AMRITA VISHWA VIDYAPEETHAM

5-yr Integrated M Sc – Data Science

CURRICULUM AND SYLLABUS

(From 2018 Admission Onwards)

Vision of the Institute

To be a global leader in the delivery of engineering education, transforming individuals to become

creative, innovative, and socially responsible contributors in their professions.

Mission of the Institute:

* To provide best-in-class infrastructure and resources to achieve excellence in technical education,
* To promote knowledge development in thematic research areas that have a positive impact on society, both nationally and globally,
* To design and maintain the highest quality education through active engagement with all stakeholders –students, faculty, industry, alumni and reputed academic institutions,
* To contribute to the quality enhancement of the local and global education ecosystem,
* To promote a culture of collaboration that allows creativity, innovation, and entrepreneurship to flourish, and
* To practice and promote high standards of professional ethics, transparency, and accountability.

PROGRAM OUTCOMES (PO)

- **Knowledge in Mathematics and Computer Science:** Understand the basic concepts, fundamental principles and the scientific theories related to Data Science.
- **Abstract thinking:** Ability to absorb and understand the abstract concepts that lead to various advanced theories in Mathematics, Statistics and Computer science.
- **Modelling and solving:** Ability in modelling and solving problems by identifying and employing the appropriate existing theories and methods.
- **Advanced theories and methods:** Understand advanced theories and methods to design solutions for complex data science problems.
- **Applications in Engineering and Sciences:** Understand the role of mathematical sciences and apply the same to solve the real life problems in fields of data science.
- **Modern software tool usage:** Acquire the skills in handling scientific tools towards problem solving and solution analysis.
- **Environment and sustainability:** Understand the significance of preserving the environment towards sustainable development.
- **Ethics:** Imbibe ethical, moral and social values in personal and social life leading to highly cultured and civilized personality. Continue to enhance the knowledge and skills in mathematics and computer science for constructive activities, and demonstrate highest standards of professional ethics.
- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication:** Develop various communication skills such as reading, listening, and speaking which will help in expressing ideas and views clearly and effectively.
- **Project management and Research:** Demonstrate knowledge, understand the scientific and management principles and apply these to one's own work, as a member/ leader in a team to manage projects and multidisciplinary research environments. Also use the research-based knowledge to analyse and solve advanced problems in data science.
- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5-yr Integrated M Sc – Data Science

CURRICULUM

(From 2018 Admission Onwards)

SEMESTER 1			
Course Code	**Course Title**	**L T P**	**Cr**
18ENG101	Communicative English	2 0 2	3
	Language Paper I	1 0 2	2
18MAT101	Calculus	3 1 0	4
18MAT104	Linear Algebra	3 10	4
18PHY101	Physics	3 0 0	3
18CSE100	Problem Solving and Computer Programming	3 0 0	3
18CSE180	Problem solving computer Programming Lab.	0 0 2	1
18PHY181	Physics Lab	0 0 2	1
18CUL101	Cultural Education I	2 0 0	2
	TOTAL		**23**

SEMESTER 2			
Course Code	**Course Title**	**L T P**	**Cr**
18ENG121	Professional Communication	1 0 2	2
	Language Paper II	1 0 2	2
18MAT115	Vector Calculus	3 1 0	4
18MAT112	Discrete Mathematics	3 0 2	4
18CSE116	Advanced Computer Programming	3 0 0	3
18CSE117	Digital Electronics	3 0 0	3
18CSE181	Advanced Computer Programming Lab.	0 0 2	1
18CSE185	Digital Electronics Lab	0 0 2	1
18CUL111	Cultural Education II	2 0 0	2
	TOTAL		**22**

SEMESTER 3			
Course Code	**Course Title**	**L T P**	**Cr**
18CSC201	Data Structures	3 1 0	4
18MAT231	Optimization Techniques	3 1 0	4
18MAT232	Probability Theory	3 1 0	4
18MAT 233	Numerical Methods	3 1 0	4
18CSC202	Foundations of Data Science	2 02	3
18ENV300	Environmental Science and Sustainability	3 0 0	3
18MAT288	Data Science Lab-I: Statistics and Numerical Methods Lab	0 0 2	1
18AVP201	Amrita Values Programme I	1 0 0	1
18CSC281	Data Structures lab	0 0 2	1

18SSK201	Life Skills I	1 0 2	2
	TOTAL		**27**

SEMESTER 4			
Course Code	**Course Title**	**L T P**	**Cr**
18MAT 241	Statistical Inference Theory	3 0 0	3
18MAT242	Introduction to Modern Algebra	3 0 0	3
18CSC211	Convex Optimization	3 0 0	3
18CSC212	Design and Analysis of Algorithms	3 1 0	4
18CSC213	Database Management Systems	3 1 0	4
	Open Elective A*	3 0 0	3
18MAT289	Data Science Lab-II: Inference Theory	0 0 2	1
18SSK211	Life Skills II	1 0 2	2
18CSC282	Design and Analysis of AlgorithmsLab	0 0 2	1
18AVP211	Amrita Values Programme II	1 0 0	1
	TOTAL		**25**

SEMESTER 5			
Course Code	**Course Title**	**L T P**	**Cr**
18CSC301	Operating Systems	3 0 2	4
18MAT331	Transform Techniques	3 0 0	3
18CSC302	Number Theory and Information Security	3 1 0	4
18MAT332	Random Process	3 00	3
18CSC303	Database Design	3 1 0	4
18MAT390	Live-in-Lab.[@] / Open Elective B*	3 0 0	3
18SSK301	Life Skills III	1 0 2	2
18CSC381	DBMS Lab	0 0 2	1
18CSC382	Open Lab-I (JAVA / C / C++ / R programming / Azure …)	0 0 2	1
	TOTAL		**25**

SEMESTER 6			
Course Code	**Course Title**	**L T P**	**Cr**
18MAT333	Graph Analytics and Algorithms	3 0 2	4
18MAT334	Regression Analysis	3 1 0	4
18CSC311	Machine Learning	3 1 0	4
18CSC312	Data Visualization	3 0 2	4
18CSC313	Theory of Computation	3 1 0	4
18CSC383	Machine Learning-Lab	0 0 2	1
18CSC314	Ethics for Data Scientist	1 0 0	1
18CSC384	Open Lab II (Algorithms.io / Hadoop / Cascading / web design..,)	0 0 2	1
	TOTAL		**23**

SEMESTER 7			
Course Code	**Course Title**	**L T P**	**Cr**
18CSC401	Parallel and Distributed Systems	3 1 0	4
18CSC402	Deep Learning	3 0 2	4
18CSC403	Practical Techniques for Big Data Processing	3 0 2	4
18CSC404	Reinforcement Learning	3 0 0	3
18CSC405	Data Security	3 0 0	3
	Elective I	3 0 0	3
	Elective II	3 0 0	3
18CSC481	Open Lab-III	0 0 2	1
	TOTAL		**25**

SEMESTER 8			
Course Code	**Course Title**	**L T P**	**Cr**
18CSC411	Software Engineering	3 1 0	4
18CSC412	Deep Learning for Natural Language Processing	3 0 2	4
	Elective III	3 0 0	3
	Elective IV	3 0 0	3
	Elective V	3 0 0	3
18CSC491	Mini Project		5
	TOTAL		**22**

SEMESTER 9			
Course Code	**Course Title**	**L T P**	**Cr**
18CSC591	Project –I		8
	(Internship in Industries / Universities)		
	Elective VI	3 0 0	3
	Elective VII	3 0 0	3
	Total		**14**

	SEMESTER 10		
Course Code	**Course Title**	**L T P**	**Cr**
18CSC599	Project-II (Research based) Dissertation		12
	TOTAL		**12**
	Total Credits	**218**	

Electives

MATHEMATICS STREAM			
Course Code	**Course Title**	**L T P**	**Cr**

18MAT 441	Advanced Algebra	3 0 0	3
18MAT442	Advanced Big Data Analytics	3 0 0	3
18MAT443	Differential Equations	3 0 0	3
18MAT444	Multivariate Statistics and Time Series Analysis	3 0 0	3
18MAT445	Wavelets	3 0 0	3
18MAT446	Computational Geometry	3 0 0	3
18MAT447	Queuing Theory and Inventory Control Theory	3 0 0	3
18MAT448	Theory of Sampling and Design of Experiments for Data Analysis	3 0 0	3
18MAT449	Computational Financial Mathematics	3 0 0	3
18MAT450	Data Analytics in Computational Biology	3 0 0	3
18MAT451	Computer Aided Drug Designing	3 0 0	3
18MAT452	Statistical Quality Control	3 0 0	3
18MAT453	Six Sigma Analysis	3 0 0	3
18MAT454	Statistical Pattern Recognition	3 0 0	3
COMPUTER SCIENCE STREAM			
18CSC441	Soft Computing	3 0 0	3
18CSC442	Cryptography	3 0 0	3
18CSC443	Business Analytics	3 0 0	3
18CSC444	Deep Learning for Image Processing	3 0 0	3
18CSC445	Predictive Analytics	3 00	3
18CSC446	Mining of Massive Datasets	3 0 0	3
18CSC447	Data Compression	3 0 0	3
18CSC448	Computer Networks	3 0 0	3
18CSC449	IoT (workshop based course)	3 0 0	3
18CSC450	Introduction to Embedded Systems	3 0 0	3
18CSC451	Information retrieval (NL)	3 0 0	3
18CSC452	Social Network Analytics	3 0 0	3
18CSC453	Big Data Storage and Analysis	3 0 0	3
18CSC454	Probabilistic Graphical Models	3 0 0	3

LANGUAGE - Paper I			
18HIN101	Hindi I	1 0 2	2
18KAN101	Kannada I	1 0 2	2
18MAL101	Malayalam I	1 0 2	2
18SAN101	Sanskrit I	1 0 2	2

LANGUAGE - Paper II			
18HIN111	Hindi II	1 0 2	2
18KAN111	Kannada II	1 0 2	2
18MAL111	Malayalam II	1 0 2	2
18SAN111	Sanskrit II	1 0 2	2

Evaluation Pattern

50:50 (Internal: External) (All Theory Courses)

Assessment	Internal	External
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

80:20 (Internal: External) (Lab courses and Lab based Courses having 1 Theory hour)

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

70:30(Internal: External) (Lab based courses having 2 Theory hours/ Theory and Tutorial)

Theory- 60 Marks; Lab- 40 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	10	
Continuous Assessment (Lab) (CAL)	40	
End Semester		30

65:35 (Internal: External) (Lab based courses having 3 Theory hours/ Theory and Tutorial)

Theory- 70 Marks; Lab- 30 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Letter Grade	**Grade Point**	**Grade Description**
O	10.00	Outstanding
A+	9.50	Excellent
A	9.00	Very Good
B+	8.00	Good
B	7.00	Above Average
C	6.00	Average
P	5.00	Pass
F	0.00	Fail

Grades O to P indicate successful completion of the course

$$CGPA = \frac{\sum (C_i x Gr_i)}{\sum C_i}$$

Where

C_i = Credit for the i^{th} course in any semester

Gr_i= Grade point for the i^{th} course

Cr. = Credits for the Course

Gr. = Grade Obtained

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SYLLABI

(From 2018 Admission Onwards)

18ENG101 **Communicative English** **2-0-2-3**

Objectives:

To help students obtain an ability to communicate fluently in English; to enable and enhance the students skills in reading, writing, listening and speaking; to impart an aesthetic sense and enhance creativity

Course Contents:

Unit I

Kinds of sentences, usage of preposition, use of adjectives, adverbs for description, Tenses, Determiners- Agreement (Subject – Verb, Pronoun- Antecedent) collocation, Phrasal Verbs, Modifiers, Linkers/ Discourse Markers, Question Tags

Unit II

Paragraph writing – Cohesion - Development: definition, comparison, classification, contrast, cause and effect - Essay writing: Descriptive and Narrative

Unit III

Letter Writing - Personal (congratulation, invitation, felicitation, gratitude, condolence etc.) Official (Principal / Head of the department/ College authorities, Bank Manager, Editors of newspapers and magazines)

Unit IV

Reading Comprehension – Skimming and scanning- inference and deduction – Reading different kinds of material –Speaking**:** Narration of incidents / stories/ anecdotes- Current News Awareness

Unit V

Prose: John Halt's 'Three Kinds of Discipline*'* [**Detailed**]
Max Beerbohm's 'The Golden Drugget' [**Detailed**]
Poems: Ogden Nash- *'*This is Going to Hurt Just a Little Bit' [**Detailed**]
Robert Kroetsch– *'*I am Getting Old Now', Langston Hughes-'I, Too'[**Detailed**]
Wole Soyinka- 'Telephone Conversation' **[Non-Detailed**]
Kamala Das- 'The Dance of the Eunuchs'[**Non-Detailed**]
Short Stories:Edgar Allan Poe's 'The Black Cat*',* Ruskin Bond's 'The Time Stops at Shamili*'* **[Non-Detailed**]

Course Outcomes

CO1: Demonstrate competency in all the four linguistic skills, viz. listening, speaking, reading and writing
CO2: Apply different styles of communication in professional context
CO3: Participate in different planned & extempore communicative activities
CO4: Interpret and discuss facts and information in a given context

CO5: Develop an appreciation for human values

CORE READING:

1. *Ruskin Bond, Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989*
2. *Syamala, V. Speak English in Four Easy Steps, Improve English Foundation Trivandrum: 2006*
3. *Beerbohm, Max, The Prince of Minor Writers: The Selected Essays of Max Beerbohm (NYRB Classics), Phillip Lopate (Introduction, Editor), The New York Review of Book Publishers.*
4. *Edger Allan Poe. The Selected Works of Edger Allan Poe. A Running Press, 2014.*
5. *Online sources*

References:

1. *Ruskin Bond, Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989*
2. *Martinet, Thomson, A Practical English Grammar, IV Ed. OUP, 1986.*
3. *Murphy, Raymond, Murphy's English Grammar, CUP, 2004*
4. *Online Sources*

18MAT101 CALCULUS 3 1 0 4

Unit 1
Differentiation: The Derivative as a Function – Differentiation Rules – The Derivative as a Rate of Change – Derivatives of Trigonometric Functions – The Chain Rule and Parametric Equations – Implicit Differentiation – Linearization and Differentials.
Chapter 2- Sec: 2.1 to 2.7 and Chapter 3- Sec: 3.1 to 3.6, 3.7, Self Study - Sec: 3.7.

Unit 2
Application of Derivatives: Extreme values of Functions – The Mean Value Theorem – Monotonic Functions and the First Derivative Test – Concavity and Curve Sketching – Intermediate Forms and L' Hospital's Rule – Anti Derivatives.
Chapter 4- Sec: 4.1 to 4.4, 4.6 to 4.8, Self Study - Sec: 4.5

Unit 3
The Definite Integral – The Fundamental Theorem of Calculus – Indefinite Integrals and the Substitution Rule – Substitution and Area between Curves.
Chapter 5- Sec: 5.1 to 5.6

Unit 4
Techniques of Integration: Basic Integration Formulas – Integration by Parts – Integration of Rational Functions by Partial Fractions – Trigonometric Integrals – Trigonometric Substitutions – Numerical Integration – Improper Integrals.
Chapter 8: 8.1 to 8.5, 8.7,8.8, Self Study - Sec: 8.6

Unit 5
Application of Definite Integrals: Volumes by Slicing and Rotation about an Axis – Volumes by Cylindrical Shells – Lengths of Plane Curves – Moments and Centre of Mass – Areas of Surface of Revolution and the Theorems of Pappus – Work – Fluid Pressure and Forces.
Chapter 6 – Sec: 6.1 to 6.7

Course Outcomes

CO1: An ability to understand the basic concepts of Derivative.
CO2: An ability to understand the concept of extreme values and apply the derivative test to identify concavity and extreme values.
CO3: Understand the concept of integration and apply them to evaluate the area between curves.
CO4: Apply the different techniques of integration to evaluate the integrals. Also understand the nature of numerical and improper integrals.
CO5: Apply the concept of integration to applications in science and engineering

TEXTBOOK:

1. Finney and Thomas, "Calculus", Pearson, Eleventh Edition, 2008.

REFERENCE BOOKS:

1. Howard Anton, IRlBivens, Stephens Davis, "Calculus" Wiley, 10th Edition, 2016 Reprint.
2. M. J. Strauss, G. L. Bradley and K. J. Smith, "Calculus", 3rd Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2007.
3. James Stewart, "Calculus: Early Transcendentals", Cengage (India), 8th Edition, 2016.

18MAT104 Linear Algebra 3 0 2 4

Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis – Dimension.
Inner Product Spaces: Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis - Orthogonal complements - Projection on subspace - Least Square Principle.

Linear Transformations: Positive definite matrices - Matrix norm and condition number - QR-Decomposition - Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis - Nilpotent transformations - Trace and Transpose, Determinants, Symmetric and Skew Symmetric Matrices,Adjoint and Hermitian Adjoint of a Matrix, Hermitian, Unitary and Normal Transformations, Self Adjoint and Normal Transformations, Real Quadratic Forms.
Eigen values and Eigen vectors: Problems inEigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections. Similarity of linear transformations - Diagonalisation and its applications - Jordan form and rational canonical form.

Course Outcomes

CO-1: To understand the axioms in the definition of a vector space through examples; to understand subspaces / quotient space / mappings and identify them; to familiarize the concept of basis and its relevance.
CO-2: To understand inner products and compute the angle/length of a vector. To construct the orthonormal basis.
CO-3: To familiarize the types of matrices, understand their properties and apply them in the real quadratic forms
CO-4: To understand the construction of matrices for a linear transformation in the triangular
CO-5 :To understand the concepts of eigen values, eigen vectors & diagonalization

TEXT BOOKS

1. Howard Anton and Chris Rorres, "*Elementary Linear Algebra*", Tenth Edition, John Wiley & Sons, 2010.

REFERENCES:

1. Nabil Nassif, Jocelyne Erhel, Bernard Philippe, Introduction to Computational Linear Algebra, CRC press, 2015.
2. Gilbert Strang, "*Linear Algebra and Its Applications*", Fourth Edition, Cengage, 2006.
3. Kenneth Hoffmann and Ray Kunze, *Linear Algebra*, Second Edition, Prentice Hall, 1971.
4. N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.
5. *Francis. W. Sears, Mark. W. Zemanski and Hugh. D. Young, University Physics, Narosa Publishing House, 2011.*
6. *Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynman Lectures on Physics Vol. 1, Narosa, 2003*

18PHY101 PHYSICS 3 0 0 3

UNIT 1

Units and measurements, Vectors: fundamentals, **Motion in One Dimension:** Displacement, Velocity, and Speed, instantaneous, velocity and speeds ,acceleration, motion diagrams, constant acceleration, varying acceleration, freely falling body, kinematic equations.

Motion in 2D and 3D: The displacement, Velocity and acceleration vectors,Relative velocity and Relative acceleration Two dimensional motion with constant acceleration, Projectile motion ,horizontal range and maximum height.

UNIT 2

Newton's laws of motion, inertia, torque, Newton's law of universal gravitation applications & Free body diagrams, work and Kinetic energy, potential energy and conservation of energy momentum & collisions.

Circular motion,uniform circular motion, Non-uniform Circular motion tangential and radial acceleration Rotational of rigid body inertia, torque, Angular momentum.

UNIT 3

Kinematics of moving fluids, equation of continuity, Euler's equation, Bernoulli's theorem, viscous fluids, surface tension and surface energy, capillarity.

