APJ ABDUL KALAM KERALA TECHNOLOGICAL UNIVERSITY

Bachelor of Technology

Syllabus and Course Plan

Branch : *Computer Science & Engineering*
Semester : *S7 & S8*
Year : *2015*

SEMESTER - 7

Course Code	*Course*	*L-T-P*	*Credits*	*Exam Slot*
CS401	Computer Graphics	4-0-0	4	A
CS403	Programming Paradigms	3-0-0	3	B
CS405	Computer System Architecture	3-0-0	3	C
CS407	Distributed Computing	3-0-0	3	D
CS409	Cryptography and Network Security	3-0-0	3	E
	Elective 3	3-0-0	3	F
CS451	Seminar & Project Preliminary	0-1-4	2	S
CS431	Compiler Design Lab	0-0-3	1	T

Total Credits = 22 Hours : 27

Cumulative Credits = 162

Elective 3

CS461	Computational Geometry
CS463	Digital Image Processing
CS465	Bio Informatics
CS467	Machine Learning
CS469	Computational Complexity

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS401	COMPUTER GRAPHICS	4-0-0-4	2015

Course Objectives

1. To understand about the graphics input and display devices.
2. To study line/circle drawing algorithms.
3. To understand two dimensional transformations.
4. To study about 3D graphics and transformations.
5. To study about projections and hidden line elimination algorithms.
6. To study about fundamentals of image processing.

Syllabus

Basic Concepts in Computer Graphics. Input devices. Display devices. Line/Circle Drawing Algorithms. Solid area scan-conversion. Polygon filling. Two dimensional transformations. Windowing, clipping. 3D Graphics, 3D transformations. Projections – Parallel, Perspective. Hidden Line Elimination Algorithms. Image processing – digital image representation – edge detection – Robert, Sobel, Canny edge detectors. Scene segmentation and labeling – region-labeling algorithm – perimeter measurement.

Expected outcome.

After completing the course, students will be able to :

1. Write programs in C/C++ for generating lines/circles.
2. Write functions to implement graphics primitives.
3. Write programs that demonstrates geometric transformations.
4. Write programs that demonstrates projections.
5. Write programs that demonstrates image processing techniques.
6. Create interactive graphics applications.

Text Books

1. Computer Graphics – Donald Hearn and M. Pauline Baker, PHI
2. Principles of Interactive Computer Graphics – William M. Newman and Robert F. Sproull. McGraw Hill
3. Pattern Recognition and Image Analysis – E. Gose, R. Johnsonbaugh, S. Jost., PHI (Module VI – Image Processing part)

References

1. Procedural Elements for Computer Graphics – David F. Rogers, McGraw Hill
2. Image Processing, Analysis, and Machine Vision – M. Sonka, V. Hlavac, and R. Boyle, Thomson India Edition.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Basic concepts in Computer Graphics – Types of Graphic Devices – Interactive Graphic inputs – Basic Raster Scan Graphics.	7	15%
II	Line Drawing Algorithms – Circle Generation Algorithms - Scan Conversion-frame buffers – solid area scan conversion – polygon filling	8	15%
FIRST INTERNAL EXAM			
III	Two dimensional transformations. Homogeneous coordinate systems – matrix formulation and concatenation of transformations. Windowing concepts – two dimensional clipping.	8	15%
IV	Introduction to graphics in three dimension – specification of a 3D view – 3D transformations	7	15%
SECOND INTERNAL EXAM			
V	Projections – Parallel and perspective projections – vanishing points. Hidden line elimination – Back face removal, Z-Buffer algorithm, scan line algorithm.	9	20%
VI	Image processing – introduction – digital image representation – relationship between pixels – gray level histogram – equalization – edge detection – Robert, Sobel, Canny edge detectors. Scene segmentation and labeling – region-labeling algorithm – perimeter measurement.	9	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18

b. *Three* questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three*questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS403	PROGRAMMING PARADIGMS	3-0-0-3	2015

Course Objectives

1. To introduce the basic constructs that underlie all programming languages
2. To introduce the basics of programming language design and implementation
3. To introduce the organizational framework for learning new programming languages.

Syllabus

Names, Scopes, and Bindings - Binding Time, Scope Rules, Storage Management, Overloading, Polymorphism; Control Flow - Expression Evaluation, Structured and Unstructured Flow, Non-determinacy; Data Types - Type Systems, Type Checking, Equality Testing and Assignment; Subroutines and Control Abstraction - Static and Dynamic Links, Calling Sequences, Parameter Passing, Exception Handling, Coroutines; Functional and Logic Languages; Data Abstraction and Object Orientation - Encapsulation, Inheritance, Dynamic Method Binding; Innovative features of Scripting Languages; Concurrency - Threads, Synchronization, Language-Level Mechanisms; Run-time program Management.

Expected Outcome:

After completing the course, students will be able to :

1. compare scope and binding of names in different programming languages
2. analyze control flow structures in different programming languages
3. appraise data types in different programming languages
4. analyze different control abstraction mechanisms
5. appraise constructs in functional and logic languages
6. analyze object oriented constructs in different programming languages
7. compare concurrency constructs in different programming languages

References

1. Scott M. L., Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers.
2. Kenneth C. Louden, Programming Languages: Principles and Practice, 2nd Edn., Cengage Learning.
3. Tucker A. B. and R. E. Noonan, Programming Languages: Principles and Paradigms, 2nd Edn. –TMH.
3. R.W. Sebesta, Concepts of Programming Languages, 8th Edn., Pearson Education.
4. Ravi Sethi, Programming Languages: Concepts & Constructs, 2nd Edn., Pearson Education
5. David A. Watt, Programming Language Design Concepts, Wiley Dreamtech.

4. Pratt T. W., M. V. Zelkowitz, and T. V. Gopal, Programming Languages: Design and Implementation, 4th Edn., Pearson Education.
5. Ghezzi C. and M. Jazayeri, Programming Language Concepts, 3rd Edn, Wiley.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Names, Scopes, and Bindings:-Names and Scopes, Binding Time, Scope Rules, Storage Management, Aliases, Overloading, Polymorphism, Binding of Referencing Environments. Control Flow: - Expression Evaluation, Structured and Unstructured Flow, Sequencing, Selection, Iteration, Recursion, Non-determinacy.	7	15 %
II	Data Types:-Type Systems, Type Checking, Records and Variants, Arrays, Strings, Sets, Pointers and Recursive Types, Lists, Files and Input/Output, Equality Testing and Assignment.	7	15 %
FIRST INTERNAL EXAM			
III	Subroutines and Control Abstraction: - Static and Dynamic Links, Calling Sequences, Parameter Passing, Generic Subroutines and Modules, Exception Handling, Coroutines.	7	15 %
IV	Functional and Logic Languages:-Lambda Calculus, Overview of Scheme, Strictness and Lazy Evaluation, Streams and Monads, Higher-Order Functions, Logic Programming in Prolog, Limitations of Logic Programming.	7	15 %
SECOND INTERNAL EXAM			
V	Data Abstraction and Object Orientation:- Encapsulation, Inheritance, Constructors and	7	20 %

	Destructors, Dynamic Method Binding, Multiple Inheritance. Innovative features of Scripting Languages:-Scoping rules, String and Pattern Manipulation, Data Types, Object Orientation.		
VI	Concurrency:- Threads, Synchronization, Language-Level Mechanisms. Run-time program Management:- Virtual Machines, Late Binding of Machine Code, Reflection, Symbolic Debugging, Performance Analysis.	7	20 %
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three*questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three*questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CS405	COMPUTER SYSTEM ARCHITECTURE	3-0-0-3	2015

Course Objectives

1. To impart an basic understanding of the parallel architecture and its operations
2. To impart key features of high performance computers

Syllabus

Basic concept of parallel computer models, SIMD computers, Multiprocessors amd multicomputers, Cache Coherence Protocols, Multicomputers, Pipeling computers and Multithreading.

