

The Post Graduate Board of Studies
(PG BOS) held on 9th July 2026 in the
Department of ICT.

SCHEME AND SYLLABI
of
TWO YEAR POSTGRADUATE PROGRAMME
M.Sc.
in
COMPUTER SCIENCE



WITH EFFECT FROM THE

SESSION
(2025-26)

Chaudhary Bansi Lal University,

Prem Nagar-127031

Bhiwani

HARYANA, INDIA

Structure for Two Year Post Graduate Programme

	Scheme	Semester	Courses				Total Credits
			Core Courses	Elective Courses	Dissertation/ Project work/ Apprenticeship /internship etc.	Value Added Course/ Employability & Entrepreneurship Skills Course	
First Year (Semester I and II)of 2 years PG program (NHEQFlevel6)							
	PG	I	CC-14 Credits CC-24 Credits CC-34 Credits CC-44 Credits	DEC-14 credits		--	20
	PG	II	CC-54 Credits CC-64 Credits CC-74 Credits CC-84 Credits	DEC-24 credits		IKS/OEC 2 credits	22
SecondYear(SemesterIIIandIV)of2yearPGprogram(NHEQFlevel6.5)(ForUTDandaffiliated colleges)							
OptionI	PG-I	III	CC-94 Credits CC-104 Credits CC-114 Credits	DEC-34 Credits DEC-44 Credits		EEC 2 Credits	22
	PG-I	IV	CC-124 Credits CC-134 Credits	DEC-54 Credits DEC-64 Credits DEC-74 Credits			20
OptionII:WhenastudentoptsforDissertation/ProjectWork/Internship/ResearchWork/ Apprenticeship/ Field work etc.							
OptionII	PG-II	III	CC-94 Credits CC-104 Credits CC-114 Credits	DEC-34 Credits DEC-44 Credits		EEC 2 Credits	22
	PG-II	IV		DEC-54 Credits DEC-64 Credits	12 Credits		20

For the 1st

Structure for One Year Post Graduate Programme

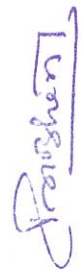
	Scheme	Semester	Courses					Total Credits
			Core Courses	Elective Courses	Dissertation/ Project work/ Apprenticeship /internship etc.	Research Thesis	Value Added Course/ Employability & Entrepreneurship Skills Course	
Option I	PG-I	III	CC-94Credits CC-104Credits CC-114Credits	DEC-34Credits DEC-44Credits			EEC 2 Credits	22
	PG-I	IV	CC-124 Credits CC-134Credits	DEC-54Credits DEC-64Credits DEC-74Credits				20
Scheme of Semester IV when a student opts for Dissertation or Project Work								
Option II	PG-II	III	CC-94Credits CC-104Credits CC-114Credits	DEC-34Credits DEC-44Credits			EEC 2 Credits	22
	PG-II	IV		DEC-54Credits DEC-64Credits	12 Credits			20
Option(III):For students opts only Research work (ForUTD'sonly)								
Option III*	PG-III	III				20 Credits	EEC 2 Credits	22
	PG-III	IV				20 Credits		20

***Option III is only for those students who have completed 4 years UG (Hons with Research) subject to the future prospective of Research)**

For the year

Scheme and Syllabus of Two Year Post Graduate Programme M.Sc. in Computer Science w.e.f. 2025-26

Courses	Nomenclature of Course	Course Code	Credits Distribution			Total Credits	Total Contact Hours			Marks				Total Marks	
							L	T	P	Theory		Practical			
										Internal	External	Internal	External		
SEMESTER-I															
CC-1@4credits	Mathematical Foundation of Computing	25MCS101	4	0	0	4	4	0	0	30	70	-	-	100	
CC-2@4credits	Data Structure using C	25MCS102	3	0	1	4	3	0	2	20	50	10	20	100	
CC-3@4credits	Database Management System	25MCS103	3	0	1	4	3	0	2	20	50	10	20	100	
CC-4@4credits	Fundamental of Web Designing	25MCS104	3	0	1	4	3	0	2	20	50	10	20	100	
PC-1@3credits	Office Automation Tools	25MCS105	0	0	3	3	0	0	6	-	-	20	50	70	
Any one of the following															
DEC-1@4 credits	Computer Architecture and Organization	25MCS106	4	0	0	4	4	0	0	30	70	-	-	100	
	Design and Analysis of Algorithms	25MCS107	4	0	0	4	4	0	0	30	70	-	-	100	
SEMESTER-II															
CC-5@4credits	Operating Systems	25MCS201	3	0	1	4	3	0	2	20	50	10	20	100	
CC-6@4 credits	Object Oriented Programming using C++	25MCS202	3	0	1	4	3	0	2	20	50	10	20	100	
CC-7@4 credits	Computer Networking	25MCS203	4	0	0	4	4	0	0	30	70	-	-	100	
CC-8@4 credits	Artificial Intelligence	25MCS204	4	0	0	4	4	0	0	30	70	-	-	100	
PC-2@3 credits	Programming in MATLAB	25MCS205	0	0	3	3	0	0	6	-	-	20	50	70	
Any one of the following															
DEC-2@4 credits	Data Mining	25MCS206	4	0	0	4	4	0	0	30	70	-	-	100	
	Linux Administration	25MCS207	4	0	0	4	4	0	0	30	70	-	-	100	
IKS/ DEC @2credits	Indian Knowledge System in Computer Science	25MCS208	2	0	0	2	2	0	0	15	35	-	-	50	
SEMESTER-III(for option I and II)															
CC-9@4 credits	Python Programming	25MCS301	3	0	1	4	3	0	2	20	50	10	20	100	
CC-10@4 credits	Software Engineering	25MCS302	4	0	0	4	4	0	0	30	70	-	-	100	
CC-11@4credits	Computer Graphics	25MCS303	3	0	1	4	3	0	2	20	50	10	20	100	



PC-3@3 credits	Data Analysis using R	25MCS304	0	0	3	3	0	0	6	-	20	50	70
Any one of the following													
DEC-3@4 credits	Internet of Things	25MCS305	4	0	0	4	4	0	0	30	70	-	100
	Management of Information System and E-commerce	25MCS306	4	0	0	4	4	0	0	30	70	-	100
	Mobile Ad-hoc Network	25MCS307	4	0	0	4	4	0	0	30	70	-	100
Any one of the following													
DEC-4@4 credits	Machine Learning	25MCS308	4	0	0	4	4	0	0	30	70	-	100
	Soft Computing	25MCS309	4	0	0	4	4	0	0	30	70	-	100
SEC@2 Credits	Seminar	25MCS310	2	0	0	2	2	0	0	--	15	35	50
SEMESTER-III (for option III)													
Research Thesis@20 credits	Research Thesis	25MCS311	0	0	20	20	*	-	-	-	150	350	500

SEMESTER-IV (for option I)

CC-12@4 credits	Cloud Computing	25MCS401	4	0	0	4	4	0	0	30	70	-	100
CC-13@4 credits	Java Programming	25MCS402	3	0	1	4	3	0	2	20	50	20	100
PC-4@3 credits	Major Project	25MCS403	0	0	3	3	0	0	6	-	20	50	70
Any one of the following													
DEC-5@4 credits	Software Testing	25MCS404	4	0	0	4	4	0	0	30	70	-	100
	Big Data Analytics	25MCS405	4	0	0	4	4	0	0	30	70	-	100
	Computer Security	25MCS406	4	0	0	4	4	0	0	30	70	-	100
Any one of the following													
DEC-6@4 credits	Blockchain Technologies	25MCS407	4	0	0	4	4	0	0	30	70	-	100
	Mobile and Wireless Networks	25MCS408	4	0	0	4	4	0	0	30	70	-	100
	Data Visualization Techniques	25MCS409	4	0	0	4	4	0	0	30	70	-	100
Any one of the following													
DEC-7@4 credits	Theory of Computation	25MCS410	4	0	0	4	4	0	0	30	70	-	100
	Compiler Design	25MCS411	4	0	0	4	4	0	0	30	70	-	100
	Cyber Security and Cyber Laws	25MCS412	4	0	0	4	4	0	0	30	70	-	100

SEMESTER-IV (for option II)

Any one of the following

DEC-5@4 credits	Software Testing	25MCS404	4	0	0	4	4	0	0	0	30	70	-	-	100
	Big Data Analytics	25MCS405	4	0	0	4	4	0	0	0	30	70	-	-	100
	Computer Security	25MCS406	4	0	0	4	4	0	0	0	30	70	-	-	100