UNIT 4

Zeroth law of thermodynamics: Concept of temperature & its measurement, Triple point of water, Thermometers: constant volume, Constant pressure, Platinum resistance thermometry, Thermal expansion,

First law of thermodynamics: Internal energy and work, Heat and Enthalpy, Heat Capacity and its measurement, Heat transfer mechanisms - Conduction, Convection, Radiation, kinetic Theory of gases, Avogadro number, Work done by an ideal gas, Molecular Speed distribution, Molar specific heat, Adiabatic, Isothermal, Constant volume Constant Pressure process for an ideal gas.

UNIT 5

Second law of thermodynamics: Kelvin Planck statements, Entropy and its variation external and internal combustion engines - Carnot engine: Steam engine, Stirling engine, Clausius statement of second law, Refrigerator, Equivalence of Kelvin-Planck and Clausius statement. Reversibility and irreversibility, Conditions for irreversibility. Irreversibility of second law of thermodynamics

COURSE OUTCOMES

CO1: Understand the units of representation of fundamental and derived physical quantities in SI system and on-dimensional motion of a particle.

CO2: Understand motion of a particle in 2D and 3D; and applying it analyze the motion with constant acceleration, Projectile motion and uniform circular motion.

CO3: Understand the Newton's laws of motion and its applications; and the relationship between a particle's kinetic energy, mass, and speed.

CO4: Understand conservative force and non-conservative force, the work done by a conservative force, the gravitational potential energy and elastic potential energy, Center of mass and momentum and rotational motion.

CO5: Understand steady, incompressible, nonviscous and irrotational flow, the equation of continuity, zeroth and second law of thermodynamics, the entropy of the system for reversible and irreversible process.

TEXTBOOK:

*David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics 9thEdition,John Wiley (2012){**Chapters 1-14, 18-20**}*

REFERENCE BOOKS:

1. *Kittel et al, Mechanics, Berkeley Physics Course Vol. 1, 2nd edition, Tata McGraw Hill 2011.*
2. *Raymond. A. Serway and Jerry. S. Faughn, College Physics 7th Ed., Thomson Brooks/Cole, USA, 2009.*

18CSE100 PROBLEM SOLVING AND COMPUTER PROGRAMMING 3 0 0 3

Introduction to problem solving: algorithmdevelopment and flowchart. Introduction to Computer terminologies and computer languages. C Fundamentals: structure of C program: directives, functions, statements, printing strings, comments; compilation and execution, Programming errors and debugging. Variables and assignment, reading input; data types, constants, identifiers, keywords, operators - arithmetic, logical, relational, assignment; expressions - precedence and associativity, type cast-implicit and explicit; selection statements:- if, if else, nested if, if else ladder, switch. Case.

Iterative structures: entry controlled and exit controlled loop, exiting from a loop: break, continue, goto; nested loops. Functions: library functions, user defined functions: defining and calling functions, function declaration, passing arguments to a function, returning values from function. Storage classes - auto, extern, static, register variables, scope of a variable. Recursion. Number systems: binary, octal and hexadecimal. Bitwise operators and enumeration.
Arrays: one dimensional numeric arrays, initialization, accessing and usage, two dimensional numeric arrays, initialization, accessing and usage. Introduction to multidimensional arrays. Strings: literal, variables: initialization, reading, writing and accessing. String handling functions. Array of strings. Passing arrays and strings to functions.

COURSE OUTCOMES

CO1	Understand the structured programming constructs: Data types, Control, selection, recursion thereby to understand a given program.
CO2	Understand and analyze a given program by tracing, identify coding errors and debug them.
CO3	Apply structured programming constructs and modularity appropriately for given problem Scenarios.
CO4	Develop Computer programs that implement suitable algorithms for problem scenarios and application performance.
CO5	Understand the efficient way of storing and retrieving data.

TEXTBOOK:

Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

REFERENCE:

ReemaThareja, "Computer Fundamentals and programming in C", Oxford University Press, 2012.

18CSE180 PROBLEM SOLVING AND COMPUTER PROGRAMMING LAB 002 1

Basic Linux commands, programs using input/output statements, operators, control structures and loops. Programs using functions and recursions. Programs using numeric one-dimensional array, two-dimensional array. Programs using strings, string handling functions and string arrays. Programs using passing arrays and strings to functions.

Course Outcomes

CO1	To understand the operating System Environment.
CO2	Develop computer programs for a given problem Scenario using imperative constructs.
CO3	Develop computer programs handling different data types.

CO4 Develop Modular Solutions for a given Scenario.

18CUL101 CULTURAL EDUCATION I 2 0 0 2

Unit 1

Introduction to Indian Culture - Introduction to Amma's life and Teachings - Symbols of Indian Culture.

Unit 2

Science and Technology in Ancient India - Education in Ancient India - Goals of Life – Purusharthas - Introduction to Vedanta and Bhagavad Gita.

Unit 3

Introduction to Yoga - Nature and Indian Culture - Values from Indian History - Life and work of Great Seers of India.

Course Outcomes

CO1: Gain a positive appreciation of Indian culture, traditions, customs and practices
CO2: Understand the foundational concepts of Indian civilization like purusharthas, law of karma, etc, which contributes towards personality growth.
CO3: Understand the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma's life and vision of holistic education
CO4: Imbibe spirit of living in harmony with nature
CO5: Get guidelines for healthy and happy living from the great spiritual masters

TEXTBOOKS:

1. The Glory of India (in-house publication)
2. The Mother of Sweet Bliss, (Amma's Life & Teachings)

18ENG121 Professional Communication 1- 0-2-2

Objectives:

To convey and document information in a formal environment; to acquire the skill of self projection in professional circles; to inculcate critical and analytical thinking.

Unit I

Vocabulary Building: Prefixes and Suffixes; One word substitutes, Modal auxiliaries,Error Analysis: Position of Adverbs, Redundancy, misplaced modifiers**,** Dangling modifiers – Reported Speech

Unit II

Instruction, Suggestion & Recommendation - Sounds of English: Stress, Intonation

- Essay writing: Analytical and Argumentative

Unit III

Circulars, Memos – Business Letters - e - mails

Unit IV

Reports: Trip report, incident report, event report - Situational Dialogue - Group Discussion

Unit V

Listening and Reading Practice - Book Review

Course Outcomes

CO1: Demonstrate competency in oral and written communication

CO2: Apply different styles of communication in professional context

CO3: Participate in different planned & extempore communicative activities

CO4: Interpret and discuss facts and information in a given context

CO5: Develop critical and analytical thinking

References

1. *FelixaEskey. Tech Talk, University of Michigan. 2005*
2. *Michael Swan. Practical English Usage, Oxford University Press. 2005*
3. *Anderson, Paul. Technical Communication: A Reader Centered Approach, V Edition, Hercourt, 2003.*
4. *Raymond V. Lesikar and Marie E. Flatley. Basic Business Communication, Tata Mc Graw Hill Pub. Co. New Delhi. 2005. Tenth Edition.*
5. *Thampi, G. Balamohan. Meeting the World: Writings on Contemporary Issues. Pearson, 2013.*
6. *Lynch, Tony. Study Listening. New Delhi: CUP, 2008.*
7. *Kenneth, Anderson, Tony Lynch, Joan Mac Lean. Study Speaking. New Delhi: CUP, 2008.*
8. *Marks, Jonathan. English Pronunciation in Use. New Delhi: CUP, 2007.*
9. *Syamala, V. Effective English Communication For You (Functional Grammar, Oral and Written Communication): Emerald, 2002.*

18MAT115 VECTOR CALCULUS 3 1 0 4

Unit-1

Calculus of vector-valued functions: Vector-valued functions of a real variable-Algebraic operations. Components- Limits, derivatives and integrals-Applications to curves. Tangency- Applications to curvilinear motion-Velocity, speed and acceleration-The unit tangent, the principal normal -The definition of arc length. Vol.1, Chapter 14- Sec. 14.1 to 14.10.

Unit-2

Differential calculus of scalar and vector fields: Functions of R^ntoR^m.Scalar and vector fields-Open balls and open sets-Limits and continuity-The derivative of a scalar field with respect to a vector-Directional derivatives and partial derivatives-Partial derivatives of higher order-Directional derivatives and continuity-The total derivative-The gradient of a scalar field-A chain rule for derivatives of scalar fields- Applications to geometry. Level sets. Tangent planes
Vol.2, Chapter-8-Sec. 8.1 to 8.17.

Unit-3
Line Integrals: Introduction-Paths and line integrals-Other notations for line integrals-Basic properties of line integral-Open connected sets. Independence of paths-The second fundamental theorem of calculus for line integrals-The first fundamental theorem of calculus for line integrals-Necessary and sufficient conditions for a vector field to be gradient-Necessary conditions for a vector field to be gradient-Special methods for constructing potential functions.
Vol.2, Chapter-10-Sec 10.1 to 10.5, 10.10 and 10.11, 10.14 to10.18.

Unit-4

Multiple Integrals: Introduction-Green's theorem in the plane-Some applications of Green's theorem-A necessary and sufficient condition for a two-dimensional vector field to be a gradient-Change of variables in double integral-Special cases of transformation formula.
Vol.2, Chapter-11-Sec. 11.19 to 11.22, 11.26 to 11.28.

Unit-5

Surface Integrals: Parametric representation of a surface-The fundamental vector product- The fundamental vector product as a normal to the surface-Surface integrals-Other notations for surface integrals-The theorem of Stokes-The curl and divergence of a vector field- Further properties of the curl and divergence-The divergence theorem (Gauss' theorem)
Vol.2, Chapter-12-Sec. 12.1 to 12.4, 12.7,12.9 to12.15, 12.19 and 12.21.

Course Outcomes

CO-1: Understand the basic concepts of vector valued functions, their limits, derivatives and integrals and its geometrical and physical interpretations.
CO-2: Understand the concepts of scalar and vector fields, their limits, derivatives and their applications.
CO-3: Understand the concepts of line integrals and its path independence.
CO-4: Understand and apply the concepts of double integrals to various problems including Green's theorem for plane..
CO-5: Understand the concepts of surface integrals, divergence theorem and Stoke's theorem.

TEXT BOOKS:

1. *Howard Anton, IRl Bivens, Stephens Davis, "Calculus" Wiley, 10th Edition, 2016 Reprint.*
2. *Tom M. Apostol, CalculusVolume1, John Wiley & Sons, Second edition, 2007.*
3. *Tom M. Apostol, Calculus Volume 2, John Wiley & Sons, Second edition, 2007.*

REFERENCE BOOKS:

1. *Howard Anton "Calculus" John Wiley and Sons*
2. *Murray R Spiegel, Theory and problems of vector analysis, Schaum's outline series, McGraw-Hill Book Compnay 1974.*
3. *Finney and Thomas , Calculus, Pearson, Eleventh Edition, 2008.*

18MAT112 Discrete Mathematics 3 0 2 4

Logic, Mathematical Reasoning and Counting: Logic, Prepositional Equivalence, Predicate and Quantifiers, Theorem Proving, Functions, Mathematical Induction. Recursive Definitions, Recursive Algorithms, Basics of Counting, Pigeonhole Principle, Permutation and Combinations. (Sections: 1.1 -1.3, 1.5 -1.7, 2.3, 4.1 - 4.4, 5.1 - 5.3 and 5.5)

Phase II

Relations and Their Properties: Representing Relations, Closure of Relations, Partial Ordering, Equivalence Relations and partitions. (Sections: 7.1, 7.3 - 7.6)

Advanced Counting Techniques and Relations: Recurrence Relations, Solving Recurrence Relations, Generating Functions, Solutions of Homogeneous Recurrence Relations, Divide and Conquer Relations,Inclusion-Exclusion. (Sections: 6.1 - 6.6)

Phase III

Graph Theory: Introduction to Graphs, Graph Operations, Graph and Matrices, Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest Path Problem, Planar Graph, Graph Colorings and Chromatic Polynomials. (Sections: 8.1 - 8.8)

Course Outcomes:

CO1: Understand the basic concepts of Mathematical reasoning and basic counting techniques. Also understand the different types of proves like mathematical induction.

CO2: Understand the concepts of various types of relations, partial ordering and equivalence relations.

CO3: Apply the concepts of generating functions to solve the recurrence relations.

CO4: Apply the concepts of divide and conquer method and principle of inclusion and exclusion to solve some simple algorithms in discrete mathematics.

CO5: Understand various definitions in graph theory and study their properties. Also, understand the shortest path problem and apply to a network.

TEXTBOOKS:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw- Hill Publishing Company Limited, New Delhi, Sixth Edition, 2007.

REFERENCES:

1. R.P. Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2007.

2. Thomas Koshy, "Discrete Mathematics with Applications", Academic Press, 2005.
3. Liu, "Elements of Discrete Mathematics", Tata McGraw- Hill Publishing Company Limited , 2004.

18CSE116 ADVANCED COMPUTER PROGRAMMING 3 0 0 3

Unit 1

Structures: structures variables - declaration, bit fields, initialization and operation on structures, typedef, nested arrays and structures: arrays in structures, nested structures, arrays of structures.

Unit 2

Pointers– Declarations, Passing arguments by call by reference, Functions returning pointer, Pointer Arithmetic. Pointer to pointer, Pointers and Arrays – pointer to array, array of pointers, Dynamic memory allocation – malloc(), calloc(), deallocation: free(), dangling pointers.

Unit 3

Pointers and structures, structures and functions: passing structure as argumentand returningstructure from functions, self-referential structure, unions.

Unit 4

Files - file pointers, standard streams and redirection, text files, binary files, file operations: open, mode, close; Input and output - character I/O, line I/O, formatted I/O. Random file access,Command line arguments.

Unit 5

Preprocessor – Macros. User defined libraries and headers, introduction to the graphics library.

COURSE OUTCOMES

CO1 Understand the way of representing, retrieving and processing Heterogeneous data using structures.

CO2 Understand the memory representations of the given data and its manipulation.

CO3 Understand the methods of storing data using files.

CO4 Develop programs using predefined and user defined libraries..

TEXTBOOK:

Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

REFERENCE:

ReemaThareja, "Computer Fundamentals and programming in C", Oxford University Press, 2012.

18CSE117 Digital Electronics 3 0 0 3

UNIT I MINIMIZATION TECHNIQUES AND LOGIC GATES

Minimization Techniques: Boolean postulates and laws – De-Morgan‟s Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don‟t care conditions – Quine - Mc Cluskey method of minimization. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND–NOR implementations – Multi level gate implementations- Multi output gate implementations. TTL and CMOS Logic and their characteristics – Tristate gates

UNIT II COMBINATIONAL CIRCUITS

Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder,parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

UNIT III SEQUENTIAL CIRCUITS

Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.

UNIT IV MEMORY DEVICES

Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM,RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

UNIT V SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS

Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VERILOG.

COURSE OUTCOMES

CO01 Understand the basics of Boolean logic and number systems

CO02 Develop Boolean functions for synthesis using different logic gates

CO03 Design various combinational circuits

CO04 Understand the characteristics of memory and their classification

CO05Analyze various synchronous and asynchronous sequential circuits

TEXT BOOK:

1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.

REFERENCES:

1. R. H. Katz and G. Boriello, Contemporary Logic Design, 2nd Ed., Prentice Hall of India, 2009.John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008.
2. A. P. Malvino, D. P. Leach and G. Saha, Digital Principles and Applications, 7th Ed., McGraw Hill, 2010.
3. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

18CSE181 ADVANCED COMPUTER PROGRAMMING LAB 002 1

Programs to demonstrate functions call by reference and returning values by reference. Programs using pointer arithmetic operations and handling pointers. Programs to demonstrate dynamic memory allocation and de-allocation. Programs to show structure and union operations. Programs using files, command line arguments and macros. Programs using user defined libraries and graphics library.

Course Outcomes

CO1 Develop programs using efficient methods for storing and handling heterogeneous data.

CO2 Develop programs by handling heterogeneous data using modularity.

CO3 Develop Computer programs using advanced programming constructs like pointers and dynamic memory allocations.

CO4 Develop program using macros and user defined libraries.

18CSE185 Digital Electronics Lab

List of Experiments:

Realization of basic gates using Universal logic gates.

2. Code conversion circuits- BCD to Excess-3 and vice-versa.

3 Four-bit parity generator and comparator circuits.

4. Construction of simple Decoder and Multiplexer circuits using logic gates.

5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.

6. Construction of simple arithmetic circuits-Adder, Subtractor.

7. Realization of RS-JK and D flip-flops using Universal logic gates.

8. Realization of Universal Register using JK flip-flops and logic gates.

9. Realization of Universal Register using multiplexer and flip-flops.

10. Realization of Asynchronous Up/Down counter.

11. Realization of Synchronous Up/Down counter.

12. Realization of Ring counter and Johnson's counter.

13. Construction of adder circuit using Shift Register and full Adder.

COURSE OUTCOMES

CO01 Apply Boolean laws to simplify the digital circuits

CO02 Construct basic combinational circuits and verify their functionalities

CO03 Apply the design procedure for basic sequential circuits

CO04 Realize various counters and shift registers

18CUL111 CULTURAL EDUCATION II 2 0 0 2

Unit 1

1. Relevance of Sri Rama and Sri Krishna in this Scientific Age
2. Lessons from the Epics of India
3. Ramayana & Mahabharata

Unit 2

4. Who is a Wise Man?
5. A Ruler's Dharma
6. The Story of King Shibi

Unit 3

7. Introduction to the Bhagavad Gita
8. Bhagavad Gita – Action without Desire

Unit 4

9. Role and Position of Women in India
10. The Awakening of Universal Motherhood

Unit 5

11. Patanjali'sAstanga - Yoga System for Personality Refinement
12. Examples of Heroism and Patriotism in Modern India

Course Outcomes

CO1: Get an overview of India and her contribution to the world in the field of science and literature
CO2: Understand the foundational concepts of ancient Indian education system and practices associated with them
CO3: Learn the important concepts of Vedas, Bhagavad-Gita and Yogasutras and their relevance to daily life
CO4: Familiarize themselves with the inspirational characters and anecdotes from the epics and Indian history
CO5: Gain a rational understanding of the underlying principles of Indian spirituality

TEXTBOOKS:

1. *Common Resource Material II (in-house publication)*
2. *Sanatana Dharma - The Eternal Truth (A compilation of Amma's teachings on Indian Culture)*

18CSC201 Data Structures 3 1 0 4

Abstraction - Abstract data types; Data Representation; Elementary data types; Basic concepts of data Structures; Mathematical preliminaries - big-Oh notation; efficiency of algorithms; notion of time and space complexity; performance measures for data structures.
ADT array - Computations on arrays - sorting and searching algorithms.
ADT Stack, Queue, list - array, linked list, cursor based implementations of linear structures. ADT Tree -tree representation, traversal of trees; ADT Binary tree - binary trees, threaded binary trees, application of binary trees - Huffmann coding; application of threaded binary trees - differentiation;
Search Tree - Binary search tree; balanced binary search trees - AVL tree; Applications of Search Trees - TRIE; 2-3 tree, 2-3-4 tree; concept of B-Tree. ADT Dictionary - array based and tree based implementations; hashing - definition and application - LZW encoding. ADT Priority Queue - Heaps; heap-based implementations; applications of heaps - sorting; Graphs - shortest path, minimum spanning tree, DFS, BFS - an application of DFS and BFS. Algorithm Design Paradigms - greedy, divide and conquer, dynamic programming, backtracking.

