trap-door functions, cryptanalysis of public key ciphers, namely RSA, key exchange problem & solutions using the Diffie-Hellman algorithm, Message Authentication Codes (MAC) & signature schemes, elliptic & hyper-elliptic curve cryptography.*

Course Content

Introduction: Basic objectives of cryptography, secret-key & public-key cryptography, one-way & trapdoor one-way functions, cryptanalysis, attack models, classical cryptography. Block ciphers: Modes of operation, DES & its variants, RCS, IDEA, SAFER, FEAL, Blowfish, AES, linear & differential cryptanalysis. Stream ciphers: Stream ciphers based on linear feedback shift registers, SEAL, unconditional security. Message digest: Properties of hash functions, MD2, MD5 & SHA-1, keyed hash functions, attacks on hash functions. Public-key parameters: Modular arithmetic, gcd, Chinese remainder theorem, modular square roots, finite fields. Intractable problems: Integer factorization problem, RSA problem, modular square root problem, discrete logarithm problem, Diffie-Hellman problem, known algorithms for solving the intractable problems. Public-key encryption: RSA, Rabin & El Gamal schemes, side channel attacks. Key exchange: Diffie-Hellman & MQV algorithms. Digital signatures: RSA, DAS & NR signature schemes, blind & undeniable signatures. Entity authentication: Passwords, challenge-response algorithms, zero-knowledge protocols. Standards: IEEE, RSA & ISO standards. Network issues:

Certification, public-key infrastructure (PKI), secured socket layer (SSL), Kerberos. Advanced topics: Elliptic & hyper-elliptic curve cryptography, number field sieve, lattices & their applications in cryptography, hidden monomial cryptosystems, cryptographically secure random number generators.

List of Experiments

1. Implementation of Ceaser, Hill & Playfair cipher
2. Implementation of simplified DES
3. Implementation of AES
4. Implementation of Diffie-Hellman Kay exchange algorithm
5. Implementation of RSA algorithm
6. Implementation of MD5 & SHA
7. Implementation of Kerberos
8. Implementation of Elliptic & hyper-elliptic curve cryptography
9. Implementation of hidden monomial cryptosystems
10. Implementation of random number generators

Text/Reference Books

1. Cryptography and Network Security. Forouzan B. A. 2nd Ed. Tata McGraw-Hill. 2010.
2. Cryptography and Network Security. Stalling W. 4th Ed. Pearson.2006.
3. Cryptography and Network Security. Kahate A. 3rd Ed. Tata McGraw-Hill. 2003.

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Semester - I

(Departmental Core Subject)

CS-554 L-T-P-C
Database Engineering 3-0-0-3

Objective: *The course offers some advance database topics in depth which are useful for working with database in real world. The topics cover introductory concepts as well as advance topics in database like Parallel & Distributed Databases, Scheduling & Concurrency Control & Web database.*

Course Content

Relational Databases: Integrity Constraints revisited: Functional, Multi-valued & Join Dependency, Template Algebraic, Inclusion & Generalized Functional Dependency, Chase Algorithms & Synthesis of Relational Schemes. Query Processing & Optimization: Evaluation of Relational Operations, Transformation of Relational Expressions, Indexing & Query Optimization, Limitations of Relational Data Model, Null Values & Partial Information. Deductive Databases: Data log & Recursion, Evaluation of Data log program, Recursive queries with negation. Objected Oriented & Object Relational Databases: Modeling Complex Data Semantics, Specialization, Generalization, Aggregation & Association, Objects, Object Identity, Equality & Object Reference, Architecture of Object Oriented & Object Relational Databases. Case Studies: Gemstone, O2, Object Store, SQL3, Oracle xxi, DB2.