Any one of the following

DEC-6@4 credits	Blockchain Technologies	25MCS407	4	0	0	4	4	0	0	0	30	70	-	-	100
	Mobile and Wireless Networks	25MCS408	4	0	0	4	4	0	0	0	30	70	-	-	100
	Data Visualization & Interpretation	25MCS409	4	0	0	4	4	0	0	0	30	70	-	-	100
Research Project/ Internship @12 credits	Project/Internship	25MCS413	0	0	12	12		*			-	100	200		300

SEMESTER-IV (for option III)

Research Thesis @ 20 credits	Research Thesis	25MCS414	0	0	20	20		*			-	-	150	350	500
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Semester: 3

Name of the Course (CC 9) (3+1 credits)	Python Programming	Course Code	25MCS301
Maximum Marks	Theory:20(Internal)+50(External)=70	Time of Examination	03 Hours
Note: Examiner will set seven questions and the candidates will be required to attempt four questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.			
Course Learning Outcomes(CLO): - To learn how to design and program Python applications - To learn how to build and package Python modules for reusability. - To learn how to read and write files in Python. - To learn how to design object-oriented programs with Python classes. - To learn how to use class inheritance in Python for reusability. - To learn how to use exception handling in Python applications for error handling.			
Section-I Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.			
Section-II Types, Operators and Expressions: Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while break, continue, pass Data Structures Lists: Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions			
Section-III Functions: Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages			
Section-IV Object-Oriented Programming OOP in Python: Classes, 'self-variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing: Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.			
References: - Python Programming: A Modern Approach, VamsiKurama, Pearson - Learning Python, Mark Lutz, Orielly - Think Python, Allen Downey, Green Tea Press - Core Python Programming, W.Chun, Pearson. - Introduction to Python, Kenneth A. Lambert, Cengage			

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Name of the Course (CC 9) (4 credits)	Software Engineering	Course Code	25MCS302
Maximum Marks	Theory:30(Internal)+70(External)=100	Time of Examination	03 Hours
Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.			
Course Learning Outcomes(CLO): - To assist the student in understanding the basic theory of software engineering, and to apply these basic theoretical principles to a group software development project. - To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods. - To expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions.			
Section-I Software Engineering: Introduction - Software characteristics - Classification of Software - Phases in Software Engineering - Key challenges in Software Engineering. SDLC-Software Process, Project and Product - Components of Software Process- Process Framework - Process Assessment. Software Re-engineering, Software Reverse Engineering. Software Life Cycle Models: Waterfall, Prototype, Spiral Models, RAD Model			
Section-II Requirements Engineering: Requirement Elicitation - Elicitation techniques. Requirement analysis - Structured Analysis - DFD, Software Requirements Specification: Purpose of SRS, Structure of SRS. Software Design: Principles of Software Design- Software Design Concepts. Software Coding: Features of Software Code - Coding Guidelines- Coding Methodology. Code verification techniques.			
Section-III Software Testing: Basics of software testing, Testing objectives, Principles of testing, Testing and debugging, Test metrics and measurements, STLC, Verification, Validation, Software Quality and Reliability. Types of testing: Functional and non - functional Testing; system testing, recovery testing, security testing, stress testing, usability testing, White box testing and its types, Structural testing: Unit/Code functional testing, Black Box testing, Boundary value analysis, Equivalence partitioning, state/graph based testing, Alpha, Beta and Acceptance Testing: Acceptance criteria;			
Section-IV Software Maintenance Activities: Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Software Configuration Management Activities, Change Control Process, Software Reuse, Software Quality Attributes, Software Quality Assurance - plans & activities, Software Documentation.			
References: - Sommerville Ian: <i>Software Engineering</i>, Addison Wesley. - Hoffer, George: <i>Valacich, Modern System Analysis and Design</i>, Pearson Education. - Pressman S. Roger: <i>Software Engineering</i>, Tata McGraw-Hill. - Software Testing techniques: <i>BarisBeizer, Dreamtech</i>. - Tom Gilb: <i>Principles of Software Engineering Management</i>, Addison-Wesley. - Michael Dyer: <i>The Cleanroom approach to Quality Software Engineering</i>, Wiley & Sons.			

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Name of the Course (CC 10) (3+1 credits)	Computer Graphics	Course Code	25MCS303
Maximum Marks	Theory:20(Internal)+50(External)=70	Time of Examination	03 Hours
Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.			
Course Learning Outcomes(CLO): - To equip students with the fundamental knowledge and basic technical competence in the field of computer graphics. - To emphasize on implementation aspect of Computer Graphics Algorithms. - To prepare the student for advance areas like Image Processing or Computer Vision or Virtual Reality and professional avenues in the field of Computer Graphics			
Section-I			
Introduction to Computer Graphics: Computer Graphics and Its Types, Applications of Computer Graphics; Graphics Display Devices. Scan conversion: Scan converting a point, line (Bresenham's, DDA), 2-D transformations (Rotation, Rotation about an arbitrary line, Scaling, Translation, Shearing, Reflection, and Reflection about an arbitrary line), circle and ellipse. Transformation: Basic Transformation, Various 2D Transformation matrices (Translation, Rotation, Scaling, Shearing and Reflection), Composite transformations: Reflection, Shearing and Transformation between coordinate Systems.			
Section-II			
Bezier Curves and surfaces, Conditions for smoothly joining curve segments, Bezier bi-cubic surface patch, B Spline Curves, Cubic B-Spline curves using uniform knot vectors, first and second order continuities, Effect of multiple control points at same location, Geometrical Construction, Computing control points given end slopes for a specified curve segment. Transformations: 3-D Transformation, Computing location of V.P, 2-D viewing, Window-to view port transformation			
Section-III			
Clipping: Line Clipping; Sutherland Cohen clipping algorithms, Sutherland-Hodgeman. Projection: Parallel and Perspective Projections Solid Modeling: Sweeping a polygon or a surface patch along a path to form solids, Boundary Representation (B-Rep), Shading: Shading, Illumination Model for diffused Reflection, Effect of ambient lighting & distances, Specular Reflection Model, Computing Reflection Vector, Curved Surfaces, Polygonal Approximations, Gourard Shading, Phong Model. Hidden Surface Removal: Floating Horizon Method, Depth Buffer (Z-Buffer, A-Buffer) Method, Scan Line Method, Depth Sorting Method, BSP-tree Method, Area Subdivision Method.			
References: - Hearn, D., Baker, : Computer Graphics, Prentice Hall. - Plastock : Theory & Problem of Computer Graphics, Schaum Series. - Foley & Van Dam: Fundamentals of Interactive Computer Graphics, Addison-Wesley. - Newman : Principles of Interactive Computer Graphics, McGraw Hill. - Foley James D, "Computer Graphics", AW 2nd Ed.			

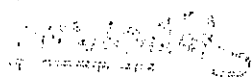
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Name of the Course (PC 3) (3 Practical credits)	Data Analysis using R	Course Code	25MCS304
Maximum Marks	Practical: 20(Internal)+50(External)=70		
Note: Examiner will set seven questions and the candidates will be required to attempt four questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.			
Course Learning Outcomes(CLO): • Master the use of the R interactive environment • Understand the different data types, data structures in R • Use R for mathematical operations • Understand the concepts of objects and assignment • Understand the concepts of vector and data types			
Introduction to R: R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes, R Programming Structures, Control Statements, Loops, Looping Over Non vector Sets, - If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return-Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion,			
Doing Math and Simulation in R: Math Function, Extended Example Calculating Probability-Cumulative Sums and Products-Minima and Maxima-Calculus, Functions for Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product-Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files			
Graphics: Creating Graphs, The Workhorse of R Base Graphics, the plot() Function Customizing Graphs, Saving Graphs to Files, Probability Distributions, Normal Distribution, Binomial Distribution, Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests, ANOVA Test			
Linear Models: Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests			
References: 1. R Cookbook, Paul Teetor, Oreilly. 2. R in Action, Rob Kabacoff, Manning 3. The Art of R Programming, Norman Matloff, Cengage Learning 4. R for Everyone, Lander, Pearson 5. Siegel, S. (1956), Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill International, Auckland. 6. Venables, W. N. and Ripley, B. D. (2000), S Programming, Springer-Verlag, New York. 7. Venables, W. N. and Ripley, B. D. (2002), Modern Applied Statistics with S, 4th ed., Springer-Verlag, New York.			