Course Outcomes:

CO1: Understand the concept and functionalities of Data Structures

CO2: Identify and apply appropriate data structures to solve problems and improve their efficiency

CO3: Analyze the complexity of data structures and associated Algorithms

CO4: Analyze the impact of various implementation and design choices on the data structure performance

CO5: Conceptualize and build data structures based on application needs

TEXTBOOKS:

1. Goodrich M T, Tamassia R and Michael H. Goldwasser, "Data Structures and Algorithms in Python++", Wiley publication, 2013.
2. Clifford A. Shaffer, "Data Structures and Algorithm Analysis", Third Edition, Dover Publications, 2012.

REFERENCES:

1. Goodrich M T and Tamassia R, "Data Structures and Algorithms in Java", Fifth edition, Wiley publication, 2010.
2. Tremblay J P and Sorenson P G, "An Introduction to Data Structures with Applications", Second Edition, Tata McGraw-Hill, 2002.

18MAT231 Optimization Techniques 3 1 0 4

Unit I

Introduction to optimization: classical optimization, Optimality criteria – Necessary and sufficient conditions for existence of extreme point.

Direct search methods: unidirectional search, evolutionary search method, simplex search method, Introduction, Conditions for local minimization. One dimensional Search methods: Golden search method, Fibonacci method, Newton's Method, Secant Method, Remarks on Line Search Sections. Hook-Jeeves pattern search method.

Unit II

Gradient-based methods- introduction, the method of steepest descent, analysis of Gradient Methods, Convergence, Convergence Rate. Analysis of Newton's Method, Levenberg-Marquardt Modification, Newton's Method for Nonlinear Least-Squares.

Sections 8.1 - 8.3 and 9.1 – 9.4

Unit-III

Conjugate direction method, Introduction The Conjugate Direction Algorithm, The Conjugate Gradient Algorithm for Non-Quadratic Quasi Newton method. Sections 10.1 - 10.4 and 11.1, 11.2

Unit IV

Nonlinear Equality Constrained Optimization- Introduction, Problems with equality constraints Problem Formulation, Tangent and Normal Spaces, Lagrange Condition

Sections 19.1 -19.6

Unit V

Nonlinear Inequality Constrained Optimization -Introduction - Problems with inequality constraints: Kuhn-Tucker conditions.

Sections 20.1, 20.2, 22.1 – 22.4

COURSE OUTCOMES

CO1. Understand different types of Optimization Techniques in engineering problems. Learn Optimization methods such as Bracketing methods, Region elimination methods,Point estimation methods.

CO2. Learn gradient based Optimizations Techniques in single variables as well as multi-variables (non-linear).

CO3. Learn conjugate direction based Optimizations Techniques.

CO4. Learn problems on linear constrained optimization techniques. Learn to verify Kuhn-Tucker conditions and Lagrangian Method.

CO5. Learn problems on non linear constrained optimization techniques and learn to verify Kuhn-Tucker conditions and Lagrangian Method.

Text Book

1. Edwin K.P. Chong, Stanislaw H. Zak, “An introduction to Optimization”, 2nd edition, Wiley, 2013.

Reference Books

1. Mokhtar S. Bazarra, Hamit D sherali, C.M. Shetty, "Nonlinear programming Theory and applications", 2nd edition, Wiley , 2004.
2. Mohan C. Joshi and Kannan M. Moudgalya, Optimization: Theory and Practice, Narosa Publishing House, New Delhi, 2004 (Reference)
3. Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", Prentice Hall of India, New Delhi, 2004.
4. S.S. Rao, "Optimization Theory and Applications", Second Edition, New Age International (P) Limited Publishers, 1995.

18MAT232 Probability Theory 3 1 0 4

Unit – I
Sample Space and Events, Interpretations and Axioms of Probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Independence, Bayes theorem.

Unit – II
Random variables, Probability Distributions and Probability mass functions, Cumulative Distribution functions, mathematical expectation, variance, moments and moment generating function.

Unit – III
Standard discrete distributions - Binomial, Poisson, Uniform, Geometric distributions, Negative binomial and Hypergeometric Distributions -Standard continuous distributions - Uniform, Exponential, Gamma, Beta and Normal distributions. Chebyshev's theorem.

Unit-IV
Two dimensional random variables-Joint, marginal and conditional probability distributions for discrete and continuous cases, independence, expectation of two dimensional random variables - conditional mean, conditional variance, covariance and correlation.

Unit – V
Functions of one and two random variables. Sampling and sampling Distributions- t, F and Chi-square distributions – central limit theorem.

COURSE OUTCOMES

CO1 Understand the basic concepts of probability and probability modeling.

CO2 Gain in-depth knowledge about statistical distributions and their properties

CO3: Undersatnd the real time problems and the special distributions that will often be used for modelling them and Chebyshev inequality

CO3 Understand two dimenstioinal statistical distributions to the real time examples.

CO5: To know the necessity of functions of random variable and Sampling distributions and central limit Theorem

Textbooks:

1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005
2. Amir D Azcel, Jayavel Sounderpandian, Palanisamy Saravanan and Rohit Joshi, Complete Business Statistics, 7th edition McGrawHill education 2012.
3. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.

Reference books:

1. Ross S.M., *Introduction to Probability and Statistics for Engineers and Scientists*, 3rd edition, Elsevier Academic Press.
2. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

18MAT233 NUMERICAL METHODS 3 1 0 4

Course Outcome:

CO-1: Understand the basic concepts of root finding methods, system of equations and their solutions.

CO-2: Understand the concepts of interpolation and construction of polynomials.

CO-3: Application of numerical methods to understand the concept of Calculus (Differentiation and Integration).

CO-4: Application of numerical concepts to solve ODEs.

CO5: Application of numerical concepts to solve PDEs.

Unit I:

Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, system of nonlinear equations.

Solution of System of Linear Algebraic Equations: Iteration methods

Eigenvalues and Eigenvectros: Jacobi Method for symmetric matrices, Power method for arbitrary matrices.

Sections : 2.2, 2.3, 2.5, 2.7, 3.4, 3.5, 3.6

Unit II:

Interpolation and Approximation: Lagrange and Newton interpolation for unequal intervals, Finite difference operators, Interpolating polynomials using finite differences.

Sections: 4.2, 4.3, 4.4.

Unit III:

Differentiation and Integration: Numerical differentiation, Methods based on interpolation, Numerical integration, Methods based on undetermined coefficients.

Sections: 5.2, 5.6, 5.7, 5.8

Unit IV:

Solutions of Ordinary Differential Equations: Initial Value problems, single step methods, Taylor series method, Second, Third and Fourth order Runge-Kutta methods.

Sections: 6.1, 6.3, 6.4

Unit V:

Solutions of Partial Differential equations: Elliptic partial Differential equations, Parabolic partial differential equations, Hyperbolic partial differential equations.

Sections: 12.1, 12.2, 12.3

TEXTBOOKS:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for scientific and Engineering computation, New Age International Publishers, 2007, 5th edition.
2. R.L. Burden, J. D. Faires, Numerical Analysis, Richard Stratton, 2011, 9th edition.

REFERENCE BOOKS:

1. S.D. Conte and Carl de Boor, 'Elementary Numerical Analysis; An Algorithmic Approach'. International series in Pune and Applied Mathematics, McGraw Hill Book Co., 1980.

2. Kandasamy P, Thilagavathi.K and Gunavathi. K. 'Numerical Methods'- S. Chand and Company Ltd., New Delhi- Revised Edition 2007.

18CSC202 Foundations of Data Science 3 1 0 4

Introduction: Big Data and Data Science hype and getting past the hypeData_cation. Current landscape of perspectives. Skill sets needed

Statistical Inference.Populations and samples. Statistical modeling, probability distributions, Introduction to R programming.

Exploratory Data Analysis and the Data Science Process. Basic tools (plots, graphs and summary statistics) of EDA. Philosophy of EDA. The Data Science Process. Case Study: Real Direct (online real estate)

Three Basic Machine Learning Algorithms. Linear Regression, k-Nearest Neighbors (k-NN), k-means

Feature Generation and Feature Selection (Extracting Meaning From Data). Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination). Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests.

Recommendation Systems: Building a User-Facing Data Product. Algorithmic ingredients of a Recommendation Engine. Dimensionality Reduction. Singular Value Decomposition. - Principal Component Analysis.

Data Visualization.Basic principles, ideas and tools for data visualization.
Data Science and Ethical Issues. Discussions on privacy, security, ethics

Course Outcomes:

CO1: Understand the statistical foundations of data science.
CO2: Learn techniques to pre-process raw data so as to enable further analysis.
CO3: Conduct exploratory data analysis and create insightful visualizations to identify patterns.
CO4: Introduce machine learning algorithms for prediction/classification and to derive insights.
CO5: Analyze the degree of certainty of predictions using statistical test and models.

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.
2. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
3. Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science.

18ENV300 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY 3 0 0 3

Unit 1

State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.

Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action.
Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/ land degradation/ pollution

Unit 2

Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology.

Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

Discuss the interrelation of environmental issues with social issues such as: Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3

Common goods and public goods, natural capital/ tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment (EIA), Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes/ Green buildings, Sustainable communities, Sustainable Cities.
Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

Course Outcomes

CO1: Integrate facts and concepts from ecological, physical and social sciences to characterize some common socio-environmental problems.
CO2: Develop simple integrated systems and frameworks for solving common interconnected socio-environmental problems.
CO3: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
CO4: Identify the ethical underpinnings of socio-environmental issues in general.

TEXTBOOKS/ REFERENCES:

1. *R. Rajagopalan, Environmental Studies: From Crisis to Cure. Oxford University Press, 2011, 358 pages. ISBN: 9780198072089.*
2. *Daniel D. Chiras, Environmental Science. Jones & Bartlett Publishers, 01-Feb-2012, 669 pages. ISBN: 9781449645311.*
3. *Andy Jones, Michel Pimbert and Janice Jiggins, 2011. Virtuous Circles: Values, Systems, Sustainability. IIED and IUCN CEESP, London. URL:http://pubs.iied.org/pdfs/G03177.pdf*
4. *Annenberg Learner, The Habitable Planet, Annenberg Foundation 2015. URL: http:// www.learner.org/courses/envsci/unit/pdfs/textbook.pdf.*

18MAT288 Data Science Lab-I: Statistics and Numerical Lab 0 0 2 1

1. Data Visualization using plot, pie chart, bar chart, histogram and Box plot
2. Find the central measures for given data, like, mean, mode, median and deviations

3. Root finding
4. Gauss iteration methods
5. Power method for finding eigenvalues and eigenvectors
6. Numerical Differentiation and integrations.
7. Interpolations.
8. Initial and Boundary value problems, solution of partial differential equations.

COURSE OUTCOMES

CO1: To visualize different Data plots

CO2: To evaluate and understand statistical measures using R

CO3: Implementing numerical methods to solve system of equations and calculate eigenvalues and eigen vectors

CO4: Implementing numerical techniques for differentiation and integration

CO5: Understanding and visualizing the numerical solution of differential equations

18AVP201 /	**Amrita Values Programme I /**	**1 0 0 1**
18AVP211	**Amrita Values Programme II**	**1 0 0 1**

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India,

display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability

Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the Vasthupurusha.

Organic Farming in Practice

Organic agriculture is the application of a set of cultural, biological, and mechanical practices that support the cycling of farm resources, promote ecological balance, and conserve biodiversity. These include maintaining and enhancing soil and water quality; conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering. This factsheet provides an overview of some common farming practices that ensure organic integrity and operation sustainability.

Ayurveda for Lifestyle Modification:

Ayurveda aims to integrate and balance the body, mind, and spirit which will ultimately leads to human happiness and health. Ayurveda offers methods for finding out early stages of diseases that are still undetectable by modern medical investigation. Ayurveda understands that health is a reflection of when a person is living in harmony with nature and disease arises when a person is out of harmony with the cycles of nature. All things in the universe (both living and nonliving) are joined together in Ayurveda. This leaflet endow with some practical knowledge to rediscover our pre- industrial herbal heritage.

Life Style and Therapy using Yoga

Yoga therapy is the adaptation of yogic principles, methods, and techniques to specific human ailments. In its ideal application, Yoga therapy is preventive in nature, as is Yoga itself, but it is also restorative in many instances, palliative in others, and curative in many others. The therapeutic effect comes to force when we practice daily and the body starts removing toxins and the rest is done by nature.

Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,- Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyan, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala's traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

Social Awareness Campaign

The course introduces the students into the concept of public social awareness and how to transmit the messages of social awareness through various media, both traditional and modern. The course goes through the theoretical aspects of campaign planning and execution.

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Course Outcomes

CO1: Understanding the impact of itihasas on Indian civilization with reference to Mahabharata

CO2: Enabling students to appreciate the relevance of Mahabharata and Bhagavad-Gita in the modern world.

CO3: Understanding the four goals of life (Purusharthas) as presented in the Mahabharata

CO4: Assimilating the positive qualities of the characters depicted in the itihasa.

CO5: Analysis of the critical events and turning points in the Mahabharata with emphasis on the underlying values and principles.

18CSC281 Data Structures Lab.0 0 2 1
Course Outcomes:

CO1: Implement linear and non-linear data structures as ADTs

CO2: Analyze the performance of different implementations of a data structure.

CO3: Develop programs demonstrating modularity and reusability.

CO4: Explore the use of data structure libraries for solving problems efficiently.

CO5: Integrate multiple data structures for real world Applications

Object Oriented Programming, Using Arrays and Array Lists, Linked list:
Implementation using Arrays, Application of Linked Lists, Stacks: Array implementation, Linked Implementation, and Applications, Queues:Array implementation, Linked Implementation and Applications, Using linear data structures in Recursion, Scheduling, and other practical applications, Implementing Priority Queues and using existing implementation for applications, Binary search tree and Application, Graph ADT, Traversal, Modelling Problems using Graphs, Minimum Spanning Trees,
Hash Table and Dictionary Applications.

18MAT241 Statistical Inference Theory 3 1 0 4

Course Outcomes:

CO1 To understand and apply point estimators of various parameters based on sampling distributions
CO2 To understand and apply interval estimators of various parameters based on parametric and sampling distributions
CO3 To understand the concept and types of hypothesis testing and its applications
CO4 To apply normal and sampling distributions for testing of various hypotheses
CO5 To apply chi square distribution for testing of goodness of fit and attributes

Unit – I

Hypothesis Testing, Tests on a Population Proportion- Tests on the Mean of a Normal Distribution with Variance known and unknown, Tests on the variance –Test for Goodness of fit, Contingency table tests - Nonparametric tests mean and median.
Sections: 9.1-9.9
Unit – II

Inference on the Difference in Means of Two Normal Distributions, Variance Known and Unknown , A nonparametric tests for difference in Two means, Paired t test, Inference on the variances of the Two Normal Distributions, Inference on Two Population Proportions.
Sections: 10.1-10.6

Unit – III

Introduction design of experiment of single factor , Completely Randomized Single Factor Experiment, computation of sum of squares, Random effect models, Randomized complete block design, computation of sum of squares – estimation of variance components.
Sections: 13.1-13.4

Unit – IV

Introduction to design of experiment with several factors – Latin Square Design – statistical model for LSD, computation of sum of squares – two factor factorial experiment – main and interaction effects, data and statistical model- computation of sum of squares – estimation of variance components.
Sections : 14.1-14.5

Unit –V

Quality improvement and statistics, Introduction to control limits - control charts for variables – X-bar chart, R-chart, S chart for individual observations- attribute control charts – Control charts for Proportions and for defects per unit.
Sections : 15.1-15.6

TEXT BOOK

1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005.
2. Cox, D.R. (2006). Principles of Statistical Inference. Cambridge University Press, Cambridge.

REFERENCES:

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8thEdition, Pearson Education Asia, 2007

2. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

3. Lehmann, E.L. (1986). Testing Statistical Hypotheses. 2-nd ed.. Wiley, New York.

4. G. Casella & R.L. Berger, Statistical Inference.

18MAT242 Introduction to Modern Algebra 3 1 0 4

Unit 1

Sets-Operations on Sets and their properties, equivalence relation, Mappings-injective and surjective mapping, composition of mappings and its properties, the Integers–Euclidean Algorithm, Unique factorization theorem and congruence modulo of a given integer. **(Sec. 1.1 to 1.3)**

Unit 2

Definition of Groups, Basic Examples of Groups including Symmetric Groups, Matrix Groups, Groups of Rigid Motions of a Plane, Finite Groups of Motions, Subgroups, Cyclic Group and Factor Groups, Lagrange's Theorem. **(Sec. 2.1 to 2.5)**

Unit 3

Normal Subgroups. Quotients of Groups, Homomorphisms,Kernal of a homomorphism, Automorphisms, Cauchy's Theorem and Sylow's Theorem for Abelian Groups, Cayley's Theorem and , Permutation Groups. **(Sec. 2.6 to 2.10)**

Unit 4

Definition of Rings, Examples including Polynomial Rings, Formal Power Series Rings, Matrix Rings and Group Rings. Commutative Rings, Integral Domain, Division Ring, Characteristics of an Integral domain, Fields. **(Sec. 3.1 to 3.2)**

Unit 5

Homomorphisms, kernel, Isomorphism, Ideals, Quotient Rings. **(Sec. 3.3 to 3.4)**

Course Outcomes:

CO-1: Ability to understand sets, functions, types of functions and operations on functions.

CO-2: Abiilty to understand the axioms in the definition of a group through examples; to understand Subgroups/ Cyclic Groups / Factor Groups and Generating sets and identify them;

CO-3: To learn Cayley's/ Lagranges/ Fundamental Theorems and their applications.

CO-4: CO-3: Familiarization of Homomorphisms/ normal subgroup of Groups and its properties;

CO-5: Familiarization of the concept of rings, integral domains and mapping between rings; to understand ideals and quotient rings and their relevance.

TEXTBOOK:

1. I. N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.

REFERENCES:

1. John B. Fraleigh, 'A First Course in Abstract Algebra', Narosa Publishing House, 2003.
2. Joseph A. Gallian, 'Contemporary Abstract Algebra', Cengage Learning, 2013.
3. M.Artin, 'Algebra', Prentice Hall inc., 1994.

18CSC211 CONVEX OPTIMIZATION 3 0 0 3

Unit 1

Introduction: Mathematical optimization, Least-squares and linear programming, Convex optimization, Nonlinear optimization.

Chapter 1.

Unit 2

Convex sets: Affine and convex sets. Some important examples. Operations that preserve convexity. Generalized inequalities. Separating and supporting hyperplanes. Dual cones and generalized inequalities.

Chapter-2

Unit 3

Convex functions: Basic properties and examples. Operations that preserve convexity. The conjugate function. Quasiconvex functions. Log-concave and log-convex functions. Convexity with respect to generalized inequalities.

Chapter-3.

Unit 4

Convex optimization problems. Optimization problems. Convex optimization. Linear optimization problems. Quadratic optimization problems. Geometric programming. Generalized inequality constraints. Vector optimization.

Chapter-4.

Unit 5:

Duality: The Lagrange dual function. The Lagrange dual problem. Geometric interpretation. Saddle-point interpretation. Optimality conditions. Perturbation and sensitivity analysis. Theorems of alternatives. Generalized inequalities.

COURSE OUTCOMES

CO1: Understand the basic concepts and different types of Optimization related to linear as well as nonlinear problems in engineering. Learn the concept of affine and convex sets and their importance.