Parallel & Distributed Databases: Distributed Data Storage: Fragmentation & Replication, Location & Fragment Transparency, Distributed Query Processing & Optimization, Distributed Transaction Modeling & Concurrency Control, Distributed Deadlock, Commit Protocols, Design of Parallel Databases, Parallel Query Evaluation. Advanced

Transaction Processing: Nested & Multilevel Transactions, Compensating Transactions & Saga, Long Duration Transactions, Weak Levels of Consistency, Transaction Work Flows, & Transaction Processing Monitors. Active Databases: Triggers in SQL, Event Constraint & Action: ECA Rules, Query Processing & Concurrency Control, Compensation & Databases Recovery. Real Time Databases: Temporal Constraints: Soft & Hard Constraints, Transaction Scheduling & Concurrency Control. Image & Multimedia Databases: Modeling & Storage of Image & Multimedia Data, Data Structures - R-tree, k-d tree, Quad trees, Content Based Retrieval: Color Histograms, Textures etc., Image Features, Spatial & Topological Relationships, Multimedia Data Formats, Video Data Model, Audio & Handwritten Data, Geographic Information Systems (GIS). WEB Databases.

Text/Reference Books

1. Database System Concepts. Silberschatz A., Korth H. F. & Sudarshan S. 6th Ed. Tata McGraw-Hill. 2010.
2. Database Management System. Pakhira M. K. PHI. 2012.
3. Database Systems: Models, Languages, Design and Application Programming. Ramez E. & ShamKant B. N. 6th Ed. Pearson. 2013.

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Semester - I

(Departmental Core Subject)

CS-555 L-T-P-C
Advanced Computer Architecture 3-0-0-3

Objective: *The course entails some of the design concepts, subsystems, & new & specialized architectures (especially parallel architectures). The principal objective is to gain an understanding of selected architectural structures as they are likely to be encountered in real systems. The course also highlights some aspects of neuro-computing architecture.*

Course Content

Introduction to High Performance Computing: Overview, Pipeline vs. Parallel Processing Parallel Architectures: Classification & Performance. Pipeline Processing: Pipeline Performance, design of arithmetic pipelines, concept of reservation table, collision vector & hazards. Instruction Processing Pipes: Instruction & data hazard, hazard detection & resolution, delayed jumps, delayed execution. RISC Philosophy. Pipeline scheduling Theory: Greedy pipeline scheduling algorithm, state diagram, modified state diagram, Latency cycles, optimal cycles, scheduling of static & dynamic Pipelines. Implementation of pipeline schedulers Interconnection Networks: Interconnection network classification, Single stage/ Multistage Networks, crossbars, clos Networks, Benes Networks, Routing algorithms. Omega, Cub-connected & other networks. Introduction to neuro-computing architectures.

Text/Reference Books

1. Computer Architecture: A Quantitative Approach. Hennessy J. L. & Patterson D. A. 3rd Ed. Morgan Kaufmann. 2002.

2. Advanced Computer Architecture. Hwang K. & Jotwani N. 2nd Ed. Tata McGraw-Hill. 2011.
3. Computer Organization and Architecture. Stallings W. Macmillan Publishing Company. 1990.

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Semester - II

(Departmental Core Subject)

CS-556 L-T-P-C
Machine Learning: Theory & Methods 3-0-0-3

Objective: *Upon successful completion of the course, the students will acquire the basic knowledge of Machine Learning, identify algorithms as well as machine learning problems & apply the knowledge of computing & mathematics appropriate to the discipline. The course also includes concepts of decision tree, artificial neural networks, Bayesian learning, genetic algorithms, clustering & classification algorithms etc. & their applications.*

Course Content

Introduction Theoretical Approaches: Inductive Inference, Grammatical Inference PAC Learning. Complexity of Learning, polynomial learnability, VC-dimension. Methodologies: parametric learning, language learning, explanation based learning, learning using exemplars, algorithms, learning in neural nets, multistrategy learning. Automatic program construction from example computations, inference of LISP & logic programs, inference of decision trees & finite automata. Architecture of machine learning programs, ID5, C4.5 etc. Applications of Machine Learning to Data Mining & Knowledge Discovery.

Text/Reference Books

1. Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Flach P. Cambridge University Press. 2012.
2. Machine Learning. Mitchell T. M. 1st Ed. Tata McGraw-Hill. 2013.
3. Introduction to Machine Learning. Alpaydin E. PHI. 2015.