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Select any one of the following

Group- A



Name of the Course (DEC-3) (4 Theory credits)	Internet of Things	Course Code	25MCS305
Maximum Marks	Practical: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO):

- Students will understand the concepts of Internet of Things and can able to build IoT applications
- To learn different applications in IOT.
- To learn different protocols used in IOT.
- To learn the concepts of smart city development in IOT.
- To learn how to analysis the data in IOT

Section-I

FUNDAMENTALS OF IoT- Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects, IoT system building blocks

Section-II

IoT PROTOCOLS- IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, 6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.

Section-III

Challenges in IoT: Design challenges, Development challenges, Security challenges, Other challenges

Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Other IoT applications

Section-IV

Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M

IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi board detail

References:

1. Vijay Madiseti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014.
4. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI

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Name of the Course (DEC-4) (4 Theory credits)	Management of Information System and E-commerce	Course Code	25MCS306
Maximum Marks	Practical: 30(Internal)+70(External)=100	Time of Examination	3 Hours
Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.			
Course Learning Outcomes(CLO) • Explain the role of Management Information Systems in planning, controlling, and decision-making within organizations. • Identify and analyze organizational processes that can be improved using information systems. • Use information systems and decision-support tools to solve managerial and business problems. • Evaluate various e-commerce strategies and revenue models.			
Section-I Management Information System(MIS): Concept & definition, Role of MIS, Process of Management, MIS- A tool for management process, Impact of MIS, MIS & computers, MIS & the user, IMS- a support to the Management. Planning & Decision making: The concept of corporate planning, Strategic planning Type of strategic, Tools of Planning, MIS-Business Planning; Decision making concepts, Methods, tools and procedures, Organizational Decision making, MIS & Decision making concepts.			
Section-II Information &System: Information concepts, Information: A quality product classification of the information, Methods of data & information collection, Value of information, MIS &System concept, MIS & System analysis ,Computer System Design. : Development of MIS: Development of long range plans of the MIS. Ascertain the class of information, determining the Information requirement, Development and implementation of the MIS, Management of quality in the MIS, organization for development of the MIS, MIS: the factors of success and failure.			
Section-III E-commerce, E-business, Features of E-commerce, Pure vs. Partial E-commerce, History of E-commerce, E-commerce Framework (People, Public Policy, Marketing and Advertisement, Support Services, Business Partnerships), Types of E-commerce: B2C, B2B, C2B, C2C, M-Commerce, U-commerce, Social-Ecommerce, Local E-commerce, Challenges in E-commerce			
Section-IV E-payment System, Online Credit Card Transaction, Online Stored Value Payment System, Digital and Mobile Wallet, Smart Cards, Social/Mobile Peer-to-Peer Payment Systems, Digital Cash/e-cash, E-Checks, Virtual Currency, Electronic Billing Presentment and Payment (EBPP) System Security in E Commerce Threats in Computer Systems: Virus, Cyber Crime Network Security: Encryption, Protecting Web server with a Firewall, Firewall and the Security Policy, Network Firewalls and Application Firewalls			
References: • Elias. M. Awad, " Electronic Commerce", Prentice-Hall of India Pvt Ltd. • RaviKalakota, Andrew B. Whinston, "Electronic Commerce-A Manager's guide", Addison-Wesley. • Efraim Turban, Jae Lee, David King, H.Michael Chung, "Electronic Commerce–A ManagerialPerspective", Addison-Wesley. • Management Information System, W.S Jawadekar, Tata Mc Graw Hill Publication. • Management Information System, David Kroenke, Tata Mc Graw Hill Publication. • MIS: Management Perspective, D.P. Goyal, Macmillan Business Books.			

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Name of the Course (DEC-3) (4 Theory credits)	Mobile Ad-hoc Network	Course Code	25MCS307
Maximum Marks	Practical: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- To study the Mobile Adhoc networks and its applications
- To study the routing algorithm in mobile adhoc network
- To study the transport protocols used in mobile adhoc network
- To understand the security mechanism used in mobile adhoc network
- To understand the quality of service for mobile adhoc network.

Section-I

Introduction: Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

Medium Access Protocols: MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

Section-II

Network Protocols: Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

Section-III

END – END Delivery and Security: Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

Section-IV

Cross Layer Design: Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of adhoc with Mobile IP networks

References:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.
2. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies “ A Survey of Mobility Models for Ad-hoc Network”
4. Research, “Wireless Communication, and Mobile Computing.. Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.
5. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri M. Bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no: 12007.

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Select any one of the following

Group- B

Name of the Course (DEC-4) (4 Theory credits)	Machine Learning	Course Code	25MCS308
Maximum Marks	Practical: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- Discovering patterns in data and then make predictions based on those patterns
- Dealing with complex patterns to answer business questions and solving problems.
- Helps to analyze data and identify trends.

Section-I

Introduction: Definition of learning systems. Goals and applications of machine learning, Aspects of developing a learning system: training data, concept representation, function approximation

Inductive Classification: The concept learning task, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, learning conjunctive concepts, the importance of inductive bias

Section-II

Decision Tree Learning: Representing concepts as decision trees, Recursive induction of decision trees, Picking the best splitting attribute: entropy and information gain, Searching for simple trees and computational complexity, Occam's razor, Over fitting, noisy data, and pruning

Ensemble Learning: Using committees of multiple hypotheses, Bagging, boosting, and DECORATE Active learning with ensembles

Section-III

Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses, Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing

Computational Learning Theory: Models of learnability, learning in the limit, probably approximately correct (PAC) learning, Sample complexity: quantifying the number of examples needed to PAC learn, Computational complexity of training, Sample complexity for finite hypothesis spaces, PAC results for learning conjunction

Section-IV

Rule Learning: Translating decision trees into rules, Heuristic rule induction using separate and conquer and information gain. First-order Horn-clause induction (Inductive Logic Programming) and Foil, Learning recursive rules, Inverse resolution

Classification problems in language: word-sense disambiguation, sequence labeling. Hidden Markov models (HMM's), Viterbi algorithm for determining most-probable state sequences, Forward-backward EM algorithm for training the parameters of HMM's, Use of HMM's for speech recognition, part-of-speech tagging, and information extraction. Conditional random fields (CRF's), Probabilistic context-free grammars (PCFG)

Reference Books:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education, 2013.
2. Miroslav Kubat, "An Introduction to Machine Learning", Springer, 2017.

Ramshen

Name of the Course (DEC-3) (4 Theory credits)	Soft Computing	Course Code	25MCS309
Maximum Marks	Practical: 30(Internal)+70(External)=100	Time of Examination	3 Hours
Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.			
Course Learning Outcomes(CLO): - To learn the basic concepts of Soft Computing - To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems. - To apply soft computing techniques to solve problems.			
Section-I Introduction to Soft Computing: Introduction, Evolution of Computing, Difference between Hard and Soft computing, From Conventional AI to Computational Intelligence, Machine Learning, Basics Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.			
Section-II Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making, Implementation using Python/Matlab			
Section-III Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Back Propagation networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Introduction to Associative Memory, Self-Organizing Map, Adaptive Resonance architectures, Advances in Neural networks, Implementation using Python/ Matlab			
Section-IV Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning, Machine Learning Approach to Knowledge Acquisition, GA based Back Propagation Networks, Implementation using Python/ Matlab, LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks, Hybrid Systems and their types.			
References: - Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002. - KwangH.Lee, —First course on Fuzzy Theory and Applications, Springer, 2005. - George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 1996.			