CO2:Understand the properties, generalized inequalities, and operations that preserve convexity in convex sets as well as convex functions. Learn the concepts of separating and supporting hyperplanes, Dual cones, and generalized inequalities

CO3:Understand and learn the applications for the different optimization problems such as Convex optimization, Optimization problems, Linear optimization, Quadratic optimization, Geometric programming, Generalized inequality constraints, and Vector optimization

CO4:Understand the duality and Lagrange dual function problem. Learn the geometric interpretation, Saddle-point interpretation, Perturbation, sensitivity analysis, generalized inequalities, and their applications

TEXT BOOKS:

1. Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press, 2009.

REFERENCES:

1. Dimitri P. Bertsekas, Convex Optimization Theory, University Press, 2016.
2. Hamdy A. Taha, "Operations Research-An Introduction", Prentice Hall, 9th Edition, 2010.
3. Edwin K.P. Chong and Stanislaw H. Zak, "An Introduction to Optimization", Second Edition, Wiley-Interscience Series in Discrete Mathematics and Optimization, 2004.

18CSC212 Design and Analysis of Algorithms 3 1 0 4

Unit 1

Introduction: Problem solving -- adding 2 n-bit numbers, multiplication as repeated addition. Running time analysis -- recall of asymptotic notation, big-oh, theta, big-omega, and introduce little-oh and little-omega. Worst case and average case

Basic design paradigms with illustrative examples -- incremental design (e.g., incremental sorting, interpolating polynomials), decremental design (e.g., GCD with discussion on input size, factorial), and pruning (e.g., order statistics). Divide and Conquer: Integer multiplication revisited with an efficient algorithm that motivates and leads into recurrences. Solving recurrences using recurrence trees, repeated substitution, statement of master theorem. Brief recall of merge sort and its recurrence. Median in worst case linear time.

Unit 2

Greedy Algorithms: Greedy choice, optimal substructure property, minimum spanning trees -- Prims and Kruskals, Dijkstras shortest path using arrays and heaps, fractional knapsack, and Huffman coding (use of priority queue). Dynamic Programming: Integral knapsack (contrasted with the fractional variant), longest increasing subsequence, edit distance, matrix chain multiplication, and independent sets in trees.

Unit 3

Graph Algorithms – Graph Traversal: Applications of BFS: distance, connectivity and connected components and cycles in undirected graphs. Applications of DFS: Topological sort, cycles in directed graphs, Biconnected Components and Strong Connectivity. Path algorithms: Shortest path algorithms (along with analysis) SSSP: Bellman Ford. APSP: Floyd Warshall's. Minimum Spanning Tree (with analysis and applications).

String Matching: Boyer Moore – KMP – Rabin Karp. NP-completeness: reduction amongst problems, classes NP, P, NP-complete, and polynomial time reductions.

COURSE OUTCOMES

Understand the correctness and analyze complexity of algorithms

Understand various algorithmic design techniques and solve classical problems

Solve real world problems by identifying and applying appropriate design techniques

Analyze and map a given real world problem to classical problems and find solution

Analyze the impact of various implementation choices on the algorithm complexity

Textbooks

1. Introduction to Algorithms, by Cormen, Leiserson, Rivest, and Stein, MIT Press, Third Edition, 2009.

References

1. Algorithms, by Dasgupta, Papadimitrou and Vazirani, McGraw-Hill Education, 2006.
2. Algorithm Design, by Kleinberg and Tardos, Pearson, 2005.
3. Algorithm Design, by Goodrich and Tamassia, Wiley, 2001.

18CSC213 Database Management Systems 3 1 0 4

Unit I

Introduction to DBMS:Database System Vs File system, Database systems applications, Purpose of database systems - Data models. Relational models: Structure of relational databases – database schema keys – schema diagrams. Relational Query Languages – fundamental relational algebra operations – additional relational algebra operations. Introduction to SQL – Background – SQL data definition – structure of SQL queries – set operations – null values - aggregate functions – modifications to the database.

Unit II

Database design - overview of the design process – the entity-relationship model – constraints – entity-relationship diagrams – reduction to relation schemas - Entity-relationship design issues – weak entity sets – extended E-R features. Intermediate SQL: Nested subqueries - Join expression – Views – Transactions – integrity constraints – authorization. Advanced SQL – Accessing SQL from a program – functions and procedures – triggers.

Unit III

Relational database design – features of good relational designs – atomic domains and normal forms - 1NF, 2NF, 3NF, 4NF and BCNF – decomposition using functional dependencies -functional dependency theory – algorithm for decomposition -decomposition using multi-values dependencies – PJNF and DKNF. Over view of Transaction Management and Concurrency control

COURSE OUTCOMES

Understand the need and architecture of database systems.

Formulate and apply relational algebraic expressions and SQL to query relational databases.

Design and Construct ER models for real world applications.

Design and build a normalized database management system for real world applications as a team.

Develop modularized programs using PL/SQL.

Understand transaction processing and concurrency control.

Text Book:

Silberschatz. A., Korth, H. F. and Sudharshan, S. "Database System Concepts", 6th Edition, TMH, 2010

Reference Books

1) Elmasri, R. and Navathe, S. B. "Fundamentals of Database Systems", 5th Edition, Addison Wesley, 2006

2) Date, C. J. "An Introduction to Database Systems", 8th Edition, Addison Wesley, 2003.

3) Ramakrishnan, R. and Gehrke, J. "Database Management Systems", 3rd Edition, McGrawHill, 2003.

18MAT289 Data Science Lab –II: Inference Theory 0 0 2 1

1. Modern Algebra:
   - Problems in Set Theory
   - Verification of different relations (equivalence and partial order relations)
   - Problems in permutation groups

2. Inference Theory:
   - Discrete and Continuous distribution
   - Correlations
   - Testing of hypothesis

COURSE OUTCOMES

CO1: To visualize different Data plots

CO2: To evaluate and understand statistical measures using R

CO3: Implementing numerical methods to solve system of equations and calculate eigenvalues and eigen vectors

CO4: Implementing numerical techniques for differentiation and integration

CO5: Understanding and visualizing the numerical solution of differential equations

18SSK211 LIFE SKILLS II 1 0 2 2

Professional Grooming and Practices: Basics of Corporate culture, Key pillars of Business Etiquette. Basics of Etiquette: Etiquette – Socially acceptable ways of behaviour, Personal hygiene, Professional attire, Cultural Adaptability. Introductions and Greetings: Rules of the handshake, Earning respect, Business manners. Telephone Etiquette: activities during the conversation, Conclude the call, To take a message. Body Language: Components, Undesirable body language, Desirable body language. Adapting to Corporate life: Dealing with people.

Group Discussions: Advantages of Group Discussions, Structured GD – Roles, Negative roles to be avoided, Personality traits to do well in a GD, Initiation techniques, How to perform in a group discussion, Summarization techniques.

Listening Comprehension advanced: Exercise on improving listening skills, Grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading Comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving – Money Related problems; Mixtures; Symbol Based problems; Clocks and Calendars; Simple, Linear, Quadratic and Polynomial Equations; Special Equations; Inequalities; Functions and Graphs; Sequence and Series; Set Theory; Permutations and Combinations; Probability; Statistics.

Data Sufficiency: Concepts and Problem Solving.

Non-Verbal Reasoning and Simple Engineering Aptitude: Mirror Image; Water Image; Paper Folding; Paper Cutting; Grouping Of Figures; Figure Formation and Analysis; Completion of Incomplete Pattern; Figure Matrix; Miscellaneous.

Special Aptitude: Cloth, Leather, 2D and 3D Objects, Coin, Match Sticks, Stubs, Chalk, Chess Board, Land and geodesic problems etc., Related Problems

Course Outcomes:

CO1: Soft Skills: At the end of the course, the students will have the ability to communicate convincingly and negotiate diplomatically while working in a team to arrive at a win-win situation. They would further develop their inter-personal and leadership skills.

CO2: Soft Skills: At the end of the course, the students shall learn to examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arrive at a consensus.

CO3: Aptitude: At the end of the course, students will be able to identify, recall and arrive at appropriate strategies to solve questions on geometry. They will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability and combinatorics.

CO4: Verbal: At the end of the course, the students will have the ability to relate, choose, conclude and

CO5: Verbal: At the end of the course, the students will have the ability to utilise prior knowledge of grammar to recognise structural instabilities and modify them.

CO6: VerbalAt the end of the course, the students will have the ability to comprehend, interpret, deduce and logically categorise words, phrases and sentences. They will also have the ability to theorise, discuss, elaborate, criticise and defend their ideas.

TEXTBOOKS:

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.

2. Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.

3. Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa& Co.

4. The Hard Truth about Soft Skills, by Amazone Publication.

REFERENCES:

1. Quantitative Aptitude, by R S Aggarwal, S Chand Publ.

2. Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.

3. Quantitative Aptitude by AbjithGuha, Tata McGraw hill Publ.

4. More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.

5. The BBC and British Council online resources

6. Owl Purdue University online teaching resources

7. www.thegrammarbook.com online teaching resources

8. www.englishpage.com online teaching resources and other useful websites.

18CSC282 Design and Analysis of Algorithms Lab 0 0 2 1

Implementation of common sorting algorithms – insertion sort, selection sort, quick sort, merge sort, bucket sort, radix sort. Greedy – task scheduling, fractional knapsack and other applications. Divide and Conquer – Closest Pair, Integer multiplication, other applications. Dynamic Programming – matrix chain multiplication, 0-1 knapsack, longest common subsequence, maximum contiguous subarray, edit distance. Graphs- minimum spanning tree algorithms, shortest path algorithms. String matching – KMP, Boyer Moore.

18CSC301 OPERATING SYSTEMS 3 1 0 4

Course Outcomes:

CO1: Understand the architecture and functionalities of modern OS

CO2: Understand and apply the algorithms for resource management and scheduling

CO3: Analyze and Apply semaphores and monitors for classical and real world synchronization scenarios

CO4: Engage in independent learning as a team to study characteristic features of modern operating systems

Unit 1

Introduction to Operating Systems: Overview - Types of systems - Computer system operations - Hardware Protection - Operating systems services - System calls - System structure - Virtual machines. Process Management: Process concepts

- Process scheduling - Operations on Process - Cooperating process - Interprocess communication - Multithreading models - Threading issues - Thread types - CPU scheduling –scheduling algorithms.

Unit 2

Process Synchronization: Critical section problem - synchronization hardware – Semaphores - Classical problems of synchronization - Critical regions – Monitors

– Deadlocks - Deadlock characterization - Methods of handling deadlocks - Deadlock prevention – Avoidance - Detection and recovery.

Unit 3

Storage Management: Memory management – Swapping - Contiguous memory allocation. Paging – Segmentation - Segmentation with Paging - Virtual memory - Demand paging - Process creation – page replacement - Thrashing. File Systems: Directory structure - Directory implementation - Disk scheduling. Case study: Threading concepts in Operating systems, Kernel structures.

TEXTBOOK:

Silberschatz and Galvin, "Operating System Concepts", Ninth Edition, John Wiley and Sons, 2012.

REFERENCES:

1. Deitel. Deitel and Choffnes, "Operating System", Third edition, Prentice Hall, 2003.
2. Tannenbaum A S, "Modern Operating Systems", Third edition, Prentice Hall, 2007.
3. Stevens W R and Rago S A, "Advanced Programming in the Unix Environment", Second Edition, Addison-Wesley, 2013.
4. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2009.

18MAT331 TRANSFORM TECHNIQUES 3 0 0 3

Fourier series, Complex Form of Fourier Series, Parseval's Identity, Fourier Integrals, Fourier Integral theorem. Sine and Cosine Integrals. Sine and Cosine Transforms, Properties, Convolution theorem and Parseval's theorem**.**
(Text Book 2: Sections: 11.1, 11.2, 11.7, 11.9)

Laplace Transforms, Inverse Transforms, Properties, Transforms of Derivatives and Integrals, Second Shifting Theorem, Unit Step Function and Dirac-Delta Function, Differentiation and Integration of Transforms.
(Text book 2: Sections: 6.1, 6.2, 6.3, 6.4)

Introduction to DFT and FFT. Z-Transform: Simple properties.

COURSE OUTCOMES

CO1: Understand the basic concepts of Fourier series for periodic functions and extension to aperiodic functions.

CO2: Understand the concepts of Complex Fourier transform, Fourier cosine and sine transform.

CO4: Understand the concept of Laplace transform and its properties.

CO5: Understand the concept of DFt and Z transforms.

TEXTBOOK

1. Robert G. Bartle and Donald R. Sherbert, "Introduction to Real Analysis", John Wiley and Sons, Third Edition,2000.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, Tenth Edition, 2016.

REFERENCE BOOKS

1) LokenathDebnath, Dambaru Bhatta, Integral Transforms and their Applications, CRC Press, Taylor &Fransis Group, Boca Raton, Third Edition, 2015.
2) Abdul J. Jerri, Integral and Discrete Transforms with Applications and Error Analysis, Monographs and text books in Pure and Applied Mathematics, Marcel Dekker,1992.
3) Joel L. Schiff, The Laplace Transform: Theory and Applictions, Springer-Verlag, Newyork, 1999.

18CSC302 Number Theory and Information Security 3 1 0 4

Course Outcome:

CO-1: Understanding of integer arithmetic

CO-2: Understanding the Finite field arithmetic

CO-3: To learn different algorithms for integer factorization

CO-4: Understanding different algorithms for quantum computational number theoretic problems

Algorithms for integer arithmetic: Divisibility, GCD, modular arithmetic, modular exponentiation, Montgomery arithmetic, congruence, Chinese remainder theorem, orders and primitive roots, quadratic residues, integer and modular square roots, prime number theorem, continued fractions and rational approximations.

Representation of finite fields: Prime and extension fields, representation of extension fields, polynomial basis, primitive elements, normal basis, optimal normal basis, irreducible polynomials, Root-finding and factorization algorithm, Lenstra-Lenstra-Lovasz algorithm.

Elliptic curves: The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm.

Primality testing algorithms: Fermat Basic Tests , Miller–Rabin Test , AKS Test.

Integer factoring algorithms: Trial division, Pollard rho method, p-1 method, CFRAC method, quadratic sieve method, elliptic curve method.

Computing discrete logarithms over finite fields: Baby-step-giant-step method, Pollard rho method, Pohlig-Hellman method, index calculus methods, linear sieve method, Coppersmith's algorithm.

Quantum Computational Number Theory : Grover's algorithm, Shor's algorithm

Applications in Algebraic coding theory and cryptography.

TEXT BOOKS/REFERENCES:

1. Yan, Song Y. *Computational Number Theory and Modern Cryptography*. John Wiley & Sons, 2012.
2. Meijer, Alko R. *Algebra for Cryptologists*. Springer, 2016
3. Lidl, Rudolf, and Harald Niederreiter. *Introduction to finite fields and their applications*. Cambridge university press, 1994.
4. Apostol, Tom M. *Introduction to analytic number theory*. Springer Science & Business Media, 2013.

18MAT332 **Random Processes** **3 0 0 3**

Unit – I

Introduction to Probability and Stochastic Processes:

Definition of Stochastic Processes, specification of Stochastic processes, Stationary processes– Markov Chains: definition and examples, higher transition probabilities, Generalization of Independent Bernoulli trails, classification of states and chains.
(Sections: 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4)

Unit – II

Markov Processes with Discrete State Space:
Poisson process, Poisson process related distributions, properties of Poisson process, Generalizations of Poisson Processes, Birth and death processes, continuous time Markov Chains. (Sections: 4.1, 4.2, 4.3, 4.4, 4.5)

Unit – III

Markov processes with continuous state space:

Brownian motion – Wiener Process - Differential equations for a Wiener process – Kolmogorov equations – first passage time distribution for Wiener process – Ornstein-Uhlenbech process.
(Sections: 5.1 to 5.6)

Unit – IV

Renewal processes and theory:

Renewal process – Renewal processes in continuous time – Renewal equation – stopping time – Wald's equation – Renewal theorems.
(Sections: 6.1 to 6.5)

Unit – V

Branching Processes:

Introduction, properties of generating functions of Branching process, Distribution of the total number of progeny, Continuous-Time Markov Branching Process, Age dependent branching process: Bellman-Harris process.
(Sections: 9.1, 9.2, 9.4, 9.7, 9.8)

COURSE OUTCOMES

CO1. Understand the concepts of random process, and classifical of states and chains.
CO2.Understand the markov process with discrete state space as poisson process and its properties with related theorems.
CO3. Understand the markov process with continuous state space as wiener process and its properties.
CO4. Understand the renewal process and related theorems.
CO5. Understand the concepts of branching process and Bellman-Harris process.

Text Book:

1. J. Medhi, "Stochastic Processes", 2nd Edition, New Age International Private limited, 2006.

Book for Reference:

1. Sheldon M. Ross, "Stochastic Processes", 2nd Edition, Wiley, 1995.
2. J. Ravichandran, "Probability and Random Processes for Engineers", 1st Edition, IK International, 2015.

18CSC303 Database Design 3-1-0-4

Unit 1

Overview of DBMS – Database design – Record Oriented File Systems – File Structures, Indexing and Hashing – Disk Storage, Basic File Structures and Hashing – Indexing Structures – Single and Multi-level indexes. Query Processing Optimization and Database Tuning: - Algorithms for Query Processing and Optimization- Physical Database Design and Tuning

Unit 2

Transactions Processing and Concurrency Control : Transaction Concept, Transaction model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability

Concurrency control : Lock-based protocols – Timestamp Ordering based control – Multiversion concurrency control – Locks, Database Recovery Techniques

Unit 3

Advanced Topics: Object Oriented, Object Relational Databases, XML Databases – Concepts, Models and Standards. Parallel and Distributed Databases, NoSQL Databases, Database Security –Introduction, Attacks and Techniques for Mitigation, Spatio-temporal and Multimedia Databases

COURSE OUTCOMES

CO1	Able to select the appropriate file structure based on the application
CO2	Distinguish concurrency control techniques in transaction processing
CO3	Understand different types of databases
CO4	Create and update Non-Relational Databases using XML and NoSQL

TEXT BOOKS

1. Ramesh Elmasri and Shamkant B Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Educaton India, 2008.

REFERENCES

1. Silberschatz A, Korth H F and Sudharshan S, "Database System Concepts", Sixth Edition, Tata McGraw-Hill Publishing Company Limited, 2010.
2. Niall O'Higgins, "MongoDB and Python", O'reilly, 2011.
3. Hector Garcia-Molina, Jeff Ullman and Jennifer Widom, "Database Systems: The Complete Book", Pearson, 2011.
4. Raghu Ramakrishnan and Johannas Gehrke, "Database Management Systems", Third Edition, McGraw-Hill, 2003.

18SSK301 LIFE SKILLS III 1 0 2 2

Team Work: Value of Team work in organisations, Definition of a Team, Why Team, Elements of leadership, Disadvantages of a team, Stages of Team formation. Group Development Activities: Orientation, Internal Problem Solving, Growth and Productivity, Evaluation and Control. Effective Team Building: Basics of Team Building, Teamwork Parameters, Roles, Empowerment, Communication, Effective Team working, Team Effectiveness Criteria, Common characteristics of Effective Teams, Factors affecting Team Effectiveness, Personal characteristics of members, Team Structure, Team Process, Team Outcomes.

Facing an Interview: Foundation in core subject, Industry Orientation/ Knowledge about the company, Professional Personality, Communication Skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced Grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, Critical reasoning: A course on verbal reasoning. Listening Comprehension advanced: An exercise on improving listening skills.

