FACULTY OF ENGINEERING & TECHNOLOGY

SYLLABUS

FOR

MASTER OF TECHNOLOGY
(COMPUTER SCIENCE)
(Two Years Course)

(Under Credit Based Continuous Evaluation Grading System)

(Session: I & II)

SESSION: 2018-19

GURU NANAK DEV UNIVERSITY
AMRITSAR

CSB2: MASTER OF TECHNOLOGY (COMPUTER SCIENCE)
(Under Credit Based Continuous Evaluation Grading System)

Eligibility:
The Minimum qualifications for admission to the first year of this programme shall be open to a person who possesses any of the following qualifications:-

1. B.Tech / BE or equivalent in any branch of Engineering / Technology with atleast 60% marks in aggregate. OR
2. MCA / M.Sc. (Computer Science) / M.Sc. (IT) or equivalent with atleast 55% marks in aggregate.

Scheme of Syllabus:

Sr. no.	**Subject**	**Credits**		
	Semester I	**L**	**T**	**P**
CSL581	Distributed Systems	4	0	0
CSL582	Programming Paradigms	4	0	0
CSL583	Research Methods in Computer Science	4	0	0
CSL584	Data Science & Analytics	4	0	0
CSP585	Programming Lab.	0	0	1
CSP586	Term Paper-I	0	0	1
	Sub Total	**16**	**0**	**2**
	Grand Total	**18**		

Note:

- **PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper) Students can opt. this paper in any odd semester. This ID Paper is one of the total ID Papers of this course.**

	Semester II			
CSL591	Computational Linguistics	4	0	0
CSL592	Software Engineering	4	0	0
	Interdisciplinary – I	4	0	0
	Elective-I	4	0	0
CSP595	Programming Lab.	0	0	1
CSP596	Term Paper-II	0	0	1
	Sub Total	**16**	**0**	**2**
	Grand Total	**18**		
	List of Electives-I			
CSL597	Software Project Management	4	0	0
CSL598	Computer Vision	4	0	0
CSL599	Computing Trends	4	0	0

	Semester III			
CSL671	Machine Learning Techniques	4	0	0
	Interdisciplinary – II	4	0	0
CSD673	Dissertation Part-I	0	0	8
	Sub Total	**8**	**0**	**8**
	Grand Total	**16**		

Note:

- **PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper) Students can opt. this paper in any odd semester. This ID Paper is one of the total ID Papers of this course.**

	Semester IV			
CSD673	Dissertation Part-I	0	0	8
CSD680	Dissertation Part-II	0	0	16

CSB2: MASTER OF TECHNOLOGY (COMPUTER SCIENCE) (SEMESTER – I)
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CSL581: DISTRIBUTED SYSTEMS

Credits		
L	T	P
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

Introduction to Distributed Systems, Message Passing, Distributed Models, Causality and Logical Time

Introduction to Distributed Systems, Trends in distributed systems, Basic Algorithms in Message Passing System

Distributed Models of Computation, Causality & Logical Time

Logical Time, Global State & Snapshot and Distributed Mutual Exclusion-Non-Token approaches

Size of Vector Clock, Matrix Clocks, Virtual Time and Physical Clock Synchronization

Global State and Snapshot Recording Algorithms

Distributed Mutual Exclusion and Non-Token based Approaches

Section–B

Distributed Mutual Exclusion-Token based approaches, Consensus & Agreement, Checkpointing & Rollback Recovery

Token Based Distributed Mutual Exclusion Approaches, Consensus and Agreement Algorithms, Checkpointing & Rollback Recovery

Distributed Operating Systems

Introduction, The Kernel, Process and Threads, Communication.

Section–C

Transaction and concurrency control

Distributed Transactions, nested transactions, locks, concurrency control, timestamp ordering

Deadlock Detection, DSM and Distributed MST

Deadlock Detection in Distributed Systems , Distributed Shared Memory, Distributed Minimum Spanning Tree

Section–D

Termination Detection, Message Ordering & Group Communication, Fault Tolerance and Self-Stabilization

Termination Detection in Distributed System, Message Ordering and Group Communication, Fault tolerance,
Self-Stabilization

Case Studies: Sensor Networks, Authentication & Security in DS

Introduction to Sensor Networks, Distributed Algorithms for Sensor Networks, Authentication in Distributed Systems
Security in Distributed Systems and Block Chain

Reference Book:

George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair: Distributed Systems: Concepts and Design 5th Edition, Addison-Wesley Publishing Company.
Distributed Algorithms-Nancy Lynch
Distributed Computing: Fundamentals, Simulations and Advanced Topics-Hagit Attiya and Jennifer Welch

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CSL582: PROGRAMMING PARADIGMS

Credits		
L	**T**	**P**
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

THE NATURE OFPROGRAMMING LANGUAGES

Imperative languages and non-imperative languages, Scripting languages, Data-oriented languages, Object-oriented languages, Event-driven Programming

PROGRAMMING ENVIRONMENTS

Compilers and Interpreters, Interactive development tools, Run-time support environments, Debugging Tools, Testing Tools, Configuration Management

Section–B

OBJECT-ORIENTATION

Basic concepts: objects, classes, methods, overloading methods, messages inheritance: overriding methods, single inheritance, multiple inheritance Interfaces (e.g. in Java), encapsulation, polymorphism

LOGIC PROGRAMMING

Basic constructs, Facts: queries, existential queries, conjunctivequeries and rules, Definition and semantics of a logic program, Recursive programming: Computational modelof logic programming, Goal reduction, Negation in logic programming

Section–C

EVENT-DRIVEN PROGRAMMING

Graphics programming – Frame – Components – working with 2D shapes – Using color,fonts, and images - Basics of event handling – event handlers – adapter classes –actions – mouse events – AWT event hierarchy – introduction to Swing – Model-View-Controller design pattern – buttons – layout management – Swing Components

Section–D

CONCURRENT PROGRAMMING

Multi-threaded programming – interrupting threads – thread states – thread properties-thread synchronization – thread-safe Collections – Executors – synchronizers – threadsand event-driven programming

References:

1. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", EighthEdition, Sun Microsystems Press, 2008.
2. K. Arnold and J. Gosling, "The JAVA programming language", Third edition, PearsonEducation, 2000.
3. Timothy Budd, "Understanding Object-oriented programming with Java", UpdatedEdition, Pearson Education, 2000.
4. C.Thomas Wu, "An introduction to Object-oriented programming with Java", FourthEdition, Tata McGraw-Hill Publishing company Ltd., 2006.
5. Clark R. G., Comparative ProgrammingLanguages, Addison-Wesley (3rd Ed.), 2000.
6. Sebesta, R. W., Concepts of ProgrammingLanguages, Addison-Wesley (11th Ed.) 2015

CSB2: MASTER OF TECHNOLOGY (COMPUTER SCIENCE) (SEMESTER – I)
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CSL583: RESEARCH METHODS IN COMPUTER SCIENCE

Credits		
L	**T**	**P**
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

Introduction to Research: Meaning, Definition, Objective and Process
Research Design: Meaning, Types - Descriptive, Exploratory and Experimental, Action research
Problem Formulation, Understanding of Problem, Review of Literature
Hypothesis:Types, Formulation of Hypothesis, Feasibility, Preparation and Presentation of Research Proposal

Section–B

Types of Data, Sources of Data: Primary and Secondary, Validation of Data
Data Collection Methods: Questionnaire, Interviews, using Tools, Mining Logs
Data Processing : Editing, Sorting, Coding, Classification and Tabulation
Scaling Techniques: Meaning & Types

Section–C

DataAnalysis: Statistical tests and Their Significance, Central Tendency, Dispersion, Correlation: Linear and Partial, Regression: Simple and Multiple Regression, Skewness, Timeseries Analysis
Multivariate Analysis: Fact or Analysis, Discriminant Analysis, Cluster Analysis, Conjoint Analysis, Multi Dimensional Scaling
Testing of Hypothesis : t- test, Z -test, Chi Square, F test, ANOVA
Intelligent Data Analysis
Validity of Results: internal, external, reliability

Section–A

Data Presentation and Visualization – using tables, graphs.
Report Writing:Essentials of Report Writing, Report Format, Technical Writing
Typesofresearch report: Dissertation and Thesis, research paper, review article, short communication, Conferencepresentationetc.,Referencingand referencing styles,ResearchJournals,Indexingandcitation
OfJournals,Intellectualproperty,Plagiarism
Statistical Software:Application of data analysis tools/languages likeR, Python

Recommended Books

C.R.Kothari, 'Research Methodology Methods & Techniques',2nd Edn., New Age International Publishers.
RanjitKumar,ResearchMethodology:AStep-by-StepGuideforBeginners,2nd Edition,SAGE,2005
Michael Baron,Probability And Statistics for Computer Scientists, Second Edition, CRC Press, 2014
Andreas C. Müller and Sarah Guido, Introduction to Machine Learningwith PythonA Guide for Data Scientists, OReilly, 2016
Johnson R.A., Probability and Statistics , PHI, New Delhi.
Meyer P.L., Introduction to Probability and Statistical, Applications , Oxford
6. Goon, A.M., Gupta, M.K. and Dasgupta, Fundamentals of Statistics , Vol. I: World Press.