Expected outcome.

After completing the course, students will be able to :

1. Understand the basics of parallel computer models.
2. Analyze the advanced processor technologies.
3. Understand multiprocessor cache coherence using the directory based and snooping class of protocols.
4. Familiarize with Scalable architectures, Message Passing Mechanisms and Message Routing schemes.
5. Compare and illustrate Pipelining and Super scalar techniques.
6. Familiarize with the various techniques to enhance a processors ability to exploit multithreading.

Text Book

1. Advanced Computer Architecture, Parallelism, Scalability, Programmability, 2001 Edn – K. Hwang,

References

1. Computer Architecture and Parallel Processing – K. Hwang & Briggs, McGraw Hill International.
2. Computer Organization and Design: The Hardware/Software Interface, Patterson D. A. and Hennessy J. L., Morgan Kaufmann, 3/e
3. Computer Architecture and Organization – H.P. Hayes, McGraw Hill.
4. The Architecture of Pipelined Computer – P.M. Kogge, McGraw Hill.
5. Introduction to Parallel Processing – M. Sasikumar, D. Shikkare, P. Raviprakash, PHI.
6. Computer System Architecture – P.V.S. Rao, PHI.
7. Computer Architecture: Pipelined and Parallel Processor Design – M. J. Flynn, Narosa.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Parallel computer models – Evolution of Computer Architecture, System Attributes to performance. Multiprocessors and Multicomputers, Multivector and SIMD computers, Conditions of parallelism.	6	15%
II	Processors and memory hierarchy – Advanced processor technology- Design Space of processors, Instruction -set Architecture, CISC Scalar Processors, RISC Scalar Processors, Superscalar and vector processors-Super Scalar Processors ,Vector and Symbolic Processors. Memory hierarchy technology. Amdahl's law.	8	15%
FIRST INTERNAL EXAM			
III	Multiprocessors and multicomputers-Multiprocessors system interconnect. Cache Coherence and Synchrronization Mechanisms, Cache Coherence Problem, Snoopy Bus Protocol, Directory Based Protocol, Hardware Synchronization Problem	7	15%
IV	Three generations of Multicomputers- Present and future development, Intel Paragon system architecture. Message Passing Mechanisms-Message Routing schemes, Deadlock and Virtual channels, Flow control Strategies, Multicast Routing Algorithms.	8	15%
SECOND INTERNAL EXAM			
V	Pipelining and Superscalar techniques –linear Pipeline processors and nonlinear pipeline processors, Instruction pipeline design, Arithmetic pipeline deign ,Superscalar and Superpipeline Design-Super Scalar Pipeline Design	8	20%
VI	Multithreaded and data flow architectures -	8	20%

	latency hiding techniques, Principles of multithreading- Multithreading Issues and Solutions, Multiple context Processors, Fine-grain Multicomputer- Fine-grain Parallelism, MIT J-Machine.		
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three*questions each having 9 marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three*questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CS407	DISTRIBUTED COMPUTING	3-0-0-3	2015

Course Objectives

1. To impart fundamental principles underlying the function of distributed system, technical challenges and key design issues of distributed system.
2. To impart knowledge of the distributed computing models, algorithms and the design of distributed system .

Syllabus

Introduction to distributed computing, Design issues, Distributed Computing Models, System models, Inter-process communication, Distributed file system, Name Service , Distributed mutual exclusion ,Distributed system design.

Expected outcome

After completing the course, students will be able to

1. Distinguish distributed computing paradigm from other computing paradigms
2. Identify the core concepts of distributed system
3. Illustrate the mechanisms of inter process communication in distributed system
4. Apply appropriate distributed system principles in ensuring transparency , consistency and fault-tolerance in distributed file system
5. Outline the need for mutual exclusion and election algorithms in distributed system
6. Illustrate the design of a distributed system

Text Book:

1. Distributed Systems: Concepts and Design – George Coulouris, Jean Dollimore and Tim Kindberg, Fifth Edition ,Pearson Education

References:

1. Distributed Operating Systems :Concepts and Design -Pradeep k Sinha,Prentice Hall of India
2. Distributed Systems: Principles and paradigms – A.S. Tanenbaum and M.V. Steen, Pearson Education
3. Distributed Systems and Computer Networks – M. Solomon and J. Krammer, PHI

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Evolution of Distributed Computing -Issues in designing a distributed system- Challenges- Minicomputer model– Workstation model- Workstation-Server model– Processor-pool model -Trends in distributed systems	7	15%
II	System models: Physical models - Architectural models - Fundamental models	7	15%
FIRST INTERNAL EXAM			
III	Interprocess communication: characteristics – group communication - Multicast Communication –Remote Procedure call - Network virtualization. Case study : Skype	7	15%
IV	Distributed file system: File service architecture - Network file system- Andrew file system- Name Service	6	15%
SECOND INTERNAL EXAM			
V	Distributed mutual exclusion – central server algorithm – ring based algorithm- Maekawa's voting algorithm – Election: Ring -based election algorithm – Bully algorithm	7	20%
VI	Distributed system design – Google search engine – Architecture- Communication paradigms- Data storage – coordination services- distributed computation services.	7	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
    a. Total marks : 18

b. *Three*questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three*questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS409	CRYPTOGRAPHY AND NETWORKS SECURITY	3-0-0-3	2015

Course Objectives

1. To introduce fundamental concepts of symmetric and asymmetric cipher models
2. To introduce fundamental concepts of authentication
3. To introduce network security and web security

Syllabus

Symmetric Cipher Models - Differential and linear Cryptanalysis- Block Cipher Design principles- Primitive operations- Key expansions- Inverse Cipher- Principles of Public key Cryptography Systems - Authentication functions- Message authentication codes- Hash functions- Digital signatures- Authentication protocols- Network security - Web Security - secure Socket Layer and Transport layer Security- Secure electronic transaction –Firewalls.

Expected Outcome:

After completing the course, students will be able to

1. appreciate principles of symmetric ciphers
2. appreciate principles of block ciphers
3. appreciate principles of public key cryptography
4. identify issues in authentication
5. identify issues in network security
6. identify issues in web security

Text Books

1. Cryptography and Network Security – William Stallings, Pearson Education
2. Cryptography and Network Security – Behrouz A. Forouzan, Tata McGraw-Hill.

References:

1. Applied Cryptography, Protocols, Algorithms, and Souce Code in C, 2 nd Edn – B. Schneier, Wiley.
2. Network Security – Charlie Kaufman, Radia Perlman, Mike Speciner.