Reading Comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Specific Training: Solving campus recruitment papers, National level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In Mathematics). Lateral Thinking problems. Quick checking of answers techniques; Techniques on elimination of options, Estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

Course Outcomes:

CO1: Soft Skills: At the end of the course, the students will have the ability to prepare a suitable resume (including video resume). They would also have acquired the necessary skills, abilities and

knowledge to present themselves confidently. They would be sure-footed in introducing themselves and facing interviews.

CO2: -Soft Skills: At the end of the course, the students will have the ability to analyse every question asked by the interviewer, compose correct responses and respond in the right manner to justify and convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.

CO3: Aptitude: At the end of the course, students will be able to interpret, critically analyze and solve logical reasoning questions. They will have acquired the skills to manage time while applying methods to solve questions on arithmetic, algebra, logical reasoning, and statistics and data analysis and arrive at appropriate conclusions.

CO4: Verbal: At the end of the course, the students will have the ability to understand and use words, idioms and phrases, interpret the meaning of standard expressions and compose sentences using the same.

CO5: Verbal: At the end of the course, the students will have the ability to decide, conclude, identify and choose the right grammatical construction.

CO6: Verbal: At the end of the course, the students will have the ability to examine, interpret and investigate arguments, use inductive and deductive reasoning to support, defend, prove or disprove them. They will also have the ability to create, generate and relate facts / ideas / opinions and share / express the same convincingly to the audience / recipient using their communication skills in English.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa& Co.*
4. *The Hard Truth about Soft Skills, by Amazon Publication.*

REFERENCES:

1. *Speed Mathematics, Secrets of Lightning Mental Calculations, by Bill Handley, Master Mind books;*
2. *The Trachtenberg Speed System of Basic Mathematics, Rupa& Co., Publishers;*
3. *Vedic Mathematics, by Jagadguru Swami Sri BharatiKrsnaTirthayi Maharaja, MotilalBanarsidass Publ.;*
4. *How to Ace the Brainteaser Interview, by John Kador, Mc Graw Hill Publishers.*
5. *Quick Arithmetics, by Ashish Agarwal, S Chand Publ.;*
6. *Quicker Maths, by M tyra& K Kundan, BSC Publishing Co. Pvt. Ltd., Delhi;*
7. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
8. *The BBC and British Council online resources*
9. *Owl Purdue University online teaching resources*
10. www.thegrammarbook.com online teaching resources
11. www.englishpage.com online teaching resources and other useful websites.

18CSC381 Database Management Systems Lab 0 0 2 1

1) Working with objects using SQL for the following
   i. Data definition language: create, alter, grant, revoke, drop, truncate.
   ii. Data manipulation language: select, insert, update, delete.
   iii. Transaction control statements: commit, rollback, savepoint.

2) Constraints – Queries: Simple selection, projection and selection with conditions.
3) Functions: aggregate functions, group by, order by, date and conversion functions.

4) Set operators, joins, sub query: simple, nested, correlated, existence test, membership test, DDL and sub queries and DML and sub queries.

5) Working with other schema objects: view, sequence, index, synonym, cluster, lock, BLOB, CLOB, nested table, type.

6) PL/SQL programs, cursors, functions, procedures, packages, triggers, exception handling.

7) Front end tool: form creation, validation, trigger and report generation.

8) Mini Project.

COURSE OUTCOMES

CO1	Develop queries for data definition and manipulation
CO2	Customize schemas based on the application need
CO3	Design and devlop front end tools to update data base
CO4	Implement programs based on PL/SQL

18CSC382 Open Lab-I 0 0 2 1

In this open lab-I, students take any one of the following programming languages:
JAVA / C / C++ / R programming.
This course provides the beginning programmer with a guide to developing applications using the Java / C / C++ language. In this, Java is popular among professional programmers because it can be used to build visually interesting graphical user interface (GUI) and Web-based applications.Java also provides an excellent environment for the beginning programmer—a student can quickly build useful programs while learning the basics of structured and object-oriented programming techniques. This course will motivate students to learn programming skills while building a cornerstone for a Computer Science curriculum.The course covers all topics of fundamental programming. Concretely, it covers:•Creating Java Programs•Using Data•Using Methods, Classes, and Objects•Making Decisions•Looping•Charactersand Strings•Arrays•Introduction to Inheritance•File Input and Output•Introduction to Swing Components•Graphics.

COURSE OUTCOMES

Understand the given programming language constructs

Solve and implement known problems using learned concepts.

Understand and apply external libraries in this programming language for high order applications.

Develop user defined libraries in mentioned programming language using standard programming practice

18MAT333 Graph Analytics and Algorithms 3 0 2 4

Course Outcomes:

CO1:Understand the various definitions and properties of graphs
CO2:Understand the Euler and Hamiltonian graphs. Also apply the concept the shortest path algorithm for the traveling salesman problem
CO3:Understand the concept of matching and apply to optimize assignment problems
CO4: Understand the concept of graph coloring and planarity
CO5: Understanding the different types of graph centralities for the network

Unit 1

Review of Graphs: Graphs and Sub graphs, isomorphism, matrices associated with graphs, degrees, walks, connected graphs, shortest path algorithm.
Trees: Trees, cut-edges and cut-vertices, spanning trees, minimum spanning trees, DFS, BFS algorithms.

Unit 2

Connectivity: Graph connectivity, k-connected graphs and blocks.
Euler and Hamilton Graphs: Euler graphs, Euler's theorem. Fleury's algorithm for Eulerian trails. Hamilton cycles, Chinese-postman problem, approximate solutions of traveling salesman problem. Closest neighbour algorithm.

Unit 3

Matching: Matchings, maximal matchings. Coverings and minimal coverings. Berge's theorem, Hall's theorem, Tutte's perfect matching theorem, Job assignment problem and matching algorithms.

Unit 4

Colorings: Vertex colorings, greedy algorithm and its consequences, Brooks' theorem. Vertex coloring algorithm. Planar graphs. Euler theorem on planar graphs.

Unit 5

Graph Networks and Centralities: Graph Networks. Network topologies. Degree and distance centralities. Clustering centrality. Closeness centrality. Betweeness centrality.

TEXTBOOKS

1. *J.A. Bondy and U.S.R. Murty, Graph Theory and Applications, Springer, 2008.*
2. Mohammed Zuhair Al-Taie, Seifedine Kadry, *Python for Graph and Network Analysis, Springer, 2018.*

REFERENCES BOOKS

1. *Barabasi and Pasfai, Network Science, Cambride University press, 2016.*
2. *Meghanathan Natarajan, Centrality Metrics for Complext Networks Analysis, IGI publisher, 2018.*
3. *Frank Harary, Graph Theory, New York Academy of Sciences, 1979.*
4. *Graph Algorithms in Neo4j*

18MAT334 Regression Analysis 3 1 0 4

Unit I

Simple Linear Regression: Linear Regression Model, Least square estimation of the parameters, Hypothesis Testing on the slope and intercept, Interval estimation in Simple linear Regression, Prediction of New Observations and Coefficient of Determination.

Unit II

Multiple Linear Regression: Multiple Linear Regression Models, Estimation of the Model Parameters, Hypothesis testing in Multiple Linear Regression, Confidence Interval on the Regression and Prediction of New observations.

Unit III

Generalized linear models - Logistic regression Models, Poisson regression - hypothesis testing on model parameter. Model Adequacy Checking: Introduction, Residual Analysis, Detection, treatment of Outliers and Lack of fit of the Regression Model.

Unit IV

Polynomial regression models – polynomial models in one variable – Polynomial models in two or more variables – variable selection and model building – computational techniques for variable selection.

Unit V

Introduction to analysis of variance- one way and two way ANOVA – Analysis of variance in Regression: Response surface designs – Introduction to response surface methodology, Method of steepest accent, Analysis of second order response surface, experimental design for fitting response surfaces.

COURSE OUTCOMES

CO 1 To understand simple linear regression models and its use for data analysis
CO 2 To understand multiple linear regression models and its use for data analysis
CO 3 To understand the importance of model adequacy checks
CO 4 To apply polynomial regression models for data analysis
CO 5 To understand nonlinear regression variable selection techniques in regression analyses

Text Books/References:

1. Douglas C. Montgomery and Elizabeth A.Peck and G.Geoffrey Vining, Introduction to Linear Regression Analysis",3rd Edition ,John Wiley& Sons, Inc
2. Douglas C. Montgomery,Design and analysis of Experiments, 8th edition, John Wiley& Sons, Inc
3. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012

18CSC311 Machine Learning 3 1 0 4

Supervised Learning (Regression/Classification) : Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naïve Bayes. Linear models: Linear Regression, Logistic Regression, Generalized Linear Models. Support Vector Machines, Nonlinearity and Kernel Methods. Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Unsupervised Learning: Clustering: K-means/Kernel K-means. Dimensionality Reduction: PCA and kernel PCA. Matrix Factorization and Matrix Completion. Generative Models (mixture models and latent factor models)

Assorted Topics: Evaluating Machine Learning algorithms and Model Selection. Introduction to Statistical Learning Theory. Ensemble Methods (Boosting, Bagging, Random Forests). Sparse Modeling and Estimation. Modeling Sequence/Time-Series Data. Deep Learning and Feature Representation Learning. Scalable Machine Learning (Online and Distributed Learning). A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

Course Outcomes:

CO1: Understand issues and challenges of machine learning: data, model selection, model complexity

CO2: Design and implement various machine learning algorithms in a range of real-world applications

CO3: Understand strengths and weaknesses of many popular machine learning approaches

CO4: Analyze the underlying mathematical relationships within and across Machine Learning algorithms

CO5: Apply the paradigms of supervised and un-supervised learning

Text books/ Reference books.

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. Hal Daumé III, A Course in Machine Learning, 2015 (freely available online).

18CSC312 Data Visualization 3 1 0 4

Course Outcomes:

CO1: Understand different visualization techniques

CO2: Apply pre-processing techniques over raw data so as to enable further analysis.

CO3: Conduct exploratory data analysis and create insightful visualizations to identify patterns.

CO4: Identify machine learning algorithms for prediction/classification and to derive insights

CO5: Analyze the degree of certainty of predictions using statistical test and models.

- Basic Data Visualization techniques (*e.g.*, tables, charts, plots, etc.), visual thinking, and workflow
- Data abstraction, task abstraction, validation, etc.
- Visualization percenption and design
- Elementary visual exploratory and comfirmatory data analysis
- Other visualization topics on tables, spatial data, time-varying data, network and trees, the use of colors and views, focus+context, etc.
- Useful algorithms in data visualization (*e.g.*, graph drawing, glyph, etc.)

Text books / References:

1. Tamara MunznerVisualization Analysis and Design, CRC press, 2015.
2. Scott Murray, Interactive Data Visualization for the Web, O'Reilly (2013)

18CSC313 THEORY OF COMPUTATION 3 1 0 4

Unit 1

Automata and Languages: Chomsky hierarchy of languages, Introduction Finite Automata - Regular Expressions - Nondeterministic Finite Automata - equivalence of NFAs and DFAs – Minimization of DFA.

Unit 2

Regular Expressions - Non-Regular Languages - Pumping Lemma for regular languages.

Unit 3

Parse tree derivations (top-down and bottom-up) Context free languages –Chomsky normal form, GNF - Push Down Automata - Pumping lemma for context free language. CYK Algorithm, Deterministic CFLs. Ambiguous grammar, removing ambiguity, Computability Theory: Turing Machines - Non-deterministic Turing Machines –CSG, Undecidability - PCP Computation histories – Reducibility.

COURSE OUTCOMES

CO1	Understand and apply the properties of formal languages
CO2	Illustrate grammar and grammar transformations for formal languages
CO3	Construct finite state machines
CO4	Apply stack data structures for automata
CO5	Design and develop computing devices such as Turing machines

TEXTBOOK:

1. *Linz P, "An Introduction to Formal Languages and Automata", Fourth Edition, NarosaPublishing House, 2009*

REFERENCES*:*

1. *Michael Sipzer, "Introduction to the Theory of Computation", Third Edition, Cengage Learning, 2012.*
2. *Martin and John, "Introduction to Languages and the Theory of Computation", New York, McGraw Hill, 2002.*
3. *Garey, Michael and Johnson D S, "Computers and Intractability: A Guide to theTheory of NP-Completeness", New York, W.H. Freeman and Company, First Edition, 1979.*
4. *J E Hopcroft, R Motwani and J D. Ullman, "Introduction to Automata Theory, Languages, and Computation", Third Edition, Addison-Wesley, 2007.*

18CSC383 Machine Learning Lab 0 0 2 2

- Decision trees
- Regressions

- K-means algorithm
- Multi-class/Structured Outputs and Ranking
- Dimensionality Reduction: PCA and kernel PCA.
- Matrix Factorization and Matrix Completion
- Bayesian Learning and Inference.

COURSE OUTCOMES

CO1	Understand/Explore R programming environment
CO2	Implement data preprocessing methods
CO3	Develop various classification and clustering techniques
CO4	Implement Association mining
CO5	Integrate R concepts for case study/project as a team.

18CSC314 Ethics for Data Scientists 1 0 0 1

Data Acquisition – source of data and its authentication-acknowledgement- privacy of data – non-disclosure agreement – confidentiality of data – traceability and identity of individuals responsible for the source data – data sharing with client organizations – permission to third party audits – restricted disclosure of outcomes-predictions and inferences drawn from the source data analytics – fairness (unbiasedness) in analytics – ownership of resulting outcomes – accountability for data source, use of data analytics and consequences.

COURSE OUTCOMES

CO1: Understanding the confidentiality of the data

CO2: To understand the necessity of data sharing and its ethics

CO3: Gaining knowledge on ownership and accountability

18CSC384 Open Lab-II 0 0 2 1

In this open lab-II, students take any one of the following tools for Big Data Analytics:
Hadoop / MongoDB./Apache Cassandra.
Learning Objectives: What Big Data is, the limitations of the traditional solutions for Big Data problems, how Hadoop solves those Big Data problems, Hadoop Ecosystem, Hadoop Architecture, HDFS, Anatomy of File Read and Write & how Map Reduce works.

COURSE OUTCOMES

CO1 Understand the given programming language constructs

CO2 Solve and implement known problems using learned concepts.

CO3 Understand and apply external libraries in this programming language for high order applications.

CO4 Develop user defined libraries in mentioned programming language using standard programming practice

18CSC401 Parallel and Distributed Systems 3 1 0 4

Unit 1

Introduction – parallelism and goals, parallel computing models – RAM, PRAM , CTA. Reasoning about Performance – Introduction -Basic Concepts - Performance Loss - Parallel Structure - Measuring Performance. Shared memory architecture.

Unit 2

Parallel Programming: Task and Data Parallelism with examples –Comparison Programming with Threads - POSIX Threads- Thread Creation and Destruction. Mutual Exclusion- Synchronization - Safety and Performance Issues – Reduction – threads Inter process communication – internet protocols – multicast communication – MPI. Remote invocation:Remote procedure call – remote method invocation -

Unit 3

System models : physical models, architecture models, operating system support. Distributed file systems – introduction- time and global states – synchronization of physical clocks – coordination and agreements: Mutual exclusion, election, consensus.

Course Outcomes:

CO1: Understand the design principles in distributed systems and the architectures for distributed systems.

CO2: Apply various distributed algorithms related to clock synchronization, concurrency control, deadlock detection, load balancing, voting etc.

CO3: Analyze fault tolerance and recovery in distributed systems and algorithms for the same.

CO4: Analyze the design and functioning of existing distributed systems and file systems.

Text Books

1. George Coulouris , Jean Dollimore , Tim Kindberg , Gordon BlairDISTRIBUTED SYSTEMS Concepts and Design Fifth Edition , Addison Wiley, 2012.
2. Calvin Lin ,Larry Snyder, Principles of Parallel Programming, Pearson, 2009

References

1. Bertil Schmidt, Jorge Gonzalez-Dominguez, Christian Hundt , Moritz Schlarb, Parallel Programming: Concepts and Practice 1st Edition, Morgan Kaufmann, 2017.
2. Ajay D. Kshemkalyani, MukeshSinghal , Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press, 1 edition, 2008.

18CSC402 **Deep Learning** **3 0 2 4**

- Basics: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.
- Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.
- Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training.
- Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).
- Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs
- Convolutional Neural Networks: LeNet, AlexNet.
- Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.
- Recent trends: Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning
- Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

Course Outcomes:

CO1 Outline the basics of artificial neural networks

CO2 Understand the difficulty of training deep neural networks

CO3 Distinguish and select appropriate Neural Network training mechanisms

CO4 Compare and contrast Recurrent and Convolutional Neural networks

CO5 Apply the deep learning concepts in Natural Language Processing and Computer Vision domains

Textbook:

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

References:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, Deep Learning, MIT press 2016
2. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
3. Pattern Recognition and Machine Learning, Christopher Bishop, 2007

18CSC403 Practical Techniques for Big Data Analytics 3 0 2 4

Unit 1

Introduction to Big Data: Types of Digital Data-Characteristics of Data – Evolution of Big Data - Definition of Big Data - Challenges with Big Data - 3Vs of Big Data - Non Definitional traits of Big Data - Business Intelligence vs. Big Data - Data warehouse and Hadoop environment - Coexistence. Big Data Analytics: Classification of analytics - Data Science - Terminologies in Big Data - CAP Theorem - BASE Concept. NoSQL: Types of Databases – Advantages – NewSQL - SQL vs. NOSQL vs NewSQL. Introduction to Hadoop: Features – Advantages – Versions - Overview of Hadoop Eco systems - Hadoop distributions - Hadoop vs. SQL – RDBMS vs. Hadoop - Hadoop Components – Architecture – HDFS - Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting - Compression. Hadoop 2 (YARN): Architecture - Interacting with Hadoop Eco systems.

Unit 2

No SQL databases: Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export. Cassandra: Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.

Unit 3

Hadoop Eco systems: Hive – Architecture - data type - File format – HQL – SerDe - User defined functions - Pig: Features – Anatomy - Pig on Hadoop - Pig Philosophy - Pig Latin overview - Data types - Running pig - Execution modes of Pig - HDFS commands - Relational operators - Eval Functions - Complex data type - Piggy Bank - User defined Functions - Parameter substitution - Diagnostic operator.

Course Outcomes:

CO1: Understanding the concepts of Big Data
CO2: Understanding the aspects of managing, cleaning and sampling of Data
CO3: Understanding Hadoop architecture and implement Map Reduce concept
CO4: To understand the aspects of Data base management and Querying system
CO5: Understanding and executing HDFS using PIG and HIVE

TEXTBOOK:

Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015.

REFERENCES:

1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013.
2. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011.

3. Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2012.

4. Russell Bradberry, Eric Blow, "Practical Cassandra A developers Approach", Pearson Education, 2014.

18CSC404 Reinforcement Learning 3 0 0 3

Introduction: Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example- Tic-Tac-Toe.
Multi-armed Bandits: A k-armed Bandit Problem , Action-value Methods, The 10-armed Testbed, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandit Algorithms.
Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards, Returns and Episodes , Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions, Optimal Policies and Optimal Value Functions, Optimality and Approximation.
Review of Markov process and Dynamic Programming.
Temporal-Difference Learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD, Sarsa: On-policy TD Control, Q-learning: Policy TD Control. Expected Sarsa. Maximization Bias and Double Learning.

Course Outcomes:

CO1 Understand the basic building blocks of reinforcement learning and its merits & limitations.

CO2 Formulate your task as a Reinforcement Learning problem, and how to begin implementing a solution.

CO3 Relate Markov decision process with Dynamic Programming

CO4 Understand the space of RL algorithms (Temporal- Difference learning , Q-learning and Sarsa)

CO5 Apply the RL algorithms to solve Multi-armed Bandit problem

Te**xt Book:**

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning:An Introduction, MIT Press, 2018.