CSB2: MASTER OF TECHNOLOGY (COMPUTER SCIENCE) (SEMESTER – I)
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CSL584: DATA SCIENCE & ANALYTICS

Credits		
L	**T**	**P**
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

Introduction to Data Science, Statistical Thinking: Examples of Statistical Thinking, Numerical Data, Summary Statistics, From Population to Sampled Data, Different Types of Biases, Introduction to Probability, Introduction to Statistical Inference.

Section–B

Statistical Thinking 2: Association and Dependence, Association and Causation, Conditional Probability and Bayes Rule, Simpsons Paradox, Confounding, Introduction to Linear Regression, Special Regression Models.

Section–C

Exploratory Data Analysis and Visualization: Goals of statistical graphics and data visualization, Graphs of Data
Graphs of Fitted Models, Graphs to Check Fitted Models, What makes a good graph?Principles of graphics.

Section–D

Introduction to Bayesian Modeling: Bayesian inference: combining models and data in a forecasting problem

Bayesian hierarchical modeling for studying public opinion, Bayesian modeling for Big Data. Introduction to Data science libraries, frameworks, modules, and toolkits.

References:

https://www.edx.org/course/statistical-thinking-data-science-columbiax-ds101x-1

Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media (2015)

An Introduction to Statistical Learning

Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer Texts in Statistics (2015)

Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, Matt Harrison,CreateSpace Independent Publishing Platform (2016)

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CSP585: PROGRAMMING LAB

Credits		
L	**T**	**P**
0	0	1

Programming exercises based on the subjects covered in first semester.

CSP586: TERM PAPER I

Credits		
L	**T**	**P**
0	0	1

CSL591: Computational Linguistics

Credits		
L	**T**	**P**
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

Introduction to Computational linguistics, Hands-on demonstrations, Ambiguity and uncertainty in language, The Turing test, Introduction to Python programming, Why Python?, Variables, numbers, strings, arrays, dictionaries, conditionals, iteration, The NLTK (Natural Language Toolkit), Probabilistic language modelling and its applications.

Section–B

Markov models, N-grams, Estimating the probability of a word, and smoothing, Generative models of language, Their application to building an automatically-trained email spam filter, and automatically determining the language, The concept of parts-of-speech, examples and usage, The Penn Treebank and Brown Corpus, Probabilistic (weighted) finite state automata, Hidden Markov models (HMMs).

Section–C

Maximum entropy models, Syntactic ambiguity, Context-free grammars, Push-down automata Pumping lemmas, Chomsky Hierarchy, Search and dynamic programming, Chart parsing (CKY, Earley), Chunking and Chinking Evaluation, Phrases that mean more than the sum of their parts, Using statistics to automatically discover them, Using word statistics to predict bracketing of noun phrases, Homonymy, polysemy, different meanings, the power of context, Language neighbourhood.

Section–D

Agglomerative clustering, Clustering by expectation maximization, Using clustering to discover different word senses, Semi-supervised document classification, Automatically discovering verb sub-categorization, Topic models, Language modelling integrated into social network analysis, Broad overview of ties between computer science, statistics and linguistics, Upcoming research trends and capabilities.

References:

1. Jurafsky, D. and J.H. Martin. 2009. Speech and Language Processing. 2nd edition. Prentice Hall.
2. Lutz and Ascher "Learning Python"O'Reilly, ISBN: 0596002815.
3. Manning and Schutze, "Statistical Natural Language Processing", MIT Press; 1st edition (June 18, 1999), ISBN: 0262133601
4. James Allen. Natural Language Understanding. The Benajmins/Cummings Publishing Company Inc. 1994. ISBN 0-8053-0334-0.
5. Tom Mitchell. Machine Learning. McGraw Hill, 1997. ISBN 0070428077
6. Cover, T. M. and J. A. Thomas: Elements of Information Theory. Wiley. 1991. ISBN 0-471-06259-6.
7. Charniak, E.: Statistical Language Learning. The MIT Press. 1996. ISBN 0-262-53141-0.