Pranzen

Name of the Course (1 credit)	PRACTICAL (BASEDON 25MCS301)	Course Code	25MCS301P
Maximum Marks	Practical:10(Internal)+20(External)=30		

Course Learning Outcomes(CLO):

- Explain the concepts used in various computer graphic devices.
- Draw different primitive drawing objects and apply transformations.
- Apply clipping on points, lines and closed objects with respect to given rectangular window.
- Implement the algorithms learnt in some programming language.
- Implementing Functions in Python Programming
- Explaining the concept of OOPS in Python Programming

List of Practical:

1. Write a Python program to sum all the items in a list.
2. Write a Python program to multiply all the items in a list.
3. Write a Python program to get the largest number from a list.
4. Write a Python program to get the smallest number from a list.
5. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings. Sample List : ['abc', 'xyz', 'aba', '1221']
6. Write a Python program to get a list, sorted in increasing order by the last element in each tuple from a given list of non-empty tuples. Sample List : [(2, 5), (1, 2), (4, 4), (2, 3), (2, 1)]
Expected Result : [(2, 1), (1, 2), (2, 3), (4, 4), (2, 5)]
7. Write a Python program to remove duplicates from a list.
8. Write a Python program to check a list is empty or not.
9. Write a Python program to clone or copy a list.
10. Write a Python program to find the list of words that are longer than n from a given list of words.
11. Write a Python function that takes two lists and returns True if they have at least one common member.
12. Write a Python program to print a specified list after removing the 0th, 4th and 5th elements. Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow']
Expected Output : ['Green', 'White', 'Black']
13. Write a Python program to generate a 3*4*6 3D array whose each element is *.
14. Write a Python program to print the numbers of a specified list after removing even numbers from it.
15. Write a Python program to shuffle and print a specified list.
16. Write a Python program to generate and print a list of first and last 5 elements where the values are square of numbers between 1 and 30 (both included).
17. Write a Python program to generate and print a list except for the first 5 elements,

Prashant

PRACTICAL (BASED ON 25MCS303)		Course Code	25MCS303P
Maximum Marks	Practical:10(Internal)+20(External)=30		
Course Learning Outcomes(CLO): CO1 Explain the concepts used in various computer graphic devices. CO2 Draw different primitive drawing objects and apply transformations. CO3 Apply clipping on points, lines and closed objects with respect to given rectangular window. CO4 Explain the concepts of interactive computer graphics.			
List of Practical: 1. A program to draw curve using function 2. A Program to draw line and circle using function 3. A program to draw a line using Digital Differential Analyzer (DDA) Algorithm 4. A program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes negative and less than 1. 5. A program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes positive and less than 1. 6. A program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes positive and greater than 1. 7. A program to draw a line using Contents Tasks List Description Bresenham's Line Algorithm (BLA) for lines with slopes negative and greater than 1. 8. A program to draw a circle using Bresenham's Circle Algorithm. 9. A program to fill different types of geometric shapes using Flood Fill.Algo. 10. A program to fill different types of geometric shapes using Boundary Fill Algo. 11. A program to draw a smiley 12. A Program to draw moving ball 13. A Program to draw kettle shape 14. A Program to draw small game 15. A Program to draw floating boat			

Praveen

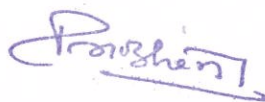
PRACTICAL
(BASED ON 25MCS304)

Course Learning Outcomes(CLO):

- CO1 Explain the concepts used in various computer graphic devices.
- CO2 Draw different primitive drawing objects and apply transformations.
- CO3 Apply clipping on points, lines and closed objects with respect to given rectangular window.
- CO4 Explain the concepts of interactive computer graphics.

List of Practical:

1. Write an R Program to Add Two Vectors
2. Find the Sum, Mean, and Product of the Vector in R Programming
3. Create an R Program to Take Input From the User
4. How to Generate Random Numbers from Standard Distributions in R
5. R Program to Sample from a Population
6. Create an R Program to Find the Minimum and Maximum
7. R Program to Sort a Vector
8. How to Find the Factorial of a Number
9. How to create R Multiplication Table
10. Write an R Program to Check Prime Number
11. R Program to check Armstrong Number
12. R Program to Print the Fibonacci Sequence
13. R Program to Check for Leap Year
14. Check if a Number is Odd or Even in R Programming
15. R Program to Calculate Simple Interest
16. R Program to Convert Celsius to Kelvin and Fahrenheit
17. R Program to Calculate the Area of a Triangle
18. R Program to Check if a String is a Palindrome
19. R Program to Find the Length of a String
20. R Program to Count the Number of Vowels in a String
21. R Program to Generate a Random Password
22. R Program to Convert Decimal to Binary, Octal, and Hexadecimal



SEMESTER-IV (for option I)

Name of the Course (CC-12) (4 Theory credits)	Cloud Computing	Course Code	25MCS401
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours
Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.			
Course Learning Outcomes(CLO) • Discuss with confidence, what is cloud computing and what are key security and control considerations within cloud computing environments. • Identify various cloud services. • Assess cloud characteristics and service attributes, for compliance with enterprise objectives. • Explain the four primary cloud category "types".			
Section-I Cloud Computing Fundamentals: Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing , usage scenarios and Applications , Business models around Cloud – Major Players in Cloud Computing - Issues in Cloud - Eucalyptus - Nimbus - Open Nebula, CloudSim.			
Section-II Types of Cloud services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service - Communication as services - Service providers- Google App Engine, Amazon EC2 - Service providers- Google App Engine, Amazon EC2 - Introduction to MapReduce - GFS - HDFS - Hadoop Framework			
Section-III Cloud architecture: Cloud delivery model - SPI framework, SPI evolution, SPI vs. tradition al IT Model, Collaborating on Calendars, Schedules and Task Management – Collaborating on Event Management, Contact Management, Project Management – Collaborating on Word Processing , Databases – Storing and Sharing Files- Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Collaborating via Social Networks – Collaborating via Blogs and Wikis.			
Section-IV Virtualization: Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLLVM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V. Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed Management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud			

Prasanth

References:

1. Cloud computing a practical approach - Anthony T.Velte, Toby J. Velte Robert Elsenperer
TATA McGraw- Hill, New Delhi - 2010
2. Cloud Computing: Web-Based Application s That Change the Way You Work and Collaborate
Online - Michael Miller - Que 2008
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
4. Cloud Computing: Principles and Paradigms, Editors: RajkumarBuyya, James Broberg, Andrzej
M. Goscinski, Wile, 2011
5. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee
Gillam, Springer, 2012
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell
Dean Vines, Wiley-India, 2010

Prashant

Name of the Course (CC-13) (3 Theory+1 Practical credits)	Java Programming	Course Code	25MCS402
Maximum Marks	Theory: 20(Internal)+50(External)=70	Time of Examination	3 Hours

Note:

Examiner will set seven questions and the candidates will be required to attempt four questions in all. Question number one will be compulsory containing four short answer type questions from all sections of 2 marks each. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- Basic Concepts of Object Oriented Programming
- Basic understanding of JAVA language
- To study the use of Java for GUI programming

Section-I

Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.

Objects and Classes: Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File, this reference

Section-II

Inheritance and Polymorphism: Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.

Section-III

Event and GUI programming: Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing

Section-IV

I/O programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files.

Multithreading in java: Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java, Introduction to JavaBeans and Network Programming.

References:

1. Patrick Naughton & Herbert Schildt.: Java 2.0: The Complete Reference, TMH.
2. Holzner Steven: Java 2, Swing, Servlets, JDBC & Java Beans Programming (Black Book), IDG Books India (P) Ltd.
3. Hatman & Eden: ASP with VBScript, SQL and HTML Programming Reference, IDG Books India(P), Ltd.
4. Jackson, J. : Java by Example, Sunsoft Press.
5. Wiber, J. : Using Java 2 Platform, PHI.
6. Harold, E. : Java Secrets, Comdex.

Prashant

PRACTICAL (BASED ON 25MCS402)		Course Code	25MCS402P
Maximum Marks	Practical:10(Internal)+20(External)=30		
Course Learning Outcomes(CLO): CO1: Programming by using the Concept of OOPS like Inheritance and Polymorphism CO2: Able to use various Loops and conditions in dealing with a real world problem CO3: Able to implement types of Inheritance and concepts like Function Overloading and Overriding CO4: Demonstrate in detailed on multilevel inheritance with suitable example. CO5: Demonstrate on multiple Thread class and use set Priority method with suitable example. CO6: Elaborate on runtime polymorphism with suitable example. CO7: Demonstrate on applet with differentiate between main () method using suitable example			
List of Practical: 1. Java Program to Calculate Simple Interest: 2. Java Program to Find Quotient and Remainder: 3. Java Program to Calculate Power of a Number: 4. Java Program to Convert char to String and String to Char: 5. Java Program to Find Duplicate Characters in a String: 6. Java Program to Check Palindrome String using Stack, Queue, For, and While loop: 7. Java Program to Sort Strings in Alphabetical Order: 8. Java Program to Reverse Words in a String: 9. Java Program to perform bubble sort on Strings: 10. Java program to find occurrence of a character in a String: 11. Java program to count vowels and consonants in a String: 12. Java Program to check two strings are anagram or not: 13. Java Program to divide a string in 'n' equal parts: 14. Java Program to find all subsets of a string: 15. Java Program to find longest substring without repeating characters: 16. Java Program to find longest repeating sequence in a string: 17. Java Program to remove all the white spaces from a string: 18. Program to find number of elements in an array: 19. Java Program to Calculate average of numbers using Array: 20. Java Program to Add the elements of an Array: 21. Java Program to reverse an array: 22. Java Program to sort an array in ascending order: 23. Java Program to convert char Array to String:			

Prashant

Select any one of the following

Group- A

Name of the Course (DEC-5) (4 Theory credits)	Software Testing	Course Code	25MCS404
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- 1.To understand the basic terminologies and types of testing
- 2.Understand different testing methods
- 3.Understand the testing process
- 4.Manage the tests, plan testing process and create reports.