References:

1. Sudharsan Ravichandiran, Hand-on Reinforcement Learning with Python, Packt Publications, 2018.

2. Sayon Dutta, Reinforcement Learning with Tensor Flow: A beginner's guide, Packt Publications, 2018.

18CSC405 Data Security 3 0 0 3

Review of Data based Management.

Multilevel secured data management.

Supporting technologies of Data base and applications security.

Information security. Information management technologies.

Discretionary security for data base systems.

Mandatory security for data base systems.

Multilevel secured rational data management systems.

Course Outcomes:

CO1: Understand information security models and analyze authentication mechanisms for challenge response scenarios.

CO2: Understand e-mail architecture and standards for securing mail communication.

CO3: Understand Internet Security Protocol and explore common solutions for security issues.

CO4: Apply and analyze Web security protocols for E-Commerce applications

Text books

3. BhavaniThuraisingham, Database and Applications Security: Integrating Information Security and Data Management, CRC, 2007.
4. *Bishop, Matt,* Introduction to computer security, Boston: Addison-Wesley, cop. 2005

18CSC481 Open Lab-III 0 0 2 1

In this open lab-III, students will study the software tools for Big Data Analytics:
HPCC / Storm / Qubole.

Learning Objectives: Using any one of the tools, students should perform analysis of big data, storage of big data.

COURSE OUTCOMES

CO1 Understand the given programming language constructs

CO2 Solve and implement known problems using learned concepts.

CO3 Understand and apply external libraries in this programming language for high order applications.

CO4 Develop user defined libraries in mentioned programming language using standard programming practice

18CSC411 Software Engineering 3 1 0 4

Software process and lifecycle: Software Product, Software Processes, Study of different process models, Project Management Concepts, Planning and Scheduling, Team organization and people management.
Software requirement engineering: Software requirements, extraction and specification, Feasibility Studies, Requirements Modeling, object oriented analysis.
Design Concepts: Object oriented design, Architectural design. Component level Design, User Interface Design, Distributed Systems Architecture, Real Time Software Design, User Interface Design, Pattern Based Design.
Risk Management: Metrics and Measurement, Estimation for software projects, software configuration management, Maintenance and Reengineering.
Software Testing: Unit testing, integration testing, black box and white box testing, regression testing, performance testing, object oriented testing. Verification and validation of Software:Software Inspections and Audit, Automated Analysis, Critical systems validation.
Software Quality Assurance, Quality Standards, Quality Planning and Control, Various Quality models. Overview of recent trends in Software Engineering, Security Engineering, Agile Methods, Service Oriented Software Engineering, Aspect Oriented Software Development.Self-Study:

Text Books: 1.Ian Sommerville, Software Engineering, Addison – Wesley
References:

1.Roger Pressman, Software Engineering A Practitioners Approach, McGraw Hill Publication 2.Rajib Mall, Fundamentals of Software Engineering, Prentice Hall of India
3.Ivar Jacobson, Object Oriented Software Engineering A use case Approach, Pearson

COURSE OUTCOMES

CO1	Understand the principles of software engineering
CO2	Understand various software process models
CO3	Apply the appropriate design methodology for a real world application
CO4	Evaluate a system developed for real-world applications in Agile Mode
CO5	Understand various industry standards

18CSC412 Deep Learning for Natural Language Processing 3 0 2 4

Introduction: Words – Morphology and Finite State transducers - Computational Phonology and Pronunciation Modelling - Probabilistic models of pronunciation and spelling – Ngram Models of syntax - Hidden markov models and Speech recognition - Word classes and Part of Speech Tagging.

Context free Grammars for English – Parsing with Context free Grammar – Features and unification - Lexicalized and Probabilistic Parsing -Language and Complexity. Semantics: Representing meaning - Semantic analysis - Lexical semantics - Word sense disambiguation and Information retrieval.

Pragmatics: Discourse - Dialog and Conversational agents - Natural language generation, Statistical alignment and Machine translation: Text alignment – word alignment – statistical machine translation.

COURSE OUTCOMES

CO1	Understand the basics of natural language processing
CO2	Apply simple and probabilistic context free grammars to parse the sentences in natural language
CO3	Understand approaches to discourse, generation, dialogue and summarization within NLP
CO4	Understand current statistical approaches to machine translation
CO5	Construct Hidden Markov Models for solving Natural language processing challenges (Part-of-speech tagging and Machine Translations)

TEXTBOOK:

Daniel and Martin J H, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2009.

REFERENCES:

1. *Manning C D and Schutze H, "Foundations of Statistical Natural Language processing", First Edition, MIT Press, 1999.*
2. *Allen J, "Natural Language Understanding", Second Edition, Pearson Education, 2003.*

18CSC591 Project-I (8 credits)

This is an industry /institution based project. Students should take internship in any one of the analytics company / good academic institutions for their project. Students will be evaluated based two internal reviews.

Students shall continue this project as a final semester project in the same field.

COURSE OUTCOMES

CO-1: Learn to study by self by real time situation and data

CO-2: Use various Data Science concepts

CO-3: Presentation and documentation of the research findings.

18CSC599 Project-II (12 credits)

This is also industry /institution based project. Students will be evaluated based two internal reviews and one external review. Research paper submission / acceptance / publication is mandatory for completion of the project. The continuous assessment of project work will be carried out as decided by the course committee. At the completion of the project work, the student will submit a bound volume of the project report in the prescribed format. The project work will be evaluated by a team of duly appointed examiners.The final evaluation will be based on the content of the report, presentation by student and a viva-voce examination on the project. There will be 40% weight for continuous assessment and the remaining 60% for final evaluation.

If the project work is not satisfactory he/she will be asked to continue the project work and appear for assessment later.

COURSE OUTCOMES

CO-1: Learn to study by self by referring various Research Articles

CO-2: Use various Data Science concepts

CO-3:Design Various new algorithms and New Tools

CO-4: Presentation and documentation of the research findings.

ELECTIVES

MATHEMATICS STREAM

18MAT441 Advanced Algebra 3 0 0 3

Maximal Ideals, the Field of Quotients of an Integral Domain, Euclidean Rings, Principal Ideal, Unit Element, Greatest Common Divisor, Prime Elements, Unique Factorization Theorem. (Sec. 3.5 to 3.7)

The ring of Gaussian integers, Fermat's Theorem, Polynomial Rings – F[x], Degree of a Polynomial, The Division Algorithm, Principal Ideal Ring, Irreducible Polynomial a principal ideal ring, Irreducible polynomial. (Sec. 3.8 to 3.9)

Sub Fields, Field Extensions, Finite Extensions, Algebraic Extensions and Their Properties. The Transcendence of 'e'. (Sec. 5.1 to 5.2)

Roots of Polynomials, Remainder Theorem, Splitting Field and its Uniqueness, The concept of constructible numbers and its Applications, Distinct and Multiple Roots, Simple Extension of a Field. (Sec. 5.3, 5.4, 5.5).

TEXTBOOK:

1. I.N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.

REFERENCES:

1. John B. Fraleigh, 'A First Course in Abstract Algebra', Narosa Publishing House, 2003.
2. Joseph A. Gallian, 'Contemporary Abstract Algebra', Cengage Learning., 2013.
3. Howard Anton and Chris Rorres,'Elementary Linear Algebra', 9th Edition, Wiley, 2005.

Note: The Problems are to be referred from Reference Book 1.

18MAT442 ADVANCED BIG DATA ANALYTICS 3-0-0-3

Unit - I

How MapReduce Works - Anatomy of a MapReduce Job Run, Failures, Shuffle and Sort, Task Execution

Unit -II

MapReduce Types and Formats - MapReduce Types, Input Formats, output formats,

Unit- III

MapReduce Features- Counters, Sorting, Joins, Side Data Distribution

Unit -IV

Simple analytics using MapReduce, Calculating frequency distributions and sorting using MapReduce, Calculating histograms using MapReduce, Calculating scatter plots using MapReduce

Unit – V

Hierarchical clustering, Clustering algorithm to large dataset, classification using Naviebayes classifier, other applications

Text Books/References:

1. Tom White , Hadoop: The Definitive Guide, Fourth Edition , O'Reilly Media ,2009
2. SrinathPerera andThilinaGunarathne , Hadoop MapReduce Cookbook : Recipes for analyzing large and complex datasets with Hadoop MapReduce, Packt PublishingLtd,2013.

18MAT443 DIFFERENTIAL EQUATIONS 3 1 0 4

Course Outcome:

CO-1: Understand the basic concepts of differential equations and solve the various forms of differential equations.

CO-2: Understand the concepts and solve the linear homogeneous/non homogeneous differential equations with constants and variable coefficients.

CO-3: Understand the concepts and solve the nth order differential equation and simultaneous linear differential equations with constant and variable coefficients.

CO-4: Understand the concepts of partial differential equations and solve the first order PDE.

CO-5: Understand the concepts and solve the linear homogeneous/non homogeneous parital differential equations with constants coefficients.

Unit 1

Review of differential equations (order, degree, linear, nonlinear, implicit and explicit form of solution, general solutions, particular solution, singular solution). Exactness, nonexact equations reduce to exact form.
Part I: 1.1-1.9, 2.12-2.22 (5 hours)
Equations solvable for $\frac{dy}{dx}$, y, x, equations in Clairaut's form, equations reducible to Clairaut's form.
Part I: 4.1-4.11 (4 hours)

Unit 2

Linear homogeneous differential equations with constant coefficients, Euler- Cauchy equation,Linear Nonhomogeneous DifferentialEquations: Wronskian, linear independence, Method of undetermined coefficients. Method of variation of parameters.
Part I: 5.1-5.5, 6.1-6.3, 1.12,1.13, 5.26-5.27, 7.1-7.5 (9 hours)

Unit 3

Conversion of nth order differential equation to n first order differential equations, homogeneous linear system with constant coefficients, fundamental matrices, complex eigen values, repeated eigenvalues. simultaneous linear differential equations with constant coefficients, simultaneous linear differential equations with variable coefficients,

PART I: 8.1-8.3, 2.1- 2.7(8 hours)

Review of partial differential equations (order, degree, linear, nonlinear).

Unit 4

Formation of equations by eliminating arbitrary constants and arbitrary functions.
General, particular and complete integrals.Lagrange's linear equation, Charpit's method, Methods to solve the first order partial differential equations of the forms f(p,q) = 0, f(z,p,q) = 0, $f_1(x,p) = f_2(y,q)$ and Clairut's form z = px + qy + f(p,q) where $p = \frac{\partial z}{\partial x}$ and $q = \frac{\partial z}{\partial y}$.

Part III: 1.1 – 1.5, 2.3-2.12, 3.1-3.2, 3.7-3.8, 3.10-3.18 (13 hours)

Unit 5

Homogeneous linear partial differential equations with constant coefficient of higher order. Non-homogeneous linear partial differential equations of higher order, method of separation of variables.
Part III: 4.1-4.12 (13 hours)

TEXTBOOKS:

1. M.D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand, 18th edition, 2016.

REFERENCES:

1. William E. Boyce and Richard C.DiPrima, Elementary differential equations and boundary value problems, Wiley india, 9th edition, 2012.
2. Nita H, Shah, Ordinary and Partial Differential Equations : Theory and Applications, PHI learning, 2nd edition, 2015.
3. Dennis Zill, A First Course in Differential Equations, Cengage Learning, 9th edition, 2009.

18MAT444 Multivariate Statistics and Time Series Analysis 3 0 0 3

Unit 1

Time series, components of time series, additive and multiplicative models, determination of trend, analysis of seasonal fluctuations.

Unit 2

Test for trend and seasonality, exponential and moving average smoothing, holt-winter smoothing, forecasting based on smoothing.

Unit 3

Time series as a discrete parameter stochastic process, auto covariance and auto correlation functions and their properties, stationary processes, test for stationarity, unit root test, stationary processes in the frequency domain, spectral analysis of time series.

Unit 4

Detailed study of the stationary processes: moving average (MA), autoregressive (AR), autoregressive moving average (ARMA) and autoregressive integrated moving average (ARIMA) models.

Unit 5

Estimation of ARMA models, maximum likelihood method (the likelihood function for a Gaussian AR(1) and a Gaussian MA(1)) and Least squares, Yule-Walker estimation for AR Processes, choice of AR and MA periods, forecasting, residual analysis and diagnostic checking.

TEXTBOOKS

1. Anderson, T.W. The Statistical Analysis of Time Series, John Wiley, New York, 1971.
2. Box, G.E.P. and Jenkins, G.M. Time Series Analysis- Forecasting and Control, Holden-day, San Francisco,1976.
3. Kendall, Sir Maurice and Ord, J.K., Time Series, Edward Arnold, London, 1990.

18MAT445 WAVELETS 3 0 0 3

Unit 1

Basic Properties of the Discrete Fourier Transform, Translation - Invariant Linear Transformations. The Fast Fourier Transform.

Unit 2

Construction of Wavelets on Z_N, The First Stage Construction of Wavelets on Z_N, The Iteration Step"s. Examples and Applications, $l2(Z)$

Unit 3

Complete Orthonormal Sets in Hilbert Spaces,$L_2([-\pi,\pi))$ and Fourier Series, The Fourier Transform and Convolution on $l_2(Z)$, First-Stage Wavelets on Z
The Iteration Step for Wavelets on Z , Implementation and Examples.

Unit 4

$L_2(R)$and Approximate Identities, The Fourier Transform on R, Multiresolution Analysis and Wavelets,

Unit 5

Construction of Multiresolution Analyses, Wavelets with Compact Support and Their Computation.

TEXTBOOK:

Michael W. Frazier, An Introduction to Wavelets Through Linear Algebra, Springer, 1999.

REFERENCES:

1. Daubechis, Ten Lectures on Wavelets, SIAM, 1992.
2. S. Mallat, A Wavelet Tour of Signal Processing, Elsevier, 2008.

18MAT446 COMPUTATIONAL GEOMETRY 3 0 0 3

Convex hulls: construction in 2d and 3d, lower bounds; Triangulations: polygon triangulations, representations, point-set triangulations, planar graphs; Voronoi diagrams: construction and applications, variants; Delaunay triangulations: divide-and-conquer, flip and incremental algorithms, duality of Voronoi diagrams, min-max angle properties; Geometric searching: point location, fractional cascading, linear programming with prune and search, finger trees, concatenable queues, segment trees, interval trees; Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems; Arrangements of lines: arrangements of hyperplanes, zone theorems, many-faces complexity and algorithms; Combinatorial geometry: Ham-sandwich cuts, Helly's theorems, k-sets, polytopes and hierarchies, polytopes and linear programming in d-dimensions, complexity of the union of convex sets, simply connected sets and visible regions; Sweep techniques: plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements; Randomization in computational geometry: algorithms, techniques for counting; Robust geometric computing; Applications of computational geometry.

References

1. Mark de Berg, Otfried Schwarzkopf, Marc van Kreveld and Mark Overmars, Computational Geometry: Algorithms and Applications, Springer.
2. F. P. Preparata and Michael I. Shamos, Computational Geometry: An Introduction, Springer.
3. Joseph O' Rourke, Computational Geometry in C, Cambridge University Press.
4. Lecture Notes by David Mount.

18MAT447 QUEUING THEORY AND INVENTORY CONTROL THEORY 3 0 0 3

Unit 1

Inventory concept – Components of Inventory model.

Unit 2

Deterministic Continuous Review model - Deterministic Periodic Review model.

Unit 3

The classical EOQ – Non zero lead time – EOQ with shortages allowed.

Unit 4

Deterministic Multiechelon Inventory models for supply chain management.

Unit 5

A stochastic continuous review model – A stochastic single period model for perishable products.

TEXTBOOKS

1. F S Hillier and Gerald J Lieberman, Introduction to Operations research, 8th edition, McGraw Hill.
2. Ravindran, Phillips and Solberg, Operations research Principles and Practice, 2nd Edition, John Wiley & Sons.

18MAT448 THEORY OF SAMPLING AND DESIGNS OF EXPERIMENTS FOR DATA ANALYSIS 3 0 0 3

Unit 1

Stratified random sampling, estimation of the population mean, total and proportion, properties of estimators, various methods of allocation of a sample, comparison of the precisions of estimators under proportional allocation, optimum allocation and srs. Systematic sampling. Comparison of systematic sampling - srs and stratified random sampling for a population with a linear trend.

Unit 2

Unbiased ratio type estimators - Hartly-Ross estimator, regression method of estimation. Cluster sampling, single stage cluster sampling with equal and unequal cluster sizes, estimation of the population mean and its standard error. Two-stage cluster sampling with equal and unequal cluster sizes, estimation of the population mean and its standard error.

Unit 3

Unequal probability sampling, PPS sampling with and without replacement, cumulative total method, Lahiris method, Midzuno-Zen method, estimation of the population total and its estimated variance under PPS wr sampling, ordered and unordered estimators of the population total under PPS wor, Horwitz – Thomson estimator.

Unit 4

Elementary concepts (one and 2 way classified data) Review of elementary design (CRD, RBD, LSD) Missing plot technique in RBD and LSD with one and two missing values, Gauss-Markov theorem, BIBD: Elementary parametric relations, Analysis, PBIBD.

Unit 5

General factorial experiments, factorial effects, best estimates and testing the significance of factorial effects, study of 2^3 and 2^4 factorial experiments.

TEXT AND REFERENCE BOOKS

1. Cochran, W.C. Sampling Techniques, Third Edition, Wiley Eastern, (1977).
2. Des Raj, Sampling Theory, Tata McGraw Hill, New Delhi, (1976).
3. Murthy, M.N., Sampling Theory, Tata McGraw Hill, New Delhi, (1967).

18MAT449 Computational Financial Mathematics 3 0 0 3

The course provides you with a strong mathematical background with the skills necessary to apply your expertise to the solution of problems. You will develop skills to formulate mathematical problems that are based on the needs of the financial industry. You will carry out relevant mathematical and financial analysis, develop and implement appropriate tools to present and interpret model results.

- Stochastic Calculus
- Financial Derivatives
- Numerical Methods I - Monte-Carlo
- Numerical Methods I - Finite Differences
- Statistics and Financial Data Analysis
- Financial Programming with C++ 1

18MAT450 Data Analytics in Computational Biology 3 0 0 3

Introduction to Bioinformatics - applications of Bioinformatics - challenges and opportunities - introduction to NCBI data model- Various file formats for biological sequences.

Bioinformatics resources – Importance of databases - Biological databases- Primary & Secondary databases (Genbank, EMBL, DDBJ, Swiss Prot , PDB, NDB, BLOCKS, Pfam, ProSITE, etc.).

Sequence alignment methods: Sequence analysis of biological data-Significance of sequence alignment-pairwise sequence alignment methods- Use of scoring matrices and gap penalties in sequence alignments-PAM and BLOSUM Scoring Matrices. Introduction to Dynamic Programming, Global alignments: Needleman Wunsch Algorithm, Local Alignments: Smith Waterman Algorithm, Gap Penalties.

Multiple sequence alignment methods – Tools and application of multiple sequence alignment. Sequence alignment tools (BLAST, FASTA, CLUSTAL-W/X, MUSCLE, TCOFFEE), Variants of BLAST (BLASTn, BLASTp, PSIBLAST, PHI-BLA

Phylogenetic analysis algorithms: Maximum Parsimony, UPGMA, Transformed Distance, Neighbors-Relation, Neighbor-Joining, jackknife, Probabilistic models and associated algorithms such as Probabilistic models of evolution and maximum likelihood algorithm, Bootstrapping methods, use of tools such as PHYLIP, MEGA, PAUP.