CSB2: MASTER OF TECHNOLOGY (COMPUTER SCIENCE) (SEMESTER – II)
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CSL592: Software Engineering

Credits		
L	**T**	**P**
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

Software Engineering Fundamentals

Origin of SE, Evolution of SE, Software Crisis, Basic Units of SE: Process, Project & Product, Development Processes, Software Quality

Software Project Management

Project Planning, Work breakthrough Structure, Project Scheduling, Execution, Monitoring and Control, Risk Management activities, Configuration Management

Section–B

Software Measurement

Size-oriented Metrics, Function-oriented Metrics, Design Metrics, Object-oriented Metrics, Use-Case-Oriented Metrics, WebApp Project Metrics

Open Source Software Development

Open Source Software Development Model, Types of Open-Source Projects, OSSD Methods, OSSD Tools

Section–C

Maintenance and Reengineering

Software Maintenance, Reengineering, BusinessProcess Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering

Risk Management

Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring and Management, The RMMM Plan

Section–D

Modern Software Practices

Agile Development, Extreme Programming, Clean Room Design, Documentation Standards, Process Automation

References:

1. Software Engineering, A Practitioner's Approach, Roger S. Pressman, McGraw Hill Education, Seventh Edition, 2017
2. Software Engineering, Jibitesh Mishra, Ashok Mohanty, Pearson Publications, 2012
3. Software Engineering, Ian Sommerville, 9th Edition,Pearson Publications, 2017
4. Software Engineering: A Precise Approach, PankajJalote, Wiley, 2010

(Elective-I)

CSL597: Software Project Management

Credits		
L	**T**	**P**
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

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Section–A

Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

PROJECT LIFE CYCLE: Software process and Process Models – Choice of Process models – mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes

Section–B

Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II A Parametric Productivity Model – Staffing Pattern.

Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

Section–C

Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking – Change control- Software Configuration Management – Managing contracts – Contract Management.

Section–D

Managing people – Organizational behavior – Motivation – crowdsourcing– Working in teams – Decision making – Team structures – Virtual teams – remote teams-global software development Communications genres – Communication plans. Volunteer software development.

TEXT BOOKS:

- Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
- Robert K. Wysocki "Effective Software Project Management" – Wiley Publication,2011.
- Walker Royce: "Software Project Management"- Addison-Wesley, 1998.
- Fred Brooks, Mythical Man Month Essays on Software Engineering
- Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013.

(Elective-I)
CSL598: Computer Vision

Credits		
L	**T**	**P**
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.
Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

Section–B

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Section–C

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.
Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Section–D

Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.
Miscellaneous: Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS.
Laboratory Work: To implement various techniques and algorithms studied during course.

Reference Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
5. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

(Elective-I)

CSL599: Computing Trends

Credits		
L	**T**	**P**
4	0	0

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
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Section–A

Deep Learning: Introduction to deep learning, overview of machine learning concepts. Building a simple multi-class classification model using logistic regression Detecting digits in hand-written digit image, starting by a simple end-to-end model, to a deep neural network

Section–B

Deep Learning implementations: Improving the hand-written digit recognition with convolutional network
Building a model to forecast time data using a recurrent network
Building text data application using recurrent LSTM (long short term memory) units

Section–C

Information security: Current Trends in information Security, Cloud Computing: benefits and Issues related to info Sec. Standards available for InfoSec: Cobit, Cadbury, ISO 27001, OWASP, OSSTMM, etc - An Overview, Certifiable Standards: How, What, When, Who.
Modern Trends in Asymmetric Key Cryptography

Section–D

Emerging trends: Cloud Security, Research trend in Cloud Computing, Fog Computing. Internet telephony, virtual reality over the web, Intranet and extranet, firewall design issues

References:

1. https://www.edx.org/course/deep-learning-explained-microsoft-dat236x-0
2. http://nptel.ac.in/syllabus/106106129/
3. http://nptel.ac.in/syllabus/106105031/
4. http://nptel.ac.in/syllabus/106105167/
5. http://nptel.ac.in/syllabus/106105084/

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CSP595: PROGRAMMING LAB

Credits		
L	**T**	**P**
0	0	1

Programming exercises based on the subjects covered in second semester.

CSP586: TERM PAPER–II

Credits		
L	**T**	**P**
0	0	1