Course Plan

Module	Contents	Hours	Sem. Exam Marks %
I	Symmetric Cipher Models- Substitution techniques- Transposition techniques- Rotor machines- Steganography- DES: Simplified DES- Block Cipher principals- The Data Encryption Standard. The Strength of DES- Differential and linear Cryptanalysis-	7	15 %

II	Block Cipher Design principles- Block Cipher modes of operations- IDEA: Primitive operations- Key expansions- One round, Odd round, Even Round- Inverse keys for description. AES: Basic Structure- Primitive operation- Inverse Cipher- Key Expansion, Rounds, Inverse Rounds.	7	15 %
FIRST INTERNAL EXAM			
III	Public key Cryptography :- Principles of Public key Cryptography Systems, Number theory- Modular arithmetic, Prime numbers. RSA algorithms- Key Management - Diffie-Hellman Key Exchange, Elliptic curve cryptography	7	15 %
IV	Authentication requirements- Authentication functions- Message authentication codes- Hash functions- SHA, MD5, Security of Hash functions and MACS- Digital signatures- Authentication protocols- Digital signature standards.	7	15 %
SECOND INTERNAL EXAM			
V	Network security: Electronic Mail Security: Pretty good privacy- S/MIME IP Security: Architecture- authentication Header- Encapsulating Security payload- Combining Security associations- Key management.	7	20 %
VI	Web Security: Web Security considerations- secure Socket Layer and Transport layer Security- Secure electronic transaction. Firewalls-Packet filters- Application Level Gateway- Encrypted tunnels .	7	20 %
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18

   b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS461	COMPUTATIONAL GEOMETRY (Elective 3)	3-0-0-3	2015

Course Objectives

1. To introduce techniques needed in designing efficient algorithms for geometric problems.
2. To discuss data structures used for geometric problems
3. To introduce combinatorial complexity of geometric problems.
4. To study rigorous algorithmic analysis of geometric problems

Syllabus

Geometric preliminaries, Plane sweep technique, Line segment intersection, Point location, Searching, Triangulation, Art Gallery theorem, Linear programming, Arrangements of lines, Convex Hulls and Voronoi Diagrams.

Expected Outcome

After completing the course, students will be able to

1. Develop efficient algorithms by exploiting geometric properties, and using appropriate data structures and geometric techniques.
2. Apply learned techniques and algorithms for solving problems in diversified fields like data base searching, data mining, graphics, and image processing pattern recognition, computer vision motion planning and robotics.
3. Perform complexity analysis of algorithms
4. Identify properties of geometric objects, express them as lemmas or theorems, and prove their correctness
5. Implement geometric algorithms.

Text Books

1. Mark. de Berg, Marc. van Kreveld, Mark. Overmars and Otfried Cheong, *Computational Geometry- Algorithms and Applications.* Springer- Verlag 3rd Edn.
2. Joseph O'Rourke, *Computational Geometry in C.* Cambridge University Press 2nd Edn.
3. Franco P. Preparata and Michael Ian Shamos, *Computational Geometry an Introduction,* Texts and Monographs in Computer Science, Springer Verlag.

References

1. Herbert Edelsbrunner, *Algorithms in Combinatorial Geometry,* EATCS Monographs on Theoretical Computer Science, Springer Verlag.
2. Joseph O' Rourke, *Art Gallery Theorems.* Oxford Press publications.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Geometric Preliminaries, DCEL (Doubly Connected Edge List) data structure, Polygon, Planar Straight Line Graph (PSLG) Area of a triangle, area of a polygon, Determinant used to test position of a point with respect to a directed line. Convex polygons, properties and point location in convex polygon (inside-outside test) Plane sweep algorithm, Algorithm for Line segment intersection problem using plane sweep technique.	6	15
II	Point location in PSLG – Slab method, Chain method and complexity analysis. Range Searching – 1D Range search, Kd Trees.	6	15
FIRST INTERNAL EXAM			
III	Polygon Triangulation : Regularization of polygons, properties of triangulations –Proofs, triangulation of monotone polygon – algorithm and complexity analysis. Linear Programming – Half plane intersection, Incremental algorithm and Randomized algorithm	8	15
IV	Art Gallery Theorem, Guarding Art Gallery, Fisk's proof using three colouring. Arrangements of Lines – Duality, Combinatorics of arrangements, Zone Theorem, Algorithm for Constructing arrangements of lines.	6	15
SECOND INTERNAL EXAM			
V	Convex Hulls- Convex Hull Algorithms in the Plane - Graham's Scan Algorithm, Jarvi's March, Divide and Conquer Algorithm.	6	20
VI	Voronoi Diagrams- Properties and applications in the plane. Proofs of properties related to vertices and edges of voronoi diagrams Algorithm for constructing voronoi diagram. Delaunay Triangulation.	8	20
END SEMESTER EXAM			

Question Paper Pattern

1. There will be three parts in the question paper – A, B and C
2. Part A
    a. Total marks : 30
3. Answer *Three* questions out of *Four* questions, each having *10* marks, uniformly covering modules I and II.
4. Part B
    a. Total marks : 30
5. Answer *Three* questions out of *Four* questions each having *10* marks, uniformly covering modules III and IV.
6. Part C
    a. Total marks : 40
    b. Answer *Four* questions out of *Six* each having *10* marks, uniformly covering modules V and VI.
7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS463	DIGITAL IMAGE PROCESSING (Elective 3)	3-0-0-3	2015

Course Objectives

1. To understand the fundamental concepts and applications of Digital Image Processing.
2. To study the various operations in Digital Image Processing.
3. To know various transform domains

Syllabus

Introduction on digital image processing fundamentals; Image Transforms; Spatial and frequency domain filtering; Image segmentation; Morphological Image processing; Representation and Description.

Expected Outcomes

After completing the course, students will be able to

1. Get the fundamental concepts of Image processing
2. Understand the need for transforms.
3. Analyze images in spatial and frequency domain.
4. Know the various applications and operations in image processing

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing (English) 3rd Edition, Pearson India, 2013.
2. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.

References

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, Thomson Learning, 2008.
2. Al Bovik, The Essential Guide to Image Processing, Academic Press, 2009.
3. S. Jayaraman, S. Esakkirajan, T. Veerakumar, Digital Image Procesing, McGraw Hill Education , 2009.

COURSE PLAN

Module	Contents	Contact	Sem. Exam Marks:%
I	Introduction to Image processing Pixels; coordinate conventions; Imaging Geometry; Spatial Domain; Frequency Domain; sampling and quantization; Image transforms and its properties – Unitary transform, Discrete Fourier Transform, Discrete Cosine Transform, Walsh Transform, Hadamard Transform; Applications of Image Processing.	8	15%

II	Image Enhancement in spatial domain Basic Gray Level Transformation functions – Point Processing: Contrast Stretching, Thresholding; Piecewise-Linear Transformation Functions: Contrast Stretching, Gray Level Slicing, Bit Plane Slicing; Histogram Processing –Specification, Equalization; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging. Basics of Spatial Filtering – Smoothing: Smoothing Linear Filters, Ordered Statistic Filters; Sharpening: The Laplacian, Unsharp Masking and High Boost Filtering.	8	15%
FIRST INTERNAL EXAM			
III	Image Enhancement in Frequency Domain Basics of Filtering in Frequency Domain, Filters - Smoothing Frequency Domain Filters : Ideal Low Pass Filter, Gaussian Low Pass Filter, Butterworth Low Pass Filter; Sharpening Frequency Domain Filters: Ideal High Pass Filter, Gaussian High Pass Filter, Butterworth High Pass Filter, Homomorphic Filtering.	6	15%
IV	Image Segmentation Pixel-Based Approach- Multi-Level Thresholding, Local Thresholding, Threshold Detection Method; Region-Based Approach- Region Growing Based Segmentation, Region Splitting, Region Merging, Split and Merge, Region Growing; Edge Detection - Edge Operators; Line Detection, Corner Detection.	7	15%
SECOND INTERNAL EXAM			
V	Morphological Operations Basics of Set Theory; Dilation and Erosion - Dilation, Erosion; Structuring Element; Opening and Closing; Hit or Miss Transformation; Morphological Algorithms- Boundary Extraction, Hole filling, Extraction of Connected Components, convex hull, Thinning, Thickening; Skeletons, Pruning.	7	20%