Section-I

Introduction: Definition of Software Testing and its Role, Terms: - Failure, Error, Fault, Defect, Bug, Goals of Testing, Principles of Testing, Software Testing Life Cycle, Verification and Validation: - V-testing Life cycle

Section-II

Types of Testing: Black Box Testing: Overview: What is & When? Techniques: Boundary Value Analysis, Equivalence class testing, Decision Table White Box Testing: What is white box Testing, Need of white box Testing, Classification , Structural : Coverage, Path testing

Section-III

Levels of Testing Unit Testing : Overview, Integration Testing : Overview, Techniques: Graph based & Path based, Functional Testing, System Testing : Overview, Categories: Reliability Security Performance Recovery, Acceptance Testing : Overview, Types of Acceptance Testing

Section-IV

Test Planning: Preparing a Test plan, Scope management, Decide Test Approach, Setting Up Criteria, for testing, Identifying responsibilities, Staffing, training needs, Resource requirements, Test deliverables, Testing Tasks

References:

1. Software Testing: Easy Learning Approach by Shubha Agarwal Kundlas"
2. Software Testing: Principles and Practice by Naresh Chauhan, Oxford
3. Software Testing: Principles and Practice by Srinivasan Desikan, Gopalaswamy Ramesh, 17 Pearson Publication

Prashant

Name of the Course (DEC-5) (4 Theory credits)	Big Data Analytics	Course Code	25MCS405
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyze big data like Hadoop.
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To enable students to have skills that will help them to solve complex real-world problems in for decision support

Section-I

Introduction to Social Network Analysis for Big Data: Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

Section-II

Introduction Hadoop: Big Data – Apache Hadoop & Hadoop Eco System – Moving Data in and out of Hadoop – Understanding inputs and outputs of Map Reduce - Data Serialization.

Section-III

Hadoop Architecture: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., Name Node, Secondary Name Node, and Data Node, Hadoop Map Reduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

Section-IV

Hive And Hiveql, Hbase: Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Suggested Readings:

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk derooset al. , "Understanding Big data ", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide", O Reilly 2012. 6 IT2015SRM(E&T)
4. VigneshPrajapati, "Big Data Analytics with R and Haoop", Packet Publishing 2013.
5. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.
6. JyLiebowitz, "Big Data and Business analytics", CRC press, 2013.

Pooja

Name of the Course (DEC-5) (4 Theory credits)	Computer Security	Course Code	25MCS406
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- learn the concepts of computer security and various cryptographic techniques for securing a system.
- understand the concepts of database security and various network security controls.
- get familiar with various Internet security protocols.
- understand various physical security breaches and Intellectual property rights

Section-I

Computer Security Concepts, Threats, Attacks and Assets, Security Functional Requirements, Security Architecture and Scope of Computer Security, Computer Security Trends and Strategies. Cryptography: Terminology and Background, Substitution Ciphers, Transpositions, Cryptanalysis, Program Security: Secure Program, Non-malicious Program Error, Viruses and other Malicious Code, Targeted Malicious Code, Control against Program Threats.

Section-II

Database Security: Database Management System, Relational Databases, Database Access Control, Inference, Security Requirements, Reliability and Integrity, Sensitive Data, Database Encryption. Network Security: Threats in Network, Network Security Controls, and Firewall- Need for firewall, Characteristics, Types of firewall, Firewall Basing, Intrusion Detection System- Types, Goals of IDS, IDS strengths and Limitations.

Section-III

Internet Security Protocols and Standards: Secure Socket Layer (SSL) and Transport Layer Security (TLS), IPv4 and IPv6 Security, Kerberos 672, X.509, Public Key Infrastructure. Linux Security Model, File System Security, Linux Vulnerability, Linux System Hardening, Application Security. Window Security Architecture, Windows Vulnerability, Windows Security Defense, Browser Defenses.

Section-IV

Physical Security Threats, Physical Security Prevention and Mitigation Measures, Recovery from Physical Security Breaches, Security Auditing Architecture, Security Audit Trail, Security Risk assessment, Security Controls or Safeguard, IT Security Plan, Implementation of Controls, Cybercrime and Computer Crime, Intellectual Property, Privacy, Ethical Issues.

References:

1. Charles. P. Pfleeger & Shari Lawrence Pfleeger, Security in Computing, Pearson Education.
2. William Stallings, Lawrie Brown, Computer Security Principles and Practice, Pearson Education.
3. Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill Education

Prashant

Select any one of the following

Group- B

Name of the Course (DEC-6) (4 Theory credits)	Blockchain Technologies	Course Code	25MCS407
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

CO1: Understand the concepts of crypto currency, blockchain, and distributed ledger technologies.

CO2: Analyze the application and impact of blockchain technology in the financial industry and other industries

CO3: Evaluate security issues relating to blockchain and crypto currency

CO4: Design and analyze the impact of blockchain technology for real world applications

Section-I

Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs. Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography

Section-II

Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Section-III

Introduction to Blockchain Platforms: Ethereum, Hyperledger, IOTA, EOS, Multichain, Bigchain, etc. Advantages and Disadvantages, Ethereum vs Bitcoin, Design a new blockchain, Potential for disruption, Design a distributed application, Blockchain applications.

Section-IV

Blockchain Challenges: Blockchain Governance Challenges, Bitcoin Blocksize Debate, Blockchain Technical Challenges, Bugs in the Core Code, Denial-of-Service Attacks, Security in Smart Contracts, Scaling, Sharding

References:

1. Mastering Blockchain – Distributed ledgers, decentralization and smart contracts explained by Imran Bashir, Packt Publishing Ltd, Second Edition, 2018
2. Mastering Bitcoin: Unlocking Digital Cryptocurrencies by Andreas Antonopoulos, O'Reilly Publishing 2014.
3. Blockchain Basics: A Non-Technical Introduction in 25 Steps by Daniel Drescher, Apress, First Edition, 2017.
4. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Princeton University Press, 2016.
5. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology by Vitalik Buterin, William Mougayar, Wiley; 1st edition, 2016.

Proshen

Name of the Course (DEC-6) (4 Theory credits)	Mobile and Wireless Networks	Course Code	25MCS408
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- Understand the fundamentals of wireless and mobile networks.
- Learn and analyze the different wireless technologies.
- Evaluate Ad-hoc networks and wireless sensor networks.
- Understand and evaluate emerging wireless technologies and standards
- Understand design considerations for wireless and mobile networks

Section-I

Introduction to Wireless Telecommunication Systems and Networks: Concepts of Wireless Communication, History and Evolution of Wireless Communication, Different Generations of Wireless Networks.

Common Cellular System Components: Cellular networks architecture, Signal strength and cell area, Common cellular networks components, Components Identification and call establishment.

Section-II

Wireless Network Architecture and Operation: Fundamentals of Cellular Architecture, Mobility Management in Wireless Network, Power Management in Wireless Network, Security in Wireless Network.

GSM Interface and Protocol Stack: GSM PLMN Interfaces, GSM Radio Interface, GSM Abis Interface, GSM A Interface , GSM Interface for Connecting Other Components, Mapping of GSM Layers onto OSI Layers, Protocols Used Across Other Interfaces of GSM.

Section-III

GSM TDMA Techniques: GSM and TDMA Techniques, GSM Channels, GSM Identifiers.

CDMA Technology: CDMA overview, CDMA channels Concept, CDMA system operations.

Speech Coding in GSM: Speech coding in GSM, Speech coding methods, Speech codec attributes, LPAS, ITU-T Standards.

Wireless Modulation Techniques: Concept of Modulation, Wireless Modulation Techniques, Air Interface, Path Loss Models, Multiple Access Techniques.