References/ Textbooks

1 Higgins,Des and Taylor Williw: Bioinformatics: Sequence , Structure and databanks, Oxford , University Press,2000.
2. Baxenvants, AD., Bioinformatics: A practical guide to the analysis of genes and proteins", Third edition, John wiley &
Sons ,2005
3. Teresa Attwood, Introduction To Bioinformatics ,Pearson Education Singapore Pte Ltd, 2007
4. Mount, DW, Bioinformatics: Sequence and Genome analysis", Second edition, Cold Spring Harbor Laboratory Press. Baxevanis 5. A.D., Davison D.B., Page R. D. M. & Petsko G.A. Current Protocols in Bioinformatics. New York, John Wiley &
Sons Inc., 2004. ISBN: 0555015254
6. S.C. Rastogi et al, Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery) Kindle Edition.

18MAT451 Computer Aided Drug Designing 3 0 0 3

Introduction to Molecular Modeling: Molecular Modeling and Pharmacoinformatics in Drug Design, Phases of Drug Discovery, Target identification and validation

Protein Structure Prediction and Analysis: Protein Structure prediction methods: Secondary Structure Prediction, Tools for Structure prediction; Protein structural visualization; Structure validation tools; Ramachandran Plot.

QSAR : Quantitative Structure and Activity Relationship - Historical Development of QSAR, Tools and Techniques of QSAR, Molecular Structure Descriptors.

Multivariate Statistical methods in QSAR -Principal Component Analysis (PCA) and Hierarchical Cluster Analysis(HCR). Regression analysis tools - Pincipal Component Regression (PCR), Partial Least Squares (PLS) - Case studies.

High Throughput / Virtual screening- Introduction, Basic Steps, Important Drug Databases, Designing Lipinski's Rule of Five, ADMET screening

Docking Studies- Target Selection, Active site analysis, Ligand preparation and conformational analysis, Rigid and flexible docking .

Molecular visualization tools: RasMol and Swiss-Pdb Viewer

Molecular docking tools: AutoDock and ArgusLab.

References/ Textbooks

1. Leach Andrew R., Valerie J. Gillet, An introduction to Chemoinformatics. Publisher: Kluwer academic , 2003. ISBN: 1402013477.
2. Gasteiger Johann, Handbook of Chemoinformatics: From Data to Knowledge (4 Volumes), 2003. Publisher: Wiley-VCH. ISBN:3527306803.
3. Opera Tudor I,Ed. , Chemoinformatics in drug discovery, Wiley-VCH Verlag,2005.
4. Bunin Barry A. Siesel Brian,Morales Guillermo,Bajorath Jürgen. Chemoinformatics: Theory, Practice, & Products Publisher:New York, Springer. 2006. ISBN: 1402050003.
5. Gasteiger Johann, Engel Thomas. Chemoinformatics: A Textbook. Publisher: WileyVCH; 1st edition. 2003. ISBN: 3527306811.
6. Kenneth M Merz, Jr, Dagmar Ringe, Charles H. Reynolds , Drug design: Structure and ligand based approaches (2010) publisher : Cmabridge University press

18MAT452 Statistical Quality Control 3-0-0-3

Unit I

Introduction to Total Quality Management – Japanese System of Total Quality Management - Quality Circles - 7 Quality Control tools - 7 New Quality Control tools.

Unit –II

Basic concept of quality control, process control and product control -Process and measurement system capability analysis - Area properties of Normal distribution. Statistical process control, theory of control charts, Shewhart control charts for variables-$\bar{x}$, R, s charts, attribute control charts - p, np, c, u charts, modified control charts.

Unit III

ARL curves of control charts, moving average control charts, EWMA charts, CUSUM charts – two sided and one sided procedures – V – mask technique, process capability analysis, process capability indices, Metrics of Six sigma, The DMAIC cycle - Design for Six Sigma - Lean Sigma – Statistical tools for Six Sigma.

Unit IV

Acceptance sampling for attributes, single sampling, double sampling, multiple sampling and sequential sampling plans, rectifying inspection plans, measuring performance of the sampling plans- OC, AOQ, ASN, ATI curves.

Unit V

Taguchi methods: Meaning of Quality, Taguchi's loss function, Introduction to orthogonal arrays – test strategies, steps in designing, conducting and analyzing an experiment, parameter and tolerance design: control and noise factors, signal to noise ratios, experimental design in Taguchi Methods, orthogonal arrays and parameter Design.

TEXT AND REFERENCE BOOKS

1. *Ishikawa K., Guide to Quality Control, 2nd Edition: Asian Productivity Organization, Tokyo (1983).*
2. *Ravichandran. J, Probability and Statistics for Engineers, 1st Edition 2012 (Reprint), Wiley India.*
3. *Montgomery Douglas C., Introduction to Statistical Quality Control, Sixth Edition. John Wiley & Sons, (2008).*
4. *Harry, M and Schroeder R., Six Sigma: The Breakthrough Management Strategy. Currency Publishers, USA. (2000).*
5. *Taguchi G, Introduction to Quality Engineering: Designing Quality into Products and Processes, Asian Productivity Organization, Second Edition. (1991).*

18MAT453 SIX SIGMA QUALITY ANALYSIS 3 0 0 3

Unit 1

Introduction to Quality Management – Japanese System of Total Quality Management.

Unit 2

Quality Circles - 7 Quality Control tools - 7 New Quality Control tools.

Unit 3

ISO 9000 Quality system Standards - Project Planning, Process and measurement system capability analysis - Area properties of Normal distribution.

Unit 4

Metrics of Six sigma, The DMAIC cycle - Design for Six Sigma - Lean Sigma – Statistical tools for Six Sigma.

Unit 5

Taguchi methods. Loss functions and orthogonal arrays and experiments.

TEXT AND REFERENCE BOOKS

6. *Ravichandran. J, Probability and Statistics for Engineers, 1st Edition 2012 (Reprint), Wiley India.*

7. *Montgomery Douglas C., Introduction to Statistical Quality Control, Sixth Edition. John Wiley & Sons, (2008).*
8. *Ishikawa K., Guide to Quality Control, 2nd Edition: Asian Productivity Organization, Tokyo (1983).*
9. *Taguchi G, Introduction to Quality Engineering: Designing Quality into Products and Processes Second Edition. (1991).*
10. *Harry, M and Schroeder R., Six Sigma: The Breakthrough Management Strategy. Currency Publishers, USA. (2000).*

18MAT454 Statistical Pattern Recognition 4 0 0 4

Introduction to theories, algorithms, and practical solutions of statistical pattern recognition. Topics covered include feature extraction, feature selection, Bayesian classifiers, neural networks, discriminative classifiers, clustering, performance evaluation, and fusion of models. Bayesian Decision Theory, Estimation Theory, EM algorithms and HMM, Nonparametric Techniques, Linear Discriminant Functions, Support vector Machine, Neural Networks, Stochastic Learning, Algorithm Independent Learning, Unsupervised Learning.

Course Outcomes:

CO1 To gain knowledge about pattern classification and dimensionality reduction method

CO2 To understand the use of Maximum-likelihood and Bayesian Parameter Estimation

CO 3 To understand and apply Nonparametric Techniques and Linear Discriminant Functions

CO4 To apply Nonmetric methods and Algorithm-independent Machine Learning

CO5 To implement clustering methods under unsupervised learning

Text books / Reference books:

1. Duda, Hart and Stork, *Pattern Classification*, Second Edition, Wiley, 2001.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani& Jerome Friedman, 2001, Springer Verlag.
3. Machine Learning: A Probabilistic Perspective, by Kevin P. Murphy, MIT Press, 2012.

COMPUTER SCIENCE STREAM

18CSC441 Soft Computing 3 1 0 4

Artificial Intelligence – a brief review – Pitfalls of traditional AI – Why Computational Intelligence? – Computational intelligence concept - Importance of tolerance of imprecision and uncertainty - Constituent techniques – Overview of Artificial Neural Networks, Fuzzy Logic, Evolutionary Computation.

Neural Network: Biological and artificial neuron, neural networks, supervised and unsupervised learning. Single layer Perceptron, Multilayer Perceptron – Back propagation learning. Neural networks as associative memories - Hopfield networks, Bidirectional Associative Memory. Topologically organized neural networks – competitive learning, kohonen maps.

Fuzzy Logic: Fuzzy sets, properties, membership functions, fuzzy operations. Fuzzy logic and fuzzy inference and applications, Evolutionary Computation - constituent algorithms, Swarm intelligence algorithms - Overview of other bio-inspired algorithms - Hybrid approaches (neural networks, fuzzy logic, genetic algorithms etc.)

Course Outcomes:

CO1: Understand the architecture and functionalities of modern OS

CO2: Understand and apply the algorithms for resource management and scheduling

CO3: Analyze and Apply semaphores and monitors for classical and real world synchronization scenarios

CO4: Engage in independent learning as a team to study characteristic features of modern operating systems

CO5: Apply improved algorithmic approaches to application scenarios.

TEXTBOOKS:

1. *Kumar S, "Neural Networks - A Classroom Approach", Tata McGraw Hill, 2004.*
2. *Konar. A, "Computational Intelligence: Principles, Techniques and Applications", Springer Verlag, 2005*

REFERENCES:

1. *Engelbrecht, A.P, "Fundamentals of Computational Swarm Intelligence", John Wiley & Sons, 2006.*
2. *Ross T J, "Fuzzy Logic with Engineering Applications", McGraw Hill, 2002.*
3. *Eiben A E and Smith J E, "Introduction to Evolutionary Computing", Second Edition, Springer, Natural Computing Series, 2007.*
4. *Jang J S R and Sun C T, Mizutani E, "Neuro - Fuzzy and Soft Computing", PHI, 2002.*

18CSC442 Cryptography 3 0 0 3

Stream ciphers: Pseudo-random generators, Attacks on the one time pad, Linear generators, Cryptanalysis of linear congruential generators, The subset sum generator, Case study: *cryptanalysis of the DVD encryption system*. Block ciphers: Pseudorandom functions and permutations (PRFs and PRPs), PRP under chosen plaintext attack and chosen ciphertext attack, Case study: *DES, AES, modes of operation*. Message integrity: Cryptographic hash functions, message authentication code, CBC MAC and its security, Cryptographic hash functions based MACs, Case study: *SHA512, SHA3, Merkle trees*. Authenticated Encryption-Authenticated encryption ciphers from generic composition, Public key encryption: RSA, Rabin, Knapsack cryptosystems, Diffie-Hellman key exchange protocol, ElGamal encryption, Elliptic curve cryptography. Digital signatures: Generic signature schemes, RSA, ElGamal and Rabin's signature schemes, blind signatures, threshold signature schemes, ECDSA, Signcryption.

TEXT BOOKS/REFERENCES:

1. A. J. Menezes, P. C. V. Oorschot and S. A. Vanstone, *Handbook of Applied Cryptography*, CRC Press, 1996.
2. O. Goldreich, *Foundations of Cryptography:* Vol. 1, *Basic Tools*, Cambridge University Press, 2001.
3. O. Goldreich, *Foundations of Cryptography:* Vol. 2, *Basic Applications*, Cambridge University Press, 2004.
4. J. Katz and Y. Lindell, *Introduction to Modern Cryptography*, Chapman & Hall/CRC, 2007.
5. Abhijit Das and VeniMadhavan C. E., *Public-Key Cryptography: Theory and Practice*, Pearson Education India, 2009.
6. Abijit Das, *Computational Number theory*,CRC Press, 2013.
7. Dan Boneh and Victor Shoup, *A Graduate Course in Applied Cryptography*,V4, 2017

18CSC443 Business Analytics 3 0 0 3

Overview of Business Analytics. Introduction to Analytics. Davenport article - "Competing on Analytics". LaValle et al. article - "Analytics: The New Path to Value"II.

Visualization/ Data Issues•Organization/sources of data. Importance of data quality. Dealing with missing or incomplete data. Data Classification. Davenport and Harris article - "The Dark Side of Customer Analytics"III. Introduction to Data Mining. Introduction to Data Mining. Data Mining Process. Data mining tool XLMiner (Excel add-in – free 15 day trial available at www.solver.com/xlminer-data-mining). Loveman article – "Diamonds in the Data Mine". Market Basket Analysis. Classification and Regression Trees. Introduction to Decision Modeling. Optimization Use of Excel to solve business problems: e.g. marketing mix, capital budgeting, portfolio optimization. Decision

Making under Uncertainty Simulation. Problems in inventory management, capital investment analysis, market share estimation, sensitivity analysis.

Text / Reference books:

1. S. Christian Albright and Wayne L. Winston, Business Analytics: Data Analysis & Decision Making, 5th edition, Cangage Learning, 2015.
2. PurbaHaladyRao, Business Analytics: An Application Focus, PHI, 2013.

18CSC444 DEEP LEARNING FOR IMAGE PROCESSING 3 0 0 3

Unit1

Mathematical Background for Image Processing: Review of Vectors and Matrices - Review of Probability and statistics. Digital Image Fundamentals: Elements of Visual Perception- Image Sensing and Acquisition – Image Sampling and Quantization – Basic Relationships between Pixels- Image interpolation. Intensity Transformations and Spatial Filtering: Basic Intensity transformation Functions – Histogram Processing – Fundamentals of Spatial Filtering – Smoothing and Sharpening Spatial Filters.

Unit2

Filtering in Frequency Domain: 2D Discrete Fourier Transforms - Basics of filtering - Image Smoothing and Image Sharpening Using Frequency Domain Filters- Selective Filtering, Image Restoration: Noise Models – Restoration using Spatial Filters – Periodic Noise Reduction by Frequency Domain Filters.

Unit 3

Morphological Image Processing: Erosion – Dilation – Opening – Closing – Hit-or-Miss Transform- Extraction of Connected Components. Image Segmentation: Fundamentals – Point, Line and Edge Detection – Thresholding- Region Based Segmentation – Region Growing – Region Splitting and Merging. Color image processing.

TEXTBOOK:

Gonzalez R C and Woods R E, "Digital Image Processing", Third Edition, Pearson Education, *2009.*

REFERENCES:

1. *Pratt W K, "Digital Image Processing", Fourth Edition, John Wiley & Sons, 2007.*
2. *Castleman K R, "Digital Image Processing", Prentice Hall, 1996.*
3. *Gonzalez, Woods and Eddins, "Digital Image Processing Using MATLAB", Prentice Hall, 2004.*
4. *Russ J C, "The Image Processing Handbook", CRC Press, 2007.*

18CSC445 Predictive Analytics 3 0 0 3

Course Objectives:

1. Gain understanding of the computational foundations in Big Data Science.
2. Develop critical inferential thinking.
3. Gather a tool chest of R libraries for managing and interrogating raw and derived, observed, experimental, and simulated big healthcare datasets.
4. Possess practical skills for handling complex datasets.

Text / Reference book:

1. Dinov, ID. Data Science and Predictive Analytics: Biomedical and Health Applications using R, Springer, (2018).
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer.
3. Kevin Murphy, Machine Learning: a Probabilistic Perspective, MIT Press, 2012.

18CSC446 Mining of Massive Datasets 3 0 0 3

Basics of Data Mining - Computational Approaches - Statistical Limits on Data Mining - Bonferroni's Principle - MapReduce - Distributed File Systems . MapReduce . Algorithms Using MapReduce . Extensions to MapReduce. Finding Similar Items - Applications of Near-Neighbor Search - Shingling of Documents - Similarity-Preserving Summaries of Sets - Locality-Sensitive Hashing for Documents - Distance Measures

Mining Data Streams: The Stream Data Model - Sampling Data in a Stream - Filtering Streams. Link Analysis: PageRank - Efficient Computation of PageRank - Topic-Sensitive PageRank - Link Spam. Frequent Itemsets : The Market-Basket Model - Market Baskets and the A-Priori Algorithm - Handling Larger Datasets in Main Memory. Clustering: Introduction to Clustering Techniques - Hierarchical Clustering - K-means Algorithms – CURE algorithm.

Recommendation Systems: A Model for Recommendation Systems - Content-Based Recommendations - Collaborative Filtering - Dimensionality Reduction. Mining Social-Network Graphs: Social Networks as Graphs - Clustering of Social-Network Graphs - Direct Discovery of Communities - Partitioning of Graphs - Finding Overlapping Communities – Simrank. Dimensionality Reduction: Eigenvalues and Eigenvectors of Symmetric Matrices- Principal-Component Analysis - Singular-Value Decomposition . Large-Scale Machine Learning - Machine-Learning Model - Perceptrons - Support-Vector Machines .

Text Book

Jure Leskovec , Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2014.

References

Tom White, Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale , O'Reilly Media; 4 edition , 2015.

18CSC447 Data Compression 3 0 0 3

Compression techniques; Modeling and coding. Mathematical preliminaries for lossless compression: Overview; Basic concepts of Information Theory; Models; Coding; Algorithmic information theory; Minimum description length principle. Huffman coding: Overview; The Huffman coding algorithm, Minimumvariance Huffman codes; Application of Huffman coding for text compression.

Dictionary Techniques: Overview; Introduction; Static dictionary; Adaptive dictionary; Applications: UNIX compress, GIF, PNG, V.42. Lossless image compression: Overview; Introduction; Basics; CALIC; JPEG-LS; Multiresoution approaches; Facsimile encoding: Run-length coding, T.4 and T.6.

Some mathematical concepts: Overview; Introduction; Distortion criteria; Models. Scalar quantization: Overview; Introduction; The quantization problem; Uniform quantizer; Adaptive quantization.

Vector quantization: Overview; Introduction; Advantages of vector quantization over scalar quantization; The LBG algorithm. Differential Encoding: Overview; Introduction; The basic algorithm; Prediction in DPCM; Adaptive DPCM; Delta modulation; Speech coding; Image coding.

Wavelet based compression Fundamentals of wavelets, Various standard wavelet bases, Multi resolution analysis and scaling function, JPEG 2000.

Text Book:

1. Khalid Sayood, Morgan Kauffman, Introduction to Data Compression, 3rd Edition,
2. David Salomon, Giovanni Motta, Handbook of Data Compression, Springer.

18CSC448 Computer Networks 3 0 0 3

Fundamentals & Link Layer: Building a network –Requirements –Layering and protocols –Internet Architecture –Network software –Performance ; Link layer Services –Framing –Error Detection –Flow control.

Media Access & Internetworking: Media access control –Ethernet (802.3) –Wireless LANs –802.11 –Bluetooth –Switching and bridging –Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP).

Routing: Routing (RIP, OSPF, metrics) –Switch basics –Global Internet (Areas, BGP, IPv6), Multicast –addresses –multicast routing (DVMRP, PIM).

Transport Layer: Overview of Transport layer –UDP –Reliable byte stream (TCP) –Connection management –Flow control –Retransmission –TCP Congestion control –Congestion avoidance (DECbit, RED) –QoS –Application requirements

Application Layer:Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) –HTTP – Web Services.

Text / Reference books:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011
2. James F. Kurose, Keith W. Ross, "Computer Networking –A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
3. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: AnOpen Source Approach",McGraw Hill Publisher, 2011.

18CSC449 IoT Workshop 3 0 0 3

Unit - 1

Introduction to loT - loT definition - Characteristics - Things in lot - loT Complete Architectural Stack - loT enabling Technologies - loT Challenges - loT Levels - A Case Study to realise the stack.