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Semester - II

(Departmental Core Subject)

CS-557 L-T-P-C
Advances in Operating System Design 3-0-0-3

Objective: *The course entails the distributed operating systems & provides theoretical foundation for distributed systems. The student will also be able to implement project Case Studies in distributed OS & Security in Distributed OS, Distributed databases etc. & analyze the requirements, make critiques & create design of secured operating systems.*

Course Content

Theory & implementation aspects of distributed operating systems. Process synchronization in multiprocessing/multiprogramming systems. Inter-process communication & co-ordination in large distributed systems. Distributed resource management. Fundamentals of real time operating systems. Case studies. Information management in distributed systems: security, integrity & concurrency problems. Fault tolerance issues. OS issues related to the Internet, intranets, pervasive computing, embedded systems, mobile systems & wireless networks. Case studies of contemporary operating systems.

Text/Reference Books

1. Advance Concepts in Operating Systems. Singhal M. & Shivaratri N. 1st Ed. Tata McGraw-Hill. 2001.
2. Distribution System Modeling & Analysis. Kersting W. H. 3rd Ed. CRC Press. 2012.
3. Distributed Operating Systems. Tanenbaum A. S. 1st Ed. Pearson. 1995.

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Semester - II

(Departmental Core Subject)

CS-558 L-T-P-C
Digital Image Processing 3-0-1-4

Objective: *The course will cover techniques & tools for digital image processing, & image analysis techniques in the form of image segmentation. The topics cover image enhancement, image filters, image transforms, Fourier transforms & Fast Fourier transforms, Edge detection, Image Segmentation & color imaging.*

Course Content

Digital Image Fundamentals; Sensor & Imaging: Imaging Optics, Radiometry of Imaging, Illumination sources & techniques, Camera Principles, Image Enhancement in Spatial Domain: histogram equalization & specification, contrast modification, neighborhood filtering, image smoothing & image sharpening; Gray Level Transformation, Histogram Processing, Spatial Filters; Image Transforms; Fourier transforms & their properties, Fast Fourier Transform, Other Transforms; Frequency domain processing: Sampling theorem, applications in image filtering, Edge detection, Image Restoration, Image segmentation, Hough transform, region based segmentation; Representation & Description; Color Imaging.

List of Experiments

1. The basic built-in functions available for image processing in Scilab to read, write & manipulate, understanding various image formats & conversion to gray scale & other formats
2. Programs related to the concept of image transforms through singular value decomposition, Haar, Walsh & Hadamaard transforms, DFT etc

3. Programs related to the statistical description of digital image through random fields, Karhunen-Loeve transform, independent component analysis
4. Programs related to image enhancement through histogram manipulation, reducing high frequency noise
5. Programs related to linear, non-linear filtering techniques like convolution, derivative, wiener & dithering
6. Programs related to image segmentation & edge detection through Sobel filters
7. Programs related to morphological image processing
8. Programs related to basic color image processing
9. Programs related to the basics of 3D image representation
10. Programs related to the concept of image compression
11. Case Study: Human face detection system & Signature verification system

Text/Reference Books

1. Digital Image Processing Pratt. William K. 4th Ed. Willey Publisher. 2007.
2. Fundamentals of Digital Image Processing. Jain A. K. 2nd Ed. PHI. 1989.

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Semester - II

(Departmental Core Subject)

CS-571 L-T-P-C
Data Mining 3-0-0-3

Objective: *Learner will be able to identify the basic principles of data mining, issues in data mining, classification & clustering algorithms in data mining & various advanced concepts in Data Mining.*

Course Content

Introduction: Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective. Knowledge mining from databases. Data pre-processing. Data Mining Techniques: A Statistical Perspective on Data Mining, Similarity Measures, Decision Trees, Neural Networks, Genetic Algorithms. Multi-dimensional data modeling. Classification: Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Neural Network-Based Algorithms, Rule-Based Algorithms, Combining Techniques. Clustering: Similarity & Distance Measures, Hierarchical Algorithms, Partition Algorithms, Clustering Large Databases, Clustering with Categorical Attributes. Frequent item set mining. Association Rules: Basic Algorithms, Parallel & Distributed Algorithms, Incremental Rules, Advanced Association Rule Techniques, Measuring the Quality of Rules. Anomaly detection. Mining special kinds of data including text & graph. Advanced Techniques: Web Mining, Spatial Mining, & Temporal Mining.