Section-IV

Wireless Modulation Techniques: Orthogonal Frequency Division Multiplexing (OFDM), Ultra Wide Band Radio Techniques, Diversity Techniques, GSM Hardware.

Wireless Local Area Networks: Evolution of Wireless LANs, Wireless LAN Topologies, Wireless LAN Requirements, IEEE 802.11 Standards, IEEE 802.15 Standards, IEEE 802.16 Standards, Wireless LAN Applications.

Wi-Fi and Wimax Technology: Wi-Fi (802.11), WiMAX(802.16).

Suggested Readings:

1. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
2. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

Prashant

Name of the Course (DEC-6) (4 Theory credits)	Data Visualization Techniques	Course Code	25MCS409
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks..

Course Learning Outcomes(CLO)

- CO1: To understand the basic principles of data visualisation.
- CO2: To evaluate data with different visual methods.
- CO3: To understand Graphical formats for various data types.
- CO4: Explore data visualizations and handling high dimensional data.
- CO5: Apply Tableau tool to understand various plots for real time applications

Section-I

Introduction to Data Visualization: Introduction, importance of Data visualization, Human perception – Methodology – Seven Stages of Data Visualization - Data Visualization Tools. Visualizing Data: Mapping Data onto Aesthetics – Visualizing Amounts - Visualizing Distributions: Histograms and Density Plots – Visualizing Propositions: – Visualizing Associations: Among Two or More Quantitative Variables – Visualizing Time Series and Other Functions of an Independent Variable – Trends – Visualizing Geospatial Data.

Section-II

Basic Applied Visualizations: Data Visualization: One dimensional (Pictogram, Pie Chart, Bar Chart,), two-dimensional (Histogram, Line plot, frequency curves& polygons, ogive curves, ScatterPlot,) and other data visualization techniques. Gantt Chart, HeatMap, Box and Whisker Plot, Waterfall Chart, Area Chart, Stacked Bar Charts - Sub Plots – Matplotlib, Seaborn Styles, Box plot - Density Plot - - Tree map - Graph Networks.

Section-III

Interactive Visualization: Introduction to D3-Fundamental Technology: The Web – HTML – DOM – CSS – JavaScript – SVG. D3 Setup – Generating Page Elements – Binding Data – Drawing with data – Scales: Domains and Ranges – Normalization – Creating a Scale – Scaling the Scatter Plot – Other Methods and Other Scales. Axes – Modernizing the Chart – Update the Data – Transition – Updates – Interactivity. Timeline, Highlight Table, Bullet Graph, Choropleth Map, Word Cloud, Path diagram, Network Diagram, Correlation Matrices.

Section-IV

Principles of Information Visualization: Visual Perception and Cognition, Gestalt's Principles, Tufte's Principles, Applications of Principles of Information Visualization, Dashboard Design.

REFERENCE BOOKS :

1. Julie Steele, Noah Iliinsky (2010); Beautiful Visualization Publisher(s): O'Reilly Media
2. Edward R. Tufte (2016): The Visual Display of Quantitative Information" by
3. Kieran Healy (2016): Data Visualization: A Practical Introduction,
4. Claus O. Wilke (2020) Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures; O'Reilly
5. Stephanie D. H. Evergreen (2020): Effective Data Visualization: The Right Chart for the Right Data

Parashant

Select any one of the following

Group - C

Name of the Course (DEC-7) (4 Theory credits)	THEORY OF COMPUTATION	Course Code	25MCS410
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- Introduce the mathematical foundations of computation including automata theory.
- Differentiate and give examples for the different types of automata like finite automata, push down automata, linear bounded automata and Turing machine.
- Correlate the different types of automata to real world applications.
- Choose and design appropriate automata for the different requirements outlined by theoretical computer science.

Section-I

Formal Languages, Need for formal computational models, Non-computability and examples of non-computable problems, diagonal argument and Russel's paradox, Chomsky hierarchy of formal languages, Regular languages, Regular sets, regular grammars, computable and non-computable problems.

Section-II

Deterministic and Non-Deterministic finite automata, equivalence of deterministic and nondeterministic finite automata, Kleen's characterization theory for sets accepted by finite automata, finite state machines and their relations to combinatorial switching circuits, complexity, State equivalence and state minimization of finite automata, pumping lemma, Algebra decomposition and structure theory.

Section-III

Context Free Grammers, Chomsky & Greibiech normal form theorems, Self embedding, Equivalence of context free languages and sets accepted by non-deterministic push down store automata, pushdown automata, closure properties of context free languages, Ambiguity, Ambiguous grammars, Parsing: Early's, Cook-Kasami-Young, Tomito's, top-down and bottom-up methods, Restrictions of push-down automata.

Section-IV

Linear bounded automata (LBA): Power of LBA, closure properties; Turing machine (TM): onetape, Multitape Turing machines and related formalism for recognition, Time and space complexity in terms of TM, Construction of TM for various problems, Unsolvability of the halting problem, reduction of post correspondence problem to the halting problem, Undecidable properties of grammars. Recursive and recursively enumerable language.

REFERENCE BOOKS :

1. Kamla kirthivshan & Rama R : Automata theory & Computation, PEARSON, 1/e.
2. Peter Linz : An introduction to formal language & automata, Jones & Bartlete pub. 5/e.
3. Hopcroft, J.E.& Ullman ,J.D : Formal languages and their relation to Automata, AddisonWasley
4. E.V.Krishnamurthy : Introductory Theory of Computer Science Ease-West press Pvt. Ltd.
5. Lewis, H.R. & Papadimitrious, C.H : Elements of the Theory of Computation.PHI.
6. Zoha Mauna : Mathematical Theory of Computation, Wiley Inter-science.

Parshant

Name of the Course (DEC-7) (4 Theory credits)	Compiler Design	Course Code	25MCS411
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks..

Course Learning Outcomes(CLO)

CO1 To deal with different translators

CO2 To use the knowledge of patterns, tokens & regular expressions for solving a problem.

CO3 Representation of expressions in the form of symbol table, parse tree, three address code, quadruple, triples etc.

CO4 To learn the new code optimization techniques to improve the performance of a program in terms of speed & space.

CO5 To acquire the knowledge of modern compiler & its features.

Section-I

Overview of language processing: Preprocessors, compiler, assembler, interpreters, linkers & loaders , structure of a compiler, phases of a compiler. Lexical Analysis: Role of Lexical Analysis, Lexical Analysis Vs. Parsing, Token, patterns and Lexemes, Lexical Errors, Regular Expression, Definitions for the language constructs, Strings, Sequences, Comments, Transition diagram for recognition of tokens, Reserved words and identifiers, Examples.

Section-II

Syntax Analysis: Role of a parser, classification of parsing techniques, Top down parsing, First and Follow, LL(1) Grammars, Non-Recursive predictive parsing, Error recovery in predictive parsing. Introduction to simple LR: Why LR Parsers, Model of an LR Parsers, Operator Precedence- Shift Reduce Parsing, Difference between LR and LL Parsers, Construction of SLR Tables.

Section-III

Powerful LR Parsers: Construction of CLR (1), LALR Parsing tables, Dangling ELSE Ambiguity, Error recovery in LR Parsing. Semantic analysis: SDT, evaluation of semantic rules, symbol tables, use of symbol tables. Runtime Environment: storage organization, stack allocation, access to non-local data, heap management, parameter passing mechanisms.

Section-IV

Intermediate code: Three address code, quadruples, triples, abstract syntax trees, basic blocks, CFG. Machine independent code optimization; Common sub expression elimination, constant folding, copy propagation, dead code elimination, strength reduction, loop optimization, procedure inlining. Machine dependent code optimization: Peephole optimization, register allocation, instruction scheduling, inter procedural optimization, garbage collection via reference counting.

REFERENCE BOOKS :

1. Compilers, Principles Techniques and Tools- Alfred V Aho, Monical S Lam, Ravi Sethi, Jeffrey-D. Ullman.
2. Principles of Compiler design, V. Raghavan, TMH.
3. Principles of Compiler design, Nandini Prasad, Elsevier
4. Compiler construction, Principles and Practice, Kenneth C Loudon, CENGAGE
5. Implementations of Compiler, A new approach to Compilers including the algebraic methods, Yunlinsu, SPRINGER.