Sensors and Hardware for loT - Accelerometer, Proximity Sensor, lR sensor, Gas Sensor,Temperature Sensor, Chemical Sensor, Motion Detection Sensor.Hardware Kits - Arduino,Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors (Lab Component)

Unit - 2

Protocols for loT - infrastructure protocol IPV4/V6|RPL), Identification (URLs), Transport (Wi-Fi, Li-Fi, BLE), Discovery, Data Protocols, Device Management Protocols. - A Case Study with MQTT/CoAP usage. (Lab Component)

Cloud and Data analytics- Types of Cloud - loT with cloud challenges - Selection of cloud for IoT applications - Fog computing for loT - Edge computing for loT - Cloud security aspects for loT applications - RFM for Data Analytics - Case study with AWS / AZURE / Adafruit / IBM Bluemix (Lab Component).

Unit - 3

Case studies with architectural analysis:

loT applications - Smart City - Smart Water - Smart Agriculture - Smart Energy - Smart Healthcare - Smart Transportation - Smart Retail -Smart waste management . (Lab Component - As a project)

Course Outcomes:

CO1: Understand the key techniques and theory behind Internet of Things.
CO2: Apply effectively the various enabling technologies (both hardware and software) for IoT.
CO3: Understand the integration of Cloud and IoT , Edge and Fog Computing.
CO4: Apply various techniques for Data Accumulation, Storage and Analytics.
CO5: Design and build IoT system for any one interesting Use case

Text and Reference Books

1. "lnternet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (UniversitiesPress)
2. lnfosys Training E Materials.

3. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases',, by pethuru Rajand Anupama C. Raman (CRC press)
4. Adrian McEwen, Designing the internet of Things, Wiley (B November 2Ot3), ISBN-13:978-.11-L1,8430620,
5. NPTEL Reference :https://onlinecourses.nptel.ac.in/noc17_cs22/preview

18CSC450 Introduction to Embedded Systems 3 0 0 3

Unit 1

Architecture of Microprocessors: General definitions of computers, micro-processors, micro controllers and digital signal processors.
Overview of Microcontrollers- Introduction to 8051 microcontroller, General Architecture of a MCU and more specific to 8051 family MCUs, Pin diagram of 8051 MCU and various control signals, Various addressing modes of 8051, 8051 Instruction Set and Programming -Data Movement, Arithmetic & Logical, Control instructions with example programs, 8051 Interfacing with peripherals - Simple IO devices and sensor devices interfacing with 8051 MCU, Timer / counter modules and interrupts in 8051, RS232 based serial Communication using 8051

Unit 2

ARM Architecture: RISC Machine, Architectural Inheritance, Programmers model. ARM Organization and Implementation. 3 Stage pipeline, 5 Stage pipeline, ARM Instruction execution,ARM Implementation, Co-processor interface, ARM Assembly language Programming, Data processing instructions, Data Transfer Instructions, Control flow instructions, Architectural support for high level programming, Thumb Instruction set.

Unit 3

Interrupt structure of 8086 and ARM: Vector interrupt table, Interrupt service routines. Introduction to DOS and BIOS Interrupts for 8086. Asynchronous and Synchronous data transfer schemes, ARM memory interface, AMBA interface, A/D Converters, PWM, timer / counter, UART and its interfacing – Application development using Keil IDE.

Text Book:

1.Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay - 8051 Microcontroller and Embedded Systems, The, 2nd Edition - 2006 - pearson
1. Steve Furber “ARM System on chip Architecture” , Second edition, Addidon Wesley, 2000

References:

1) Douglas Hall, Microprocessors and its Interfacing (SIE), McGraw Hill Education (India), 3rd Ed., 2012.

2) Kenneth Ayala - The 8051 Microcontroller & Embedded Systems Using Assembly and C 1st Edition
3) Arnold S. Berger, "Embedded System Design", CMP Books, USA 2002.
4) Michael Barr, "Programming Embedded Systems with C and GNU‖, O Reilly, 2003.

18CSC451 INFORMATION RETRIEVAL 3 0 0 3

Unit 1

Boolean Retrieval – The term vocabulary and postings lists – Dictionaries and tolerant retrieval – Index construction – Index compression – Scoring, term weighting and the vector space model – Evaluation in Information retrieval.

Unit 2

Relevance feedback and query expansion – XML retrieval – Probabilistic information retrieval – Text classification – Vector space classification – Clustering – Matrix decomposition and latent semantic indexing.

Unit 3
Web search basics – Web crawling and indexes – Link analysis.

TEXTBOOK:

Manning C D., Raghavan P a ndSchutze H., "Introduction to Information Retrieval", Cambridge University Press, 2008

REFERENCES:

1. R.Baeza-Yates and B. RibeiroNeto, "Modern Information Retrieval: The Concepts and Technology behind Search", Second Edition, Addison Wesley, 2011
2. David A.Grossman and OphirFrieder,"Information Retrieval: Algorithms and Heuristics", Second Edition, Springer 2004.

18CSC452 Social Network Analytics 3 0 0 3

Unit 1 : Online Social Networks (OSNs)

Introduction - Types of social networks (e.g., Twitter, Facebook), Measurement and Collection of Social Network Data. Techniques to study different aspects of OSNs -- Follower-followee dynamics, link farming, spam detection, hashtag popularity and prediction, linguistic styles of tweets. Case Study: An Analysis of Demographic and Behaviour Trends using Social Media: Facebook, Twitter and Instagram

Unit 2: Fundamentals of Social Data Analytics

Introduction - Working with Social Media Data, Topic Models, Modelling social interactions on the Web – Agent Based Simulations, Random Walks and variants, Case Study: Social Network Influence on Mode Choice and Carpooling during Special Events: The Case of Purdue Game Day

Unit 3 : Applied Social Data Analytics

Application of Topic models, Information Diffusion, Opinions and Sentiments - Mining, Analysis and Summarization, Case Study: Sentiment Analysis on a set of Movie Reviews using Deep Learning techniques, Recommendation Systems, Language dynamics and influence in online communities, Community identification, link prediction and topical search in social networks, Case Study: The Interplay of Identity and Social Network: A Methodological and Empirical Study

Text and Reference Literature

1. Cioffi-Revilla, Claudio. *Introduction to Computational Social Science*, Springer, 2014.
2. Matthew A. Russell. *Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More*, 2nd Edition, O'Reilly Media, 2013.
3. Robert Hanneman and Mark Riddle. *Introduction to social network methods.* Online Text Book, 2005.
4. Jennifer Golbeck, *Analyzing the social web*, Morgan Kaufmann, 2013.
5. Claudio Castellano, Santo Fortunato, and Vittorio Loreto, *Statistical physics of social dynamics*, Rev. Mod. Phys. 81, 591, 11 May 2009.
6. S. Fortunato and C. Castellano, *Word of mouth and universal voting behaviour in proportional elections*, Phys. Rev. Lett. 99, (2007).
7. Douglas D. Heckathorn, *The Dynamics and Dilemmas of Collective Action*, American Sociological Review (1996).
8. Michael W. Macy and Robert Willer, *From factors to actors: Computational Sociology and Agent-Based Modeling,* Annual Review of Sociology Vol. 28: 143-166 (2002).
9. Nilanjan Dey Samarjeet Borah Rosalina Babo Amira Ashour, *Social Network Analytics - Computational Research Methods and Techniques, First Edition,* eBook ISBN: 9780128156414, Paperback ISBN: 9780128154588, Imprint: Academic Press, Published Date: 23rd November 2018

18CSC453 Big Data Storage and Analysis 3 0 0 3

Unit 1

Introduction: Scaling with Traditional Databases - NoSQL need - First Princples – Desired Properties- Lambda Architectures. Batch Layer- Big data model – properties – fact based modeling – graph schemas – Apache Thrift,

Unit 2

Data Storage on Batch Layers – Requirements- Solutions- Distributed File Systems and Partitioning- Hadoop basics, Computing on Batch Layer- Algorithms-Scalability-MapReduce, Batch Layer Architecture and Algorithms – Design Overview and Workflow, Ingesting New Data, Normalization.

Unit 3

Serving Layer- Performance Metrics, Requirements and Design, ElephantDB. Speed Layer- Realtime Views, Cassandra basics, Query and Stream Processing , Apache Storm

TEXT BOOKS:

1. Nathan Marz, James Warren, "Big Data: Principles and best practices of scalable real-time data systems", Manning Publications 2015.

REFERENCES:

1. Tom White, "Hadoop – The Definitive Guide", O′Reilly; 3 edition (12 June 2012)

Randy Abernethy, "Programmer's Guide to Apache Thrift", Manning Publications, 2019

https://thrift.apache.org/

2. Jeff Carpenter, Eben Hewitt, "Cassandra: The Definitive Guide: Distributed Data at Web Scale", 2nd Edition, O'Reilly, 2016

3. Ankit Jain, "Mastering Apache Storm", Packt Publishing, 2017

https://www.elephantsql.com/

18CSC454 Probabilistic Graphical Models 3 0 0 3

The aim of this course is to develop the knowledge and skills necessary to effectively design, implement and apply these models to solve real problems. The course will cover (a) Bayesian and Markov (MRF) networks; (b) exact and approximate inference methods; (c) estimation of both the parameters and structure of graphical models.

Text Book: 1. Daphne Koller and Nir Friedman, *Probabilistic Graphical Models: Principles and Techniques* MIT Press, 2018.

Reference Book:

1. Martin J. Wainwright and Michael I. Jordan, *Graphical models, exponential families, and variational inference*, 2018.
2. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective, 2018*.

19CSE Computer Networks 3 0 0 3

FUNDAMENTALS & LINK LAYER : Building a network – Requirements – Layering and protocols – Internet Architecture – Network software – Performance ; Link layer Services – Framing – Error Detection – Flow control.

MEDIA ACCESS & INTERNETWORKING. Media access control – Ethernet (802.3) – Wireless LANs – 802.11 – Bluetooth – Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)

ROUTING: Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)

TRANSPORT LAYER: Overview of Transport layer – UDP – Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements.

APPLICATION LAYER: Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP .

TEXT BOOK:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach",Mc Graw Hill Publisher, 2011.

LANGUAGES

18HIN101 HINDI I 1-0-2[2cr]

Unit-1

a)Introduction to Hindi Language, -other Indian Language's, Official Language, link Language Technical terminology..
b) Hindi alphabet: ParibhashaAurBhed.
c) Shabda: ParibhashaAurBhed, RoopantharkiDrishti se
d) Sangya -ParibhashaAurBhed,SangyakeRoopanthar-ling, vachan, karak
e) Sarvanaam- ParibhashaAurBhed.

Unit-2

a) Common errors and error corrections in Parts of Speech –with emphasis on use of pronouns, Adjective and verb in different tenses –gender& number
b) Conversations, Interviews, Short speeches.

Unit -3

a) Letter writing –ParibhashaAurBhed, Avedanpatra (request letter) & Practice
b) Translation-ParibhashaAurBhed, English to Hindi

Unit- 4

Peom :
a) Maithilisharangupth: sakhivemujsekahakarjaate
b) Suryakanthtripatinirala :Priyatam
c) Mahadevivarma- adhikaar
d) Shiyaramsharangupth:ekphoolkichah

Unit- 5

Kahani
a) Kafan - Premchand ,
b) Rajasthan kiEkGaavkeetheerthyatra -Beeshmasahni
c) Raychandrabhai :ByMahathma Gandhi - Sathyakeprayog
d) Rajani -Mannu Bhandari

18HIN111 HINDI II 1-0-2[2cr]

Unit -1

a) Visheshan- ParibhashaAurBhed.special usage of adverbs, changing voice and conjunctions in sentences.
b) kriya- ParibhashaAurBhed, rupantharkidrushti se-kaal
c) padhparichay.
d) VigyapanLekhan (Advertisement writing), Saar Lekhan (Precise writing).

Unit -2

Communicative Hindi – MoukhikAbhivyakthi –understanding proper pronunciation, Haptics …etc in Interviews ,short speeches .

Unit -3

Film review,Audio –Visual-Media in Hindi – Movies appreciation and evaluation.News reading and presentations in Radio and Tv channels in Hindi, samvaadhlekhan,

Unit -4

a) Harishankarparasaiyi- SadacharkaThavis
b) Jayashankarprasadh – Mamata
c) Mannubandari- Akeli
d) Habibtanvir- Karthus

Unit -5

KavyaTarang

a) Himadrithungshrung se (poet- Jayasankarprasad)
b) Dhabba (poet- kedarnath sing) ,
c) Proxy (poet- Venugopal),
d) Machis(poet –Suneeta Jain) ,
e) Vakth. (poet – Arunkamal)
f) Fasal (poet- SarveshwarDayalSaxena)

18KAN101 KANNADA I 1-0-2[2cr]

- To enable the students to acquire basic skills in functional language.
- To develop independent reading skills and reading for appreciating literary works.
- To analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech

UNIT – 1

- Railway Nildanadalli – K. S. NarasimhaSwamy
- Amma, AacharaMattuNaanu – K. S. NisarAhamad
- KeregeHaara – Janapada
- Simhaavalokana – H.S. Shivaprakash

UNIT – 2

- DhanwantriChikitse - Kuvempu
- Mouni - Sethuram
- MeenakshiManeyaMestru - Kuvempu

UNIT – 3

- Sukha –H.GSannaguddayya
- Mobile ThenkaraJen NonagalaJhenkara – NageshHegade
- NammaYemmegeMaatuTiliyitu – GoruruRamaswamyIyangar

UNIT – 4

Language structure

- Usage of punctuation marks
- Introduction to words (right usage)
- Reading skills
- Sentence formation (simple & complex)
- Translation- English to Kannada

References:

1. Kannada SamskrutiKosha – Dr. Chi. C Linganna
2. Kannada SannaKathegalu – G H Nayak
3. Lekhana Kale – N. Prahlad Rao
4. Kannada SahithyaCharithre – R. Sri Mugali

18KAN111 KANNADA II 1-0-2[2cr]

Objectives:

- To enable the students to acquire basic skills in functional language.
- To develop independent reading skills and reading for appreciating literary works.
- To develop functional and creative skills in language.
- To enable the students to plan, draft, edit & present a piece of writing.

UNIT – 1

- BettadaMelonduManeyaMaadi – AkkaMahadevi
- ThallanisadiruKandya – Kanakadasa
- Avva – P. Lankesh
- Neevallave – K. S. NarasimhaSwamy

UNIT – 2

Gunamukha – Drama by P. Lankesh

UNIT – 3

Karvalo – Novel by PoornachandraThejaswi

UNIT – 4

Letter Writing –

Personal (congratulation, invitation, condolence etc.)

- Official (To Principal, Officials of various departments, etc.,)
- Report writing
- Essay writing
- Precise writing

Prescribed text:

1. Gunamukha by P. Lankesh(LankeshPrakashana)
2. Karvalo by PoornachandraThejaswi (Mehtha publishing house)

Reference

1. SaamanyanigeSahithyaCharitre (chapter 1 to 10) – Bangalore University Publication
2. Hosa Kannada SaahithyaCharithre – L.S Sheshagiri Rao
3. KacheriKaipidi – Kannada AdhyayanaSamsthe (Mysuru University)
4. Kannada SahithyaCharithre – R. Sri Mugali
5. H.S.Krishna Swami Iyangar – *Adalitha Kannada – Chetana Publication, Mysuru*

18MAL101 Malayalam I

Unit 1

Ancient poet trio:*Adhyatmaramayanam,LakshmanaSwanthanam (Lines: valsasoumitre… mungikidakayal),*Ezhuthachan -Medieval period classics – *Jnanappana(Lines:201 to 298*),Poonthanam.

Unit 2

Modern Poet trio: *EnteGurunathan,* VallatholNarayanaMenon- Critical analysis of the poem.

Unit 3

Short stories from period 1/2/3:*Poovanpazham*-VaikaomMuhammedBasheer-Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: *BharathaParyadanam-VyasanteChiri*–Ithihasa studies-KuttikrishnaMararu-Outline of literary Criticism in Malayalam Literature-Introduction to KuttikrishnaMararu& his outlook towards literature &life.

Unit 5

Error-freeMalayalam: **1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha
Malayalam – Writing-**a**. Expansion of ideas; **b**.PrecisWriting; **c**. Essay Writing; **d**.Letter writing; **e**.RadioSpeech;**f**.Script/Feature/Script Writing;**g**.NewsEditing;**h**.Advertising;**i.**Editing;j.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

18MAL111 Malayalam II

Unit 1

Ancient poet trio: *Kalayanasougandhikam,(Lines: kallummarangalum… namukkennarikavrikodara),*KunjanNambiar - Critical analysis of his poetry-Ancient Drama: *Kerala Sakunthalam* (Act 1), Kalidasan (Transilated by Attor Krishna Pisharody).

Unit 2

Modern/romantic/contemporary poetry: *Chandanakkattil* –G.Sankarakurupu-Romanticism – modernism.

Unit 3

Memoirs from Modern Poets: *Theeppathi*, Balachandran Chullikkadu-literary contributions of his time.

Unit 4

Partof an autobiography/travelogue: *KannerumKinavum*, Chapter: ValarnnuVarunnoratmavu, V.T.Bhattathirippadu-Socio-cultural literature-historical importance.

Unit 5

Error-free Malayalam-**1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha Malayalam-Writing-**a**.Expansion of ideas;**b**.PrécisWriting;**c.** Essay Writing; **d**.Letter writing;**e**.RadioSpeech;**f**.Script/Feature/ScriptWriting;**g**.NewsEditing;**h.**Advertising;**i**.Editing; **j**.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

18SAN101 SANSKRIT I 1-0-2[2cr]

To familiarize students with Sanskrit language and literature.

To read and understand Sanskrit verses and sentences.

Self-study of Sanskrit texts and to practice communication in Sanskrit.

To help the students imbibe values of life and Indian traditions propounded by the scriptures.

To be able to speak in Sanskrit.

Module I

Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit.

(7 hours)

Module II

Verbs- Singular, Dual and plural — First person, Second person, Third person.

Tenses – Past, Present and future – Atmanepadi and parasmaipadi-kartharipraYoga.

(8hrs)

Module III

Words for communication and moral stories.

(4 hrs)

Module IV

Chanakya Neethi first chapter (first 15 Shlokas)

(6 hrs)

Module V

Translation of simple sentences from Sanskrit to English and vice versa.

(5hrs)

18SAN111 SANSKRIT II 1-0-2[2cr]

Module I

Seven cases, Avyayas, sentence making with Avyayas, Saptha kakaras.

(5hrs)

Module II

Kthavathu' Prathyayam, Upasargas, Kthvatha,Thumunnantha, Lyabantha Prathyayam. Three Lakaras – brief introduction, Lot lakara

(5hrs)

Module III

New words and sentences for the communication, Slokas, moral stories(panchathanthra) Subhashithas, riddles (Selected from the Pravesha Book)

(5hrs)

Module IV

Introduction to classical literature, classification of Kavyas, classification of Dramas - Important five Maha kavyas

(5hrs)

Module V

Translation of paragraphs from Sanskrit to English and wise -verse

(5hrs)

Module VI

Bhagavad - Geeta fourteenth chapter (all 27 Shlokas)

(5hrs)

Essential Reading:

1. Praveshaha; Publisher : Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085
2. Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad
3. PrakriyaBhashyamwritten and published by Fr. John Kunnappally

4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5. Sabdamanjari, R.S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7. SubhashitaRatnaBhandakara by Kashinath Sharma, published by Nirnayasagarpress