VI	Representation and Description Representation - Boundary, Chain codes, Polygonal approximation approaches, Boundary segments; Boundary Descriptors – Simple descriptors, Shape numbers, Fourier descriptors, Statistical moments; Regional Descriptors – Simple descriptors, Topological descriptors.	6	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be three parts in the question paper – A, B and C
2. Part A
    a. Total marks : 30
3. Answer *Three* questions out of *Four* questions, each having *10* marks, uniformly covering modules I and II. Each question may include subdivisions.
4. Part B
    a. Total marks : 30
5. Answer *Three* questions out of *Four* questions each having *10* marks, uniformly covering modules III and IV. Each question may include subdivisions.
6. Part C
    a. Total marks : 40
    b. Answer *Four* questions out of *Six* each having *10* marks, uniformly covering modules V and VI. Each question may include subdivisions.

There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS 465	**BIOINFORMATICS (Elective 3)**	**3-0-0-3**	**2015**

Course Objectives

1. To enable the students to understand scope of Bioinformatics
2. To understand popular bioinformatics database
3. To understand secondary and tertiary structures
4. To learn fundamentals of Sequence alignment
5. To learn Genomics and Gene Recognition
6. To study predictive methods using DNA and Protein Sequences

Syllabus

Introduction to bioinformatics and molecular biology: Databases tools and their uses, Data searches and Pairwise Alignments, Multiple Sequence Alignments, Molecular Phylogenetic, Genomics and Gene Recognition, Protein and RNA structure Prediction

Expected Outcome

After completing the course, students will be able to

1. Students become comfortable to think about problems and arriving at solutions as biologists and as computer scientists.
2. Identify different types of biological sequence
3. Analyse multiple sequences and find conserved regions
4. Capable to predict RNA, Protein secondary structures
5. Analyse genomic sequences and able to identify regions that encoded genes

References

1. S.C. Rastogi, N. Mendiratta and P.Rastogi, " Bioinformatics: Methods and Applications" , 2015, ISBN : 978-81-203-4785-4, published by PHI Learning Private Limited, New Delhi.
2. D. E. Krane and M. L. Raymer, Fundamental Concepts of Bioinformatics, ISBN 978-81-7758-757-9, Pearson Education, 2006.
3. Andreas D.Baxevanis, B.F. Francis Ouellette, "Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins", Third Edition, 2005-2006, ISBN: 978-81-265-2192-0, published by John Wiley & Sons INC. , U.K.
4. Neil C Jones and Pavel A Pevzner, An Introduction to Bioinformatics Algorithms, MIT press, 2004.

Course Plan			
Module	**Contents**	**Contact Hours**	**Sem. Exam Marks;%**
I	Bioinformatics and Computational Biology, Nature & Scope of Bioinformatics. The central dogma of molecular biology and bio-sequences associated with it, RNA classification –coding and non coding RNA-mRNA, tRNA, miRNA and sRNA, RNAi. DNA and RNA structure – Nucleic Acid structure and function, Genetic Code, Genes and Evolution	6	15
II	Importance of databases - Biological databases-primary sequence databases, Composite sequence databases- Secondary databases-nucleic acid sequence databases - Protein sequence data bases - structure databases, Types of databases, Data retrieval tools - Entrez	8	15
	FIRST INTERNAL EXAM		
III	Sequence alignment – local/global, pairwise sequence alignment, scoring methods. Needleman and Wunsch algorithm, global and local alignments. Multiple sequence alignment. Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived. Differences between distance & similarity matrix.	10	20
IV	Introduction, Advantages, Phylogenetic Trees, Tree topologies, Methods for phylogenetic analysis-Distance Matrix methods, Character based methods. HMM (Hidden Markov Model): Introduction to HMM, Forward algorithm, Viterbi algorithm, applications in Bioinformatics	8	15
	SECOND INTERNAL EXAM		
V	General introduction to Gene expression in prokaryotes and eukaryotes- Prokaryotic Genomes – Gene structure, GC content, Gene Density,	10	20

	Eukaryotic Genomes- Gene structure, GC content, Gene Density, Gene Expression, Transposition, Gene prediction approaches.		
VI	Protein and RNA structure Prediction: Predicting RNA secondary structure - Nussinov Algorithm, Energy minimisation methods - Zuker Algorithm. Amino Acids, Polypeptide Composition, Protein Structures, Algorithm for protein folding, Structure prediction	8	15
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS 467	MACHINE LEARNING (Elective 3)	3-0-0-3	2015

Course Objectives:

1. To familiarize with the prominent methods for machine learning
2. To understand the basics of supervised and unsupervised learning
3. To learn the basics of connectionist and other architectures
4. To apply these methods to real life problems involving machine learning

Syllabus

Introduction to Machine Learning, Learning in Artificial Neural Networks, Decision trees, HMM, SVM, and other Supervised and Unsupervised learning methods.

Expected Outcome

After completing the course, students will be able to

1. Differentiate different learning approaches, and to interpret theoretical foundations of supervised learning.
2. Contrast the different dimensionality reduction techniques.
3. Apply theoretical foundations of decision trees to identify best split and Bayesian classifier to label data points
4. Illustrate the working of classifier models like SVM, Neural Networks and identify classifier model for typical machine learning application.
5. Identify the state sequence and evaluate a sequence emission probability from a given HMM
6. Illustrate and apply clustering algorithms and identify its applicability in real life problems

References:

1. Ethem Alpaydın, *Introduction to Machine Learning* (Adaptive Computation and Machine Learning), MIT Press, 2004.
2. Mitchell. T, *Machine Learning,* McGraw Hill, Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
3. Ryszard S. Michalski, Jaime G. Carbonell, and Tom M. Mitchell, *Machine Learning : An Artificial Intelligence Approach*, Tioga Publishing Company.
4. Margaret H. Dunham. Data Mining: introductory and Advanced Topics, Pearson, 2006

Course Plan

Module	Contents	Contact Hours	Sem. Exam Marks;%
I	What is Machine Learning, Examples of Machine Learning applications - Learning associations, Classification, Regression, Unsupervised Learning,	6	15