Prashant

Name of the Course (DEC-7) (4 Theory credits)	Cyber Security and Cyber Laws	Course Code	25MCS412
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

1. Learn, structure, mechanics and evolution of various crime threats
2. Learn to protect information systems from external attacks by developing skills in enterprise security, wireless security and computer forensics.
3. Analyse the risks involved while sharing their information in cyber space and numerous related solutions like sending protected and digitally signed documents
4. Insights of ethical hacking and usage of password cracking tools
5. Get an overview of different ciphers used for encryption and decryption.

Section-I

Introduction to Cyber Security - Importance and challenges in Cyber Security, Cyberspace , Cyber threats, Cyber warfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure , Cyber security, Organizational Implications, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control and Cryptography. Web attack: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks. Network Vulnerabilities: Overview of vulnerability scanning, Open, Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe

Section-II

Types of Hackers- Hackers and Crackers - Cyber-Attacks and Vulnerabilities- Malware threats- Sniffing - Gaining Access - Hiding Files - Covering Tracks- Worms - Trojans Viruses- Backdoors. Vulnerabilities- Overview, Vulnerabilities in Software, System administration, Threat Actors, Attacks, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications. Cyber Security Safeguards Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

Section-III

Basics of Law, Sources of Laws, Types of Laws, Constitutional System in India, Role of Court system, Fundamental Rights & IT Laws in India, Landmark cases , Conceptual and theoretical perspective of cyber law, Cyber Jurisdiction, Development of Cyber Law – National and International Perspective

Section-IV

Cyber Law: E-Governance Definitions, objectives of Information Technology Act, 2000, Data Protection, Cyber Security, Legal recognition of Digital Evidence, Recognition of liability in the digital world, E-Contract, E-Auditing, Digital Signatures & Authentication under IT Act, 2000 E-Governance, Appointment of Controller, Legal Aspects of Certifying Authorities, Subscribers, Procedure for obtaining license and DSC

REFERENCE BOOKS :

1. Donaldson, S., Siegel, S., Williams, C.K., and Aslam, A. (2015). —Enterprise Cyber security -How to Build a Successful Cyber defense Program against Advanced Threats, Apress, 1st Edition.
2. Franke, Don Cyber Security Basics: Protect your organization ... (Paperback)
3. Nina Godbole, Sumit Belapure, (2011). —Cyber Security, Willey.
4. Yatindra Singh : Cyber Laws.
5. Ajit Narayanan and Bennum (ed.) : Law, Computer Science and Artificial Intelligence.
6. Linda Brennan and Victoria Johnson : Social, ethical and policy implication of Information Technology.

Prashant

SEMESTER-IV (for option II)

Select any one of the following
(Group A)

1000

Name of the Course (DEC-5) (4 Theory credits)	Software Testing	Course Code	25MCS404
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours
Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.			
Course Learning Outcomes(CLO) 1.To understand the basic terminologies and types of testing 2.Understand different testing methods 3.Understand the testing process 4.Manage the tests, plan testing process and create reports.			
Section-I Introduction: Definition of Software Testing and its Role, Terms: - Failure, Error, Fault, Defect, Bug, Goals of Testing, Principles of Testing, Software Testing Life Cycle, Verification and Validation: - V-testing Life cycle			
Section-II Types of Testing: Black Box Testing: Overview: What is & When? Techniques: Boundary Value Analysis, Equivalence class testing, Decision Table White Box Testing: What is white box Testing, Need of white box Testing, Classification , Structural : Coverage, Path testing			
Section-III Levels of Testing Unit Testing : Overview, Integration Testing : Overview, Techniques: Graph based & Path based, Functional Testing, System Testing : Overview, Categories: Reliability Security Performance Recovery, Acceptance Testing : Overview, Types of Acceptance Testing			
Section-IV Test Planning: Preparing a Test plan, Scope management, Decide Test Approach, Setting Up Criteria, for testing, Identifying responsibilities, Staffing, training needs, Resource requirements, Test deliverables, Testing Tasks			
References: 1. Software Testing: Easy Learning Approach by Shubha Agarwal Kundlas" 2. Software Testing: Principles and Practice by Naresh Chauhan, Oxford 3. Software Testing: Principles and Practice by Srinivasan Desikan, Gopalaswamy Ramesh, 17 Pearson Publication			

For Signature

Name of the Course (DEC-5) (4 Theory credits)	Big Data Analytics	Course Code	25MCS405
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyze big data like Hadoop.
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To enable students to have skills that will help them to solve complex real-world problems in for decision support

Section-I

Introduction to Social Network Analysis for Big Data: Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

Section-II

Introduction Hadoop: Big Data – Apache Hadoop & Hadoop Eco System – Moving Data in and out of Hadoop – Understanding inputs and outputs of Map Reduce - Data Serialization.

Section-III

Hadoop Architecture: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, Name Node, Secondary Name Node, and Data Node, Hadoop Map Reduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering – Monitoring & Maintenance.

Section-IV

Hive And Hiveql, Hbase: Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Suggested Readings:

7. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
8. Chris Eaton, Dirk deroos et al., "Understanding Big data", McGraw Hill, 2012.
9. Tom White, "HADOOP: The definitive Guide", O Reilly 2012. 6 IT2015SRM(E&T)
10. VigneshPrajapati, "Big Data Analytics with R and Hadoop", Packet Publishing 2013.
11. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.
12. JyLiebowitz, "Big Data and Business analytics", CRC press, 2013.

Prajapati

Name of the Course (DEC-5) (4 Theory credits)	Computer Security	Course Code	25MCS406
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- learn the concepts of computer security and various cryptographic techniques for securing a system.
- understand the concepts of database security and various network security controls.
- get familiar with various Internet security protocols.
- understand various physical security breaches and Intellectual property rights

Section-I

Computer Security Concepts, Threats, Attacks and Assets, Security Functional Requirements, Security Architecture and Scope of Computer Security, Computer Security Trends and Strategies. Cryptography: Terminology and Background, Substitution Ciphers, Transpositions, Cryptanalysis, Program Security: Secure Program, Non-malicious Program Error, Viruses and other Malicious Code, Targeted Malicious Code, Control against Program Threats.

Section-II

Database Security: Database Management System, Relational Databases, Database Access Control, Inference, Security Requirements, Reliability and Integrity, Sensitive Data, Database Encryption. Network Security: Threats in Network, Network Security Controls, and Firewall- Need for firewall, Characteristics, Types of firewall, Firewall Basing, Intrusion Detection System- Types, Goals of IDS, IDS strengths and Limitations.

Section-III

Internet Security Protocols and Standards: Secure Socket Layer (SSL) and Transport Layer Security (TLS), IPv4 and IPv6 Security, Kerberos 672, X.509, Public Key Infrastructure. Linux Security Model, File System Security, Linux Vulnerability, Linux System Hardening, Application Security. Window Security Architecture, Windows Vulnerability, Windows Security Defense, Browser Defenses.

Section-IV

Physical Security Threats, Physical Security Prevention and Mitigation Measures, Recovery form Physical Security Breaches, Security Auditing Architecture, Security Audit Trail, Security Risk assessment, Security Controls or Safeguard, IT Security Plan, Implementation of Controls, Cybercrime and Computer Crime, Intellectual Property, Privacy, Ethical Issues.

References:

1. Charles. P. Pfleeger & Shari Lawrence Pfleeger, Security in Computing, Pearson Education.
2. William Stalling, Lawrie Brown, Computer Security Principles and Practice, Pearson Education.
3. Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill Education

[Signature]

Select any one of the following
(Group B)

Name of the Course (DEC-6) (4 Theory credits)	Block chain Technologies	Course Code	25MCS407
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- CO1:** Understand the concepts of crypto currency, blockchain, and distributed ledger technologies.
CO2: Analyze the application and impact of blockchain technology in the financial industry and other industries
CO3: Evaluate security issues relating to blockchain and crypto currency
CO4: Design and analyze the impact of blockchain technology for real world applications

Section-I

Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs. Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography

Section-II

Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Section-III

Introduction to Blockchain Platforms: Ethereum, Hyperledger, IOTA, EOS, Multichain, Bigchain, etc. Advantages and Disadvantages, Ethereum vs Bitcoin, Design a new blockchain, Potential for disruption, Design a distributed application, Blockchain applications.