Text/Reference Books

1. Data Mining: Concepts and Techniques. Han J. & Kamber M. 2nd Ed. Morgan Kauffman. 2006.
2. Data Mining: Introductory and Advanced Topics. Dunham M. H. Pearson .2006.
3. Building the Data Warehouse. Inmon W. H. 3rd Ed. Wiley. 2002.

4. Data Warehousing, Data Mining & OLAP. Bezon A. & Smith S. J. Tata McGraw-Hill. 2001.

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Semester - II

(Departmental Core Subject)

CS-572 L-T-P-C
Statistical Simulation & Data Analysis 3-0-0-3

Objective: *After completion of this course, the student will be able to analyze simulation of random variables, statistical distributions & various methods for the same.*

Course Content

Simulation of random variables from discrete, continuous, multivariate distributions & stochastic processes, Monte-Carlo methods. Regression analysis, scatter plot, residual analysis. Computer Intensive Inference Methods - Jack-Knife, Bootstrap, cross validation, Monte Carlo methods & permutation tests. Graphical representation of multivariate data, Cluster analysis, Principal component analysis for dimension reduction. Dimension reduction using LASSO, E.M. Algorithm, & Markov Chain Monte Carlo.

Text/Reference Books

1. Data Analysis and Decision Making. Albright S. C., Winston W. L., Zappe C. J., Hinrichs C. & Rogove J. South-Western Publisher. 2002.
2. Simulation. Ross S. M. 4th Ed. Academic Press.2006.
3. Data Analysis, Optimization and Simulation Modeling. Albright B. 4th Ed. Cengage. 2012.

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Semester - III

(Departmental Core Subject)

CS-573 L-T-P-C
Information Retrieval 3-0-1-4

Objective: *On completion of this course the student will be able to understand the advanced concepts of complex retrieval operations as probabilistic language models, stochastic models, TREC text classification & summarization etc.*

Course Content

Introduction: Principles of Information Retrieval, Indexing, Zipfs Law, Search. Vector space model, cosine similarity. Scoring techniques. Stemming, Stop words, Query expansion, Rochhio. Probabilistic models language. Relevance feedback. Evaluation: Precision, recall, f-measure. TREC Text classification, clustering, query routing. Advanced topics like summarization & question answering.

List of Experiments

1. Experiments related to tokens
2. Experiments related to text processing
3. Experiments related to data preprocessing
4. Experiments related to word indexing
5. Experiments related to stemming
6. Experiments related to parsing
7. Experiments related to word count
8. Experiments related to index creation
9. Experiments related to stop word identification & removal etc
10. Experiments related to index based searching & document searching

Text/Reference Books

1. An Introduction to Information Retrieval. Manning C. D., Raghavan P. & Schtze H. Cambridge University Press. 2009.
2. Modern Information Retrieval. Ricardo B. Y. & Berthier R. N. 1st Ed. Addison-Wesley Publishing Co. 1999.
3. Information Retrieval: Algorithms and Heuristics. Grossman D. A. & Frieder O. Springer – The Information Retrieval Series. 2004.

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Semester - III

(Departmental Core Subject)

CS-574 L-T-P-C
Pattern Recognition 3-0-0-3

Objective: *This course entails advanced pattern recognition methods using various schemes of machine learning & application development for speech recognition & handwriting recognition etc.*

Course Content

Basics of pattern recognition, statistical & syntactic pattern recognition; Bayes' decision theory, maximum likelihood estimation, nonparametric techniques, & linear discriminant analysis: nonmetric methods; algorithm independent machine learning; unsupervised learning & clustering; statistical learning theory. Introduction to formal languages; string languages for pattern description; stochastic languages for syntactic pattern recognition; cluster analysis for syntactic patterns. Applications: web searching, handwriting recognition, multimedia data retrieval, speech recognition, network traffic analysis.