II	Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis (VC) Dimension Probably Approximately Learning (PAC), Noise, Learning Multiple classes, Model Selection and Generalization, Dimensionality reduction- Subset selection, Principle Component Analysis	8	15
FIRST INTERNAL EXAM			
III	Classification- Cross validation and re-sampling methods- K-fold cross validation, Boot strapping, Measuring classifier performance- Precision, recall, ROC curves. Bayes Theorem, Bayesian classifier, Maximum Likelihood estimation, Density functions, Regression	10	20
IV	Decision Trees- Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART), Neural Networks- The Perceptron, Activation Functions, Training Feed Forward Network by Back Propagation.	8	15
SECOND INTERNAL EXAM			
V	Kernel Machines- Support Vector Machine- Optimal Separating hyperplane, Soft-margin hyperplane, Kernel trick, Kernel functions. Discrete Markov Processes, Hidden Markov models, Three basic problems of HMMs- Evaluation problem, finding state sequence, Learning model parameters. Combining multiple learners, Ways to achieve diversity, Model combination schemes, Voting, Bagging, Booting	10	20
VI	Unsupervised Learning - Clustering Methods - K-means, Expectation-Maximization Algorithm, Hierarchical Clustering Methods , Density based clustering	8	15
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS469	COMPUTATIONAL COMPLEXITY (Elective 3)	3-0-0-3	2015

Course Objectives

1. Introduce the fundamentals of computational complexity theory.
2. Discuss basic concepts such as computational models, computational complexity measures (e.g., time and space complexity measures), complexity classes, reducibility and completeness notions.
3. Familiarize the concepts of randomized and approximation algorithms and discuss the related complexity classes.

Syllabus

Turing machines, decision problems, time and space complexity, polynomial time algorithms, NP and NP-completeness, standard time and space complexity classes, optimization problems and approximation algorithms, randomized algorithms and complexity classes based on randomized machine models, interactive proofs and their relation to approximation.

Expected Outcome

Student is able to

1. Classify decision problems into appropriate complexity classes, including P, NP, PSPACE and other complexity classes based on deterministic, non-deterministic and randomized machine models and use this information effectively in practice.
2. State precisely what it means to reduce one decision problem to another, and construct reductions for different decision problems.
3. Use the concept of interactive proofs in the analysis of optimization problems.
4. Classify optimization problems into appropriate approximation complexity classes and use this information effectively.

Text Books

1. Sanjeev Arora and Boaz Barak, Computational Complexity: A Modern Approach, Cambridge University Press,2009
2. Michael Sipser, Introduction to the Theory of Computation, (First edition - PWS Publishing Company, January 1997, or second edition - Thomson Course Technology, 2005).

References

1. Oded Goldreich, Computational Complexity, Cambridge University press.
2. Christos H Papadimitriou, Computational Complexity, Addison-Wesley, 1994.
3. M R Garey and D S Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979.
4. Vijay Vazirani, Approximation Algorithms, Springer--Verlag, 2001
5. Christos H Papadimitriou, Computational Complexity, Addison-Wesley, 1994.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	**Introduction:** Easy and hard problems. Algorithms and complexity. **Turing machines:** Models of computation. Multi-tape deterministic and non-deterministic Turing machines. Decision problems	**5**	**15%**
II	**The Halting Problem and Undecidable Languages:** Counting and diagonalization. Tape reduction. Universal Turing machine. Undecidability of halting. Reductions. Rice's theorem. **Deterministic Complexity Classes:** DTIME[t]. Linear Speed-up Theorem. P Time. Polynomial reducibility. Polytime algorithms: 2-satisfiability, 2-colourability.	**10**	**15%**
FIRST INTERNAL EXAM			
III	**NP and NP-completeness:** Non-deterministic Turing machines. NTIME[t]. NP. Polynomial time verification. NP-completeness. Cook-Levin Theorem. Polynomial transformations: 3-satisfiability, clique, colourability, Hamilton cycle, partition problems. Pseudo-polynomial time. Strong NP-completeness. Knapsack. NP-hardness.	**10**	**15%**
IV	**Space complexity and hierarchy theorems:** DSPACE[s]. Linear Space Compression Theorem. PSPACE, NPSPACE. PSPACE = NPSPACE. PSPACE-completeness. Quantified Boolean Formula problem is PSPACE-complete. L, NL and NL-completeness. NL=coNL. Hierarchy theorems.	**10**	**15%**
SECOND INTERNAL EXAM			
V	**Randomized Complexity:** The classes BPP, RP, ZPP. Interactive proof systems: IP = PSPACE.	**6**	**20%**
VI	**Optimization and approximation:** Combinatorial optimization problems. Relative error. Bin-packing problem. Polynomial and fully polynomial approximation schemes. Vertex cover, traveling salesman problem, minimum partition.	**7**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CS431	**COMPILER DESIGN LAB**	**0-0-3-1**	**2018**

Pre-requisite : CS331 System Software Lab

Course Objectives

1. Learn to implement the different Phases of compiler.
2. Learn simple optimization techniques.
3. Be exposed to compiler writing tools.

List of Exercises/Experiments :

1. Design and implement a lexical analyzer for given language using C and the lexical analyzer should ignore redundant spaces, tabs and new lines.
2. Implementation of Lexical Analyzer using Lex Tool
3. Generate YACC specification for a few syntactic categories.
   a) Program to recognize a valid arithmetic expression that uses operator +, – , * and /.
   b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.

c) Implementation of Calculator using LEX and YACC
d) Convert the BNF rules into YACC form and write code to generate abstract syntax tree

4. Write program to find ε – closure of all states of any given NFA with ε transition.
5. Write program to convert NFA with ε transition to NFA without ε transition.
6. Write program to convert NFA to DFA
7. Write program to minimize any given DFA.
8. Develop an operator precedence parser for a given language.
9. Write program to find Simulate First and Follow of any given grammar.
10. Construct a recursive descent parser for an expression.
11. Construct a Shift Reduce Parser for a given language.
12. Write a program to perform loop unrolling.
13. Write a program to perform constant propagation.
14. Implement Intermediate code generation for simple expressions.
15. Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using an 8086 assembler. The target assembly instructions can be simple move, add, sub, jump etc.

Expected Outcome:

After completing the course, students will be able to

1. Implement the techniques of Lexical Analysis and Syntax Analysis.
2. Apply the knowledge of Lex & Yacc tools to develop programs.
3. Generate intermediate code.
4. Implement Optimization techniques and generate machine level code.

SEMESTER - 8

Course Code	*Course*	*L-T-P*	*Credits*
CS402	Data Mining and Ware Housing	3-0-0	3
CS404	Embedded Systems	3-0-0	3
	Elective 4	3-0-0	3
	Elective 5 (Non Departmental)	3-0-0	3
CS492	Project		6

Total Credits = 18 Hours : 29

Cumulative Credits = 180

Elective 4

CS462	Fuzzy Set Theory and Applications
CS464	Artificial Intelligence
CS466	Data Science
CS468	Cloud Computing
CS472	Principles of Information Security

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS 402	DATA MINING AND WAREHOUSING	3-0-0-3	2015

Course Objectives:

1. To understand what is Data Mining, its origin, taxonomy and applications
2. To understand types of data and to improve the quality of data and efficiency and the ease of the mining process.
3. To study how to investigate the data using practical data mining tools.
4. To understand the supervised learning that is Classification, its applications and approaches
5. To study the alternative approaches for Classification and to learn how to compare and contrast various approaches
6. To understand how to identify associations among objects and to learn various algorithms to find them and to understand methods and need for finding complex Association Rules
7. To learn the unsupervised learning to identify the relation among the objects and to understand applications and algorithms for Clustering

Syllabus

Data Mining, Applications, Data Mining Models, Data Warehousing and OLAP, Challenges, Tools, Data Mining Principles, Data Preprocessing: Data Preprocessing Concepts, Data Visualization, Data Sets and Their Significance, Classification Models, Multi Resolution Spatial Data Mining, Classifiers, Association Rules Mining, Cluster Analysis, Practical Data Mining Tools, Advanced Data Mining Techniques, Web Mining, Text Mining, CRM Applications and Data Mining, Data warehousing.