Section-IV

Blockchain Challenges: Blockchain Governance Challenges, Bitcoin Blocksize Debate, Blockchain Technical Challenges, Bugs in the Core Code, Denial-of-Service Attacks, Security in Smart Contracts, Scaling, Sharding

References:

- 1 .Mastering Blockchain – Distributed ledgers, decentralization and smart contracts explained by Imran Bashir, Packt Publishing Ltd, Second Edition, 2018
2. Mastering Bitcoin: Unlocking Digital Cryptocurrencies by Andreas Antonopoulos, O'Reilly Publishing 2014.
3. Blockchain Basics: A Non-Technical Introduction in 25 Steps by Daniel Drescher, Apress, First Edition, 2017.
4. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Princeton University Press, 2016.
5. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology by Vitalik Buterin, William Mougayar, Wiley; 1st edition, 2016.

Prashant

Name of the Course (DEC-6) (4 Theory credits)	Mobile and Wireless Networks	Course Code	25MCS408
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- Understand the fundamentals of wireless and mobile networks.
- Learn and analyze the different wireless technologies.
- Evaluate Ad-hoc networks and wireless sensor networks.
- Understand and evaluate emerging wireless technologies and standards
- Understand design considerations for wireless and mobile networks

Section-I

Introduction to Wireless Telecommunication Systems and Networks: Concepts of Wireless Communication, History and Evolution of Wireless Communication, Different Generations of Wireless Networks.

Common Cellular System Components: Cellular networks architecture, Signal strength and cell area, Common cellular networks components, Components Identification and call establishment.

Section-II

Wireless Network Architecture and Operation: Fundamentals of Cellular Architecture, Mobility Management in Wireless Network, Power Management in Wireless Network, Security in Wireless Network.

GSM Interface and Protocol Stack: GSM PLMN Interfaces, GSM Radio Interface, GSM Abis Interface, GSM A Interface , GSM Interface for Connecting Other Components, Mapping of GSM Layers onto OSI Layers, Protocols Used Across Other Interfaces of GSM.

Section-III

GSM TDMA Techniques: GSM and TDMA Techniques, GSM Channels, GSM Identifiers.

CDMA Technology: CDMA overview, CDMA channels Concept, CDMA system operations.

Speech Coding in GSM: Speech coding in GSM, Speech coding methods, Speech codec attributes, LPAS, ITU-T Standards.

Wireless Modulation Techniques: Concept of Modulation, Wireless Modulation Techniques, Air Interface, Path Loss Models, Multiple Access Techniques.

Section-IV

Wireless Modulation Techniques: Orthogonal Frequency Division Multiplexing (OFDM), Ultra Wide Band Radio Techniques, Diversity Techniques, GSM Hardware.

Wireless Local Area Networks: Evolution of Wireless LANs, Wireless LAN Topologies, Wireless LAN Requirements, IEEE 802.11 Standards, IEEE 802.15 Standards, IEEE 802.16 Standards, Wireless LAN Applications.

Wi-Fi and Wimax Technology: Wi-Fi (802.11), WiMAX(802.16).

Suggested Readings:

1. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
2. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

Praveen

Name of the Course (DEC-6) (4 Theory credits)	Data Visualization Techniques	Course Code	25MCS409
Maximum Marks	Theory: 30(Internal)+70(External)=100	Time of Examination	3 Hours

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions of two mark each from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes(CLO)

- CO1: To understand the basic principles of data visualisation.
- CO2: To evaluate data with different visual methods.
- CO3: To understand Graphical formats for various data types.
- CO4: Explore data visualizations and handling high dimensional data.
- CO5: Apply Tableau tool to understand various plots for real time applications

Section-I

Introduction to Data Visualization: Introduction, importance of Data visualization, Human perception – Methodology – Seven Stages of Data Visualization - Data Visualization Tools. Visualizing Data: Mapping Data onto Aesthetics – Visualizing Amounts - Visualizing Distributions: Histograms and Density Plots – Visualizing Propositions: – Visualizing Associations: Among Two or More Quantitative Variables – Visualizing Time Series and Other Functions of an Independent Variable – Trends – Visualizing Geospatial Data.

Section-II

Basic Applied Visualizations: Data Visualization: One dimensional (Pictogram, Pie Chart, Bar Chart,), two-dimensional (Histogram, Line plot, frequency curves & polygons, ogive curves, Scatter Plot,) and other data visualization techniques. Gantt Chart, Heat Map, Box and Whisker Plot, Waterfall Chart, Area Chart, Stacked Bar Charts - Sub Plots – Matplotlib, Seaborn Styles, Box plot - Density Plot - - Tree map - Graph Networks.

Section-III

Interactive Visualisation: Introduction to D3-Fundamental Technology: The Web-HTML – DOM – CSS – JavaScript – SVG. D3 Setup – Generating Page Elements – Binding Data - Drawing with data – Scales: Domains and Ranges – Normalization – Creating a Scale – Scaling the Scatter Plot – Other Methods and Other Scales. Axes – Modernizing the Chart – Update the Data – Transition – Updates – Interactivity. Timeline, Highlight Table, Bullet Graph, Choropleth Map, Word Cloud, Path diagram, Network Diagram, Correlation Matrices.

Section-IV

Principles of Information Visualization: Visual Perception and Cognition, Gestalt's Principles, Tufte's Principles, Applications of Principles of Information Visualization, Dashboard Design.

REFERENCE BOOKS :

1. Julie Steele, Noah Iliinsky (2010); Beautiful Visualization Publisher(s): O'Reilly Media
2. Edward R. Tufte (2016): "The Visual Display of Quantitative Information" by
3. Kieran Healy (2016): Data Visualization: A Practical Introduction,
4. Claus O. Wilke (2020) Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures, O'Reilly
5. Stephanie D. H. Evergreen (2020): Effective Data Visualization: The Right Chart for the Right Data

Prashant

Research Project/ Dissertation/Inter nship @12 credits	Project/Internship	12 Credit
Maximum Marks	Practical : 100(Internal)+200(External)=300	Course Code: 25MCS413

Prashant

SEMESTER-III (for option III)

Research Thesis @20 credits	Research Thesis	20 Credit
Maximum Marks	Practical :150(Internal)+350(External)=500	Course Code: 25MCS311

Pragathi

SEMESTER-IV (for option III)

Research Thesis @20 credits	Research Thesis	20 Credit
Maximum Marks	Practical :150(Internal)+350(External)=500	Course Code: 25MCS414

Prashant

Course Learning Outcomes (CLO) for M.Sc. Computer Science

- PLOs1: Fundamental knowledge in problem solving, general computing, and in depth knowledge in Computer Science (Disciplinary Knowledge).
- PLOs 2: An ability to identify, analyse, design, optimize and implement system solutions using suitable computing techniques leading to propulsion towards employability (Research-related skills).
- PLOs 3: An ability to understand and provide solutions to real life problems in Internet of Things with thrust in lifelong learning (Problem Solving).
- PLOs 4: Fundamental knowledge in computational methods and tools for solving realtime problems (Communication Skills).
- PLOs 5: An ability to act as a leader, or as a part of a team to create multifunctional software products (Leadership readiness/qualities).
- PLOs 6:An Ability to demonstrate individual practical experiences in a variety of programming languages and situations (Analytical reasoning).
- PLOs 7:An understanding of professional, ethical, legal, security and social issues and responsibilities (Moral and ethical awareness/reasoning).
- PLOs 8: An ability to use current techniques, skills, and tools necessary for computing practice (Scientific reasoning).
- PLOs 9:An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices (Critical thinking).

Programme Learning Outcomes (PLOs) for M.Sc. Computer Science

The Master of Science with Computer Science (MSc with CS) program enables students to attain, by the time of graduation:

PLO-A. Demonstrate the aptitude of Computer Programming and Computer based problem solving skills.

PLO-B. Display the knowledge of appropriate theory, practices and tools for the specification, design, and implementation

PLO-C. Ability to learn and acquire knowledge through online courses available at different MOOC Providers.

PLO-D. Ability to link knowledge of Computer Science with other two chosen auxiliary disciplines of study.

PLO-E. Display ethical code of conduct in usage of Internet and Cyber systems.

PLO-F. Ability to pursue higher studies of specialization and to take up technical employment.

PLO-G. Ability to formulate, to model, to design solutions, procedure and to use software tools to solve real world problems and evaluate.

PLO-H. Ability to operate, manage, deploy, configure computer network, hardware, software operation of an organization.

PLO-I. Ability to present result using different presentation tools.

PLO-J. Ability to appreciate emerging technologies and tools.