Text/Reference Books

1. Pattern Recognition. Gibson W. Penguin UK. 2011.
2. Pattern Recognition and Image Analysis. Earl G. G., Richard J. & Steve J. PHI. 2011.
3. Adaptive Pattern Recognition and Neural Networks. Pao Y. Addison-Wesley Publishing Co.1989.

(Specialization in Data Mining)

Semester - III

(Departmental Core Subject)

CS-575 L-T-P-C
Emerging Trends in Data Mining 3-0-0-3

Objective: *The student will be exposed to the recent trends in Data Mining & the advanced concepts like opinion mining, sentiment analysis, big data morpheme extraction from unstructured data etc.*

Course Content

Data mining in a Parallel Environment, Validation of data mining techniques, Argumentation Mining, Recent innovations & trends in Business Analytics, Spanning Organizations & Technical, Processes, User Interface Design & System Integration, Exploring Advances in Interdisciplinary Field such as Data Mining in Earth Science, Agriculture, Telecommunications, Social Networks, & Aerospace with special emphasis to the recent publications in the field. Web Data Mining, Opinion Mining & Sentiment Analysis, Information Access & Big Data- Legal Perspectives, Shared Task on Transliterated Search track, Morpheme Extraction in unstructured data using Finite State Machines, Information access in Legal domain.

Text/Reference Books

1. Knowledge Discovery Practices and Emerging Applications of Data Mining: Trends and New Domains. Kumar A. V .S.1st Ed. IGI Global. 2010.
2. Next Generation of Data Mining. Kargupta H., Han J., Yu P. S., Motwani R. & Kumar V. CRC Press. 2008.
3. Data Mining: Technologies, Techniques, Tools and Trends. Thuraisingham B. CRC Press.1998.

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Semester - III

(Departmental Core Subject)

CS-580A	L-T-P-C
Dissertation - I	0-0-5-5

The Dissertation for M.Tech programme consists of two parts: Dissertation-I & Dissertation-II. Dissertation-I is undertaken during the III Semester.

The Dissertation is by far the most important single piece of work in the post-graduate programme. It provides the opportunity for student to demonstrate independence & originality, to plan & organize a large Dissertation over a long period & to put into practice some of the techniques students have been taught in the course. Students will choose a dissertation, in consultation with a faculty member, who will act as the Supervisor. Dissertation involves a combination of sound background research, a solid implementation, or piece of theoretical work, & a thorough evaluation of the dissertation's output in both absolute & relative terms. The very best dissertations invariably covers some new ground, e.g. by developing a complex application which does not already exit, or by enhancing some existing application or method to improve its functionality, performance etc.

The student will prepare the Dissertation report as per the prescribed format/guidelines, & present the same as a seminar at the end of the semester.

The Dissertation will be evaluated continuously over the span of the III Semesters, as per the approved procedure.

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Semester - IV

(Departmental Core Subject)

CS-580B	L-T-P-C
Dissertation - II	0-0-9-9

After completion of Dissertation-I, students will undertake the Dissertation-II in the IV Semester. The idea conceived & progress made in the Dissertation-I shall be extended as Dissertation-II under the supervision of a faculty member. Students shall complete the theoretical & practical aspect of the project. Thereafter they will prepare a report, as per the prescribed format/ guidelines, incorporating the results, their analysis & interpretation. The report, duly certified by the Supervisor, should be submitted to the Head of the Department. The report should also be presented as a seminar at the end of the semester. Progress made by the student will be continuously monitored throughout the semester & evaluated as per the approved procedure.

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Semester - IV

(Departmental Core Subject)

CS-580C	L-T-P-C
Dissertation Viva Voce	0-0-0-3

Dissertation Viva Voce is the verbal defence of the dissertation carried out by the student in front of a panel of examiners. The objective of Viva Voce examination is to confirm that the piece of work submitted as a dissertation is student's own work, he/she has a sound understanding of the subject of the dissertation, aware of the recent works in the area of dissertation, methodology adopted, and importance/relevance/merits of the output in relation with the existing results in the area.