Expected Outcome

After completing the course, students will be able to

1. Learn the fundamental concepts of Data mining and Warehousing.
2. Apply them to real world problems involving huge data analysis.
3. Apply in emerging areas like social network and web mining.
4. Use practical data mining tools.
5. Analyze and understand various case studies relevant to the current trends in data mining.

Text Books

1. Jaiwei Han, Micheline Kamber, "Data Mining Concepts and Techniques", Elsevier, 2006.
2. M. Sudeep Elayidom, "Data Mining and Warehousing", 1st Edition, 2015 Cengage Learning India Pvt. Ltd.

References

1. Pang-Ning Tan, Michael Steinbach, "Introduction to Data Mining", Addison Wesley, 2006.

2. Dunham M H, "Data Mining: Introductory and Advanced Topics", Pearson Education, New Delhi, 2003.
3. Mehmed Kantardzic, "Data Mining Concepts, Methods and Algorithms", John Wiley and Sons, USA, 2003.

Course Plan			
Module	**Contents**	**Hours**	**Sem Exam . Marks**
I	Data Mining: Concepts: Concepts, Data Mining Applications, Data Mining Stages, Data Mining Models, Data Warehousing and OLAP, Need for Data Warehousing, Challenges, Application of Data Mining Principles, Machine Learning and Statistics, Ethics of Data Mining, Popular Tools. OLTP Vs DWH, Applications of DWH	6	15
II	Data Preprocessing: Data Preprocessing Concepts, Data Cleaning, Handling Missing Data, Data Transformation and Discretization, Data Visualization. UCI Data Sets and Their Significance	6	15
FIRST INTERNAL EXAM			
III	Classification Models: Introduction to Classification Models, Decision Tree, Neural Networks	6	15
IV	Naive Bayes Classifier, Support Vector Machines. Prediction Models, Issues regarding classification and prediction.	6	15
SECOND INTERNAL EXAM			
V	Regression Analysis, Association Rules Mining: Concepts, Apriori Algorithm. Cluster Analysis: Introduction, Concepts, K-Means Clustering, Density-Based Clustering, Weighted Graph Partitioning, Hypergraph Partitioning,	8	20
VI	Practical Data Mining Tools: Introduction to Weka and R Package for Data Mining. Advanced Data Mining Techniques: Introduction, Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining. Text Mining, CRM Applications and Data Mining, CRM Data Mining Models. Introduction to new trends in data mining: Social Network Analysis	8	20
END SEMESTER EXAMINATION			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS 404	EMBEDDED SYSTEMS	3-0-0-3	2015

Course Objectives

1. Develop an understanding of the technologies behind embedded computing systems.
2. Introduce students to the various software components invloved in embedded system design and development.
3. Expose students to the recent trends in embedded system design.

Syllabus

Introduction to embedded systems, basic components, its characteristics. Modelling embedded systems, firmware development. Integration and testing of embedded systems, development environment. Characteristics of RTOS, interrupt handling, creating tasks in a typical RTOS. Embedded product development life cycle.

Expected outcome.

At the end of the course, student is able to

1. Demonstrate the role of individual components involved in a typical embedded system.
2. Analyze the characteristics of different computing elements and select the most appropriate one for an embedded system.
3. Model the operation of a given embedded system.
4. Substantiate the role of different software modules in the development of an embedded system.
5. Develop simple tasks to run on an RTOS.
6. Examine the latest trends prevalent in embedded system design.

References:

1. Shibu K.V., Introduction to Embedded Systems, McGraw Hill Education (India), 2009.
2. Raj Kamal, Embedded Systems: Architecture, Programming and Design, Third Edition, McGraw Hill Education (India).
3. Jean J. Labrose, MicroC OS II: The Real Time Kernel, Second Edition, CRC Press.
4. Steave Heath, Embedded System Design, Second Edition, Elsevier.
5. J Staunstrup and Wayne Wolf, Hardware / Software Co-Design: Principles and Practice, Prentice Hall.

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	**Introduction to Embedded System:** Understanding the Basic Concepts, The Typical Embedded System – Characteristics and Quality attributes.	6	15%
II	Hardware Software Co-Design and Program Modelling – Fundamental Issues, Computational Models- Data Flow Graph, Control Data Flow Graph, State Machine, Sequential Model,	9	15%

	Concurrent Model, Object oriented model, UML		
FIRST INTERNAL EXAMINATION			
III	Design and Development of Embedded Product – Firmware Design and Development – Design Approaches, Firmware Development Languages.	6	15%
IV	Integration and Testing of Embedded Hardware and Firmware- Integration of Hardware and Firmware. Embedded System Development Environment – IDEs, Cross Compilers, Disassemblers, Decompilers, Simulators, Emulators and Debuggers.	6	15%
SECOND INTERNAL EXAMINATION			
V	RTOS based Design – Basic operating system services. Interrupt handling in RTOS environment. Design Principles. Task scheduling models. How to Choose an RTOS. Case Study – MicroC/OS-II.	9	20%
VI	Embedded Product Development Life Cycle – Description – Objectives -Phases – Approaches. Recent Trends in Embedded Computing.	6	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40

b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CS462	FUZZY SET THEORY AND APPLICATIONS (Elective 4)	3-0-0-3	2015

Course Objectives

1. Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
2. Provide an emphasis on the differences and similarities between fuzzy sets and classical sets theories.
3. Cover fuzzy logic inference with emphasis on their use in the design of intelligent or humanistic systems.
4. Provide a brief introduction to fuzzy arithmetic concepts.
5. Provide an insight into fuzzy inference applications in the area of control.

Syllabus

Theory of Fuzzy Sets: Classical Sets vs Fuzzy Sets, Types of Fuzzy Sets, Operations on Fuzzy Sets, Zadeh's Extension Principle, Fuzzy Relations, Fuzzy Relational Equations, Possibility Theory and Fuzzy Measures. Applications of Fuzzy Sets: Approximate Reasoning, Fuzzy Relational Inference, Fuzzy Controllers, Efficiency and Effectiveness of inference schemes, Functional Approximation capabilities.

Expected outcome.

At the end of the course, student is able to

1. Defines and argues about fuzzy set theory and uncertainty concepts.
2. Identifies the similarities and differences between probability theory and fuzzy set theory and their application conditions.
3. Applies fuzzy set theory in modeling and analyzing uncertainty in a decision problem.
4. Applies fuzzy control by examining simple control problem examples.

Text BookS:

1. George J Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic : Theory and Applications", Prentice Hall NJ,1995.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Willey, 2010.

References:

1. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, New Delhi, 1991.
2. Kevin M Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman, 1998.
3. Michal Baczynski and Balasubramaniam Jayaram, Fuzzy Implications, Springer Verlag, Heidelberg, 2008.
4. E P Klement, R Mesiar and E. Pap, Triangular norms, Kluwer Academic Press, Dordrecht, 2000.
5. M Grabisch et al., Aggregation Functions, Series - Encyclopedia Of Mathematics And Its Applications, Cambridge University Press, 2009

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Classical sets vs Fuzzy Sets - Need for fuzzy sets - Definition and Mathematical representations - Level Sets - Fuzzy functions - Zadeh's Extension Principle.	06	15%
II	Operations on [0,1] - Fuzzy negation, triangular norms, t-conorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations	06	15%
FIRST INTERNAL EXAMINATION			
III	Fuzzy Binary and n-ary relations - composition of fuzzy relations - Fuzzy Equivalence Relations - Fuzzy Compatibility Relations - Fuzzy Relational Equations	07	15%
IV	Fuzzy Measures - Evidence Theory - Necessity and Belief Measures - Probability Measures vs Possibility Measures	07	15%
SECOND INTERNAL EXAMINATION			
V	Fuzzy Decision Making - Fuzzy Relational Inference - Compositional Rule of Inference - Efficiency of Inference - Hierarchical	08	20%
VI	Fuzzy If-Then Rule Base - Inference Engine - Takagi-Sugeno Fuzzy Systems - Function Approximation Applications *Advanced topics: Adaptive fuzzy inference systems: Adaptive networks - Architectures - Learning rules.* *Adaptive neuro-fuzzy inference systems (ANFIS) - Architectures - Hybrid learning rules.*	08	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D

a. Total marks : 18
b. *Three* questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS464	ARTIFICIAL INTELLIGENCE (Elective 4)	3-0-0-3	2015

Course Objectives

1. To impart basic principles that drive complex real world intelligence applications.
2. To familiarize basic concepts of Robotics.

Syllabus

Introduction to AI, Intelligent Agents-Environments, Structure of Agents, Solving Problems by Searching-uninformed,informed,heuristic,Adversial search-Alpha beta pruning, Stochastic games, Constraint Satisfaction problems-back tracking search, Local search, Classical Planning- Planning as state space search, Planning Graphs, Concepts of Robotics- Robot Hardware ,Perception, Robotic Software Architectures, Applications.

Expected outcome

At the end of the course, student is able to

1. Describe the scope and limits of the artificial intelligence (AI) field.
2. Understand different types of AI agents.
3. Explain various search algorithms (uninformed, informed, and heuristic) for problem solving.
4. Compare minimax search and alpha-beta pruning in game playing.
5. Model complex real world problems using different AI approaches (e.g. as a search problem, as a constraint satisfaction problem, as a planning problem.)
6. Comprehend the fundamentals of Robotics.

Text Book:

1. Stuart Jonathan Russell, Peter Norvig, Artificial intelligence, A modern approach,3rd edition, pearson,2010

References:

1. George.F.Luger, Artificial Intelligence- Structures and Strategies for Complex Problem Solving, 4/e, Pearson Education. 2002.
2. Deepak Khemeni,A First course in Artificial Intelligence,Tata McGraw Hill,2013
3. Stefan Edelkamp, Stefan Schroedl, Heuristic Search: Theory and Applications, Morgan Kaufman, 2011.
4. D. Poole and A. Mackworth. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010 Available online: *http://artint.info/*
5. E. Rich, k.knight, Artificial Intelligence, 3/e, Tata McGraw Hil, 2009.
6. Maja J. Mataric ,Robotics Primer,MIT press,2007
7. Patrick Henry Winston,Artificial intelligence,Addisson wessley,1992
8. Dan W Patterson, Introduction to Artificial Intelligence,Pearson,2009

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	**Introduction**: What is AI, The foundations of AI, *History, The state of the Art.* **Intelligent Agents**-Agents and Environments, Good Behaviour, The nature of Environments, The Structure of Agents.	5	15%
II	**Solving problems by searching**: Problem solving Agents, Example problems, Searching for solutions, Uninformed search strategies, Informed (Heuristic) Search strategies, Heuristic Functions	9	15%
FIRST INTERNAL EXAMINATION			
III	**Adversial search**: Games, optimal decision in Games, Alpha Beta pruning, Imperfect real time decisions, stochastic Games, Partially Observable games, *State of the art Game programs, Alternative Approaches*	6	15%
IV	**Constraint Satisfaction Problems**: Defining CSPs, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.	6	15%
SECOND INTERNAL EXAMINATION			
V	**Classical planning**: Definition of classical planning, Algorithms for Planning as state space search, Planning Graphs, Other Classical planning approaches, Analysis of planning approaches	9	20%
VI	**Introduction to Robotics**: Robot Hardware, Robotic Perception, Planning to Move, Planning Uncertain Movements, Moving, Robotic Software Architectures, *Application Domains.*	7	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18

b. *Three* questions each having 9 marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS466	DATA SCIENCE (Elective 4)	3-0-0-3	2015

Course Objectives

1. Able to apply fundamental algorithmic ideas to process data.
2. Learn to apply hypotheses and data into actionable predictions.
3. Document and transfer the results and effectively communicate the findings using visualization techniques

Syllabus

Modern scientific, engineering, and business applications are increasingly dependent on data, existing traditional data analysis analysis technologies were not designed for the complexity of the modern world. Data Science has emerged as a new, exciting and fast-paced discipline that explores novel statistical, algorithmic, and implementation challenges that emerge in processing, storing, and extracting knowledge from Big Data.

Expected Outcome

At the end of the course, student is able to

6. Explain and discuss the significance data science and key data science functionalities
7. Discuss and demonstrate various models suitable for data science
8. Perform preliminary statistical analysis using R language on simple data sets
9. Perform python-based predication and filtering on simple data sets
10. Explain the functionality of Hadoop and Map-Reduce and use it for data analysis.
11. Explain and perform data visualization techniques at a basic level.

References

1. Nina Zumel, John Mount "Practical Data Science with R ··. Manning Publications. 2014.
2. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets". Cambridge University Press, 2014.
3. W. N. Venablcs. D. M. Smith and the R Core Team, "An Introduction to R", 2013.
4. Tony Ojeda, Sean Patrick Murphy, Benjarnin Bengfort. Abhijit Dasgupta. "Practical Data Science Cookbook", Packt Publishing Limited, 2014.
5. Sameer Madhavan , "Mastering Python for Data Science", Packt Publishing Limited, 2015.
6. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization and Statistics", Wiley, 2011.
7. Boris Lublinsky, Kevin T. Smith. Alexcy Yakubovich, "Professional Hadoop Solutions", Wiley, 2015.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Data science process-roles, stages in data science project-working with data from files-working with relational databases-exploring data –managing data-cleaning and sampling for modeling and validation-introduction to NoSQL	6	15
II	Choosing and evaluating models-mapping problems to machine learning, evaluating clustering models, validating models-cluster analysis-k-means algorithm, Naive Bayes-Memorization Methods - Linear and logistic regression-unsupervised methods.	8	20
FIRST INTERNAL EXAM			
III	Reading and getting data into R- ordered and unordered factors - arrays and matrices lists and data frames - reading data from files - probability distributions - statistical models In R manipulating objects - data distribution.	8	15
IV	Python-based data visualization, predication through linear regression, collaborative filtering.	6	15
SECOND INTERNAL EXAM			
V	Introduction distributed file system mar reduce. Algorithm using Map Reduce –Matrix –Vector Multiplication by map reduce – Hadoop – Understanding Map Reduce architecture – writing Hadoop Map-Reduce programs-Loading data into HDFS Map-Reduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.	6	20
VI	Documentation and deployment - producing effective presentations - introduction to graphical analysis – plot() function - display ing multivariate data - matrix plots multiple plots in one window - exporting graph - using graphics parameters. Case studies.	6	15
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS468	CLOUD COMPUTING (Elective 4)	3-0-0-3	2015

Course Objectives

1. To impart the fundamentals of virtualization techniques.
2. To impart fundamentals , advanced concepts and security issues of cloud paradigm.
3. To introduce cloud computing based programming techniques and cloud services.

Syllabus- Introduction to Virtualization – Introduction to Cloud Computing , Cloud Architecture and Resource Management ,Cloud Programming ,Security in the Cloud , Using Cloud Services.

Expected outcome:

At the end of the course, student is able to

1. Identify the significance of implementing virtualization techniques.
2. Understand the various cloud computing models and services
3. Compare the various public cloud platforms and software environments.
4. Apply appropriate cloud programming methods to solve big data problems.
5. Appreciate the need of security mechanisms in cloud
6. Illustrate the use of various cloud services available online.

Text Book:

1. Kai Hwang – Geoffrey C Fox – Jack J Dongarra – "Distributed and Cloud Computing – From Parallel Processing to the Internet of Things" – Morgan Kaufmann Publishers – 2012.

References:

1. John W.Rittinghouse and James F.Ransome – "Cloud Computing: Implementation – Management – and Security" – CRC Press – 2010.
2. Michael Miller – "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online" – Pearson Education – 2009.
3. Toby Velte – Anthony Velte – Robert Elsenpeter – "Cloud Computing – A Practical Approach" – TMH – 2009.
4. George Reese – "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud(Theory in Practice)" – O'Reilly Publications – 2009.
5. James E. Smith – Ravi Nair – Virtual Machines: Versatile Platforms for Systems and Processes – MorganKaufmann – ELSEVIER Publication – 2006.
6. Alex Amies – Harm Sluiman – QiangGuo Tong – and GuoNing Liu – Developing and Hosting Applications on the cloud – IBM Press – 2012.
7. Haley Beard – "Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing – applications and Data Centers in the Cloud with SLAs" – Emereo Pty Limited – July 2008
8. Richard N. Katz – "The Tower and The Cloud" – Higher Education in the Age of Cloud Computing – 2008.

Course Plan			
Module	**Contents**	**Hours**	**Sem.ExamMarks**
I	**INTRODUCTION TO VIRTUALIZATION** Virtual Machines and Virtualization Middleware – Data Center Virtualization for Cloud Computing – Implementation Levels of Virtualization – Virtualization Structures/Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices	7	15%
II	**INTRODUCTION TO CLOUD COMPUTING** System Models for Distributed and Cloud Computing – Software Environments for Distributed Systems and Clouds – Cloud Computing and Service Models – Public – Private – Hybrid Clouds – Infrastructure-as-a-Service (IaaS) – Platform-as-a-Service (PaaS) - Software-as-a-Service (SaaS)-Different Service Providers	8	15%
FIRST INTERNAL EXAMINATION			
III	**CLOUD ARCHITECTURE AND RESOURCE MANAGEMENT** Architectural Design of Compute and Storage Clouds – Public Cloud Platforms: GAE – AWS – Azure- Emerging Cloud Software Environments – Eucalyptus-Nimbus – Open Stack – Extended Cloud Computing Services – Resource Provisioning and Platform Deployment – Virtual Machine Creation and Management.	8	15%
IV	**CLOUD PROGRAMMING** Parallel Computing and Programming Paradigms – Map Reduce – Twister – Iterative Map Reduce – Hadoop Library from Apache – Pig Latin High Level Languages- Mapping Applications to Parallel and Distributed Systems – Programming the Google App Engine – Google File System (GFS) – Big Table – Google's NOSQL System	7	15%
SECOND INTERNAL EXAMINATION			
V	**SECURITY IN THE CLOUD** Security Overview – Cloud Security Challenges – Security -as-a-Service – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.	6	20%
VI	**USING CLOUD SERVICES :** Email Communications – Collaborating on To-Do Lists –	6	20%

	Contact Lists – Cloud Computing for the Community- Collaborating on Calendars – Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Project Management -Word Processing – Databases .		
END SEMESTER EXAM			

Question Paper Pattern

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    b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 50% analytical/numerical questions.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS472	PRINCIPLES OF INFORMATION SECURITY (Elective 4)	3-0-0-3	2015

Course Objectives

1. To impart fundamental understanding of security.
2. To impart the relevance of security in operating system, web services etc.
3. To impart the fundamental understanding of secure electronic transactions

Syllabus

Overview of computer security, Security concepts, Need of Security, Access Control, Access control matrix, Security policies, Software vulnerabilities, Security in current domains - Wireless LAN security, Cellphone security, Secure Electronics transactions, Web Services security

Expected outcome

At the end of the course, student is able to

1. Students are able to understand the common threats faced today.
2. Understand the foundational theory behind information security.
3. Learn to design a secure system.
4. Identify the vulnerability possibilities in softwares.
5. Understand the relevance of security in various domains.
6. Gather in depth knowledge to make the secure web services and perform secure e-transactions.

Text Book:

1. Bernard Menezes, Network security and Cryptography, Cengage Learning India, 2010.
2. M. Bishop, Computer Security: Art and Science, Pearson Education, 2003.

References:

1. E. Whiteman and J. Mattord, Principles of information security 4th edn, Cengage Learning
2. V.K Pachghare, Cryptography and information security, PHI
3. Behrousz A Forouzan, D Mukhopadhyay, Cryptography and network Security, Mc Graw Hill
4. W. Mao, Modern Cryptography: Theory & Practice, Pearson Education, 2004.
5. C. P. Fleeger and S. L. Fleeger, Security in Computing, 3/e, Pearson Education, 2003.

Course Plan			
Module	**Contents**	**Hours**	**Sem. ExamMarks**
I	**Introduction**: Overview of computer security, Security concepts, Need of Security- Threats- Deliberate software attacks, Deviation in quality of service, Attacks- malicious code, brute force, Timing attack, sniffers **Access Control Mechanisms** - Access Control, Access control matrix, Access control in OS- Discretionary and Mandatory access control, Role-based access control, case study SELinux	9	15%
II	**Security policies and models**: confidentiality policies, Bell-LaPadula model, Integrity policies, Biba model, Clark-Wilson models, Chinese wall model, waterfall model	9	15%
FIRST INTERNAL EXAMINATION			
III	**Software vulnerabilities**: Buffer and stack overflow, Cross-site scripting(XSS) , and vulnerabilities, SQL injection and vulnerabilities , Phishing.	8	15%
IV	**Malware**: Viruses, Worms and Trojans. Topological worms. Internet propagation models for worms.	8	15%
SECOND INTERNAL EXAMINATION			
V	**Security in current domains:** Wireless LAN security - WEP details. wireless LAN vulnerabilities – frame spoofing. Cellphone security - GSM and UMTS security. Mobile malware - bluetooth security issues.	10	20%
VI	**Secure Electronics transactions:** **F**ramework, strength and weakness, Security in current applications : Online banking , Credit Card Payment Systems. **Web Services security**: XML, SOAP, SAML, RFID	10	20%
END SEMESTER EXAM			

Question Paper Pattern

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    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.