

Course code	Course Name	L-T-P Credits	Year of Introduction
CS401	COMPUTER GRAPHICS	4-0-0-4	2016
<b>Course Objectives :</b> <ul style="list-style-type: none"> <li>• To introduce concepts of graphics input and display devices.</li> <li>• To discuss line and circle drawing algorithms.</li> <li>• To introduce 2D and 3D transformations and projections.</li> <li>• To introduce fundamentals of image processing.</li> </ul>			
<b>Syllabus:</b> Basic Concepts in Computer Graphics. Input devices. Display devices. Line and 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.			
<b>Expected Outcome:</b> The Students will be able to : <ol style="list-style-type: none"> <li>i. compare various graphics devices</li> <li>ii. analyze and implement algorithms for line drawing, circle drawing and polygon filling</li> <li>iii. apply geometrical transformation on 2D and 3D objects</li> <li>iv. analyze and implement algorithms for clipping</li> <li>v. apply various projection techniques on 3D objects</li> <li>vi. summarize visible surface detection methods</li> <li>vii. interpret various concepts and basic operations of image processing</li> </ol>			
<b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996</li> <li>2. E. Gose, R. Johnsonbaugh and S. Jost., Pattern Recognition and Image Analysis, PHI PTR, 1996 (Module VI – Image Processing part)</li> <li>3. William M. Newman and Robert F. Sproull , Principles of Interactive Computer Graphics. McGraw Hill, 2e, 1979</li> <li>4. Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum’s outline Series), McGraw Hill, 1986.</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>1. David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill, 2001.</li> <li>2. M. Sonka, V. Hlavac, and R. Boyle, Image Processing, Analysis, and Machine Vision, Thomson India Edition, 2007.</li> <li>3. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing. Pearson, 2017</li> </ol>			

<b>Course Plan</b>			
<b>Module</b>	<b>Contents</b>	<b>Hours</b>	<b>End Sem. Exam Marks</b>
<b>I</b>	Basic concepts in Computer Graphics – Types of Graphic Devices – Interactive Graphic inputs – Raster Scan and Random Scan Displays.	7	15%
<b>II</b>	Line Drawing Algorithm- DDA, Bresenham's algorithm – Circle Generation Algorithms –Mid point circle algorithm, Bresenham's algorithm- Scan Conversion-frame buffers – solid area scan conversion – polygon filling algorithms	8	15%
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	Two dimensional transformations. Homogeneous coordinate systems – matrix formulation and concatenation of transformations. Windowing concepts –Window to Viewport Transformation- Two dimensional clipping-Line clipping – Cohen Sutherland, Midpoint Subdivision algorithm	8	15%
<b>IV</b>	Polygon clipping-Sutherland Hodgeman algorithm, Weiler-Atherton algorithm, Three dimensional object representation- Polygon surfaces, Quadric surfaces – Basic 3D transformations	8	15%
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Projections – Parallel and perspective projections – vanishing points. Visible surface detection methods– Back face removal- Z-Buffer algorithm, A-buffer algorithm, Depth-sorting method, Scan line algorithm.	9	20%
<b>VI</b>	Image processing – Introduction - Fundamental steps in image processing – digital image representations – relationship between pixels – gray level histogram –spatial convolution and correlation – edge detection – Robert, Prewitt, Sobel.	8	20%
<b>END SEMESTER EXAM</b>			

## Question Paper Pattern (End semester exam)

1. There will be **FOUR** parts in the question paper – **A, B, C, D**
2. **Part A**
  - a. **Total marks : 40**
  - b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from **modules I & II**; **THREE** questions from **modules III & IV**; **FOUR** questions from **modules V & VI**).  
*All the TEN* questions have to be answered.
3. **Part B**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question *uniformly* covers **modules I & II**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
4. **Part C**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question *uniformly* covers **modules III & IV**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
5. **Part D**
  - a. **Total marks : 24**
  - b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question *uniformly* covers **modules V & VI**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
6. There will be **AT LEAST 50%** analytical/numerical questions in all possible combinations of question choices.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS403	PROGRAMMING PARADIGMS	3-0-0-3	2016
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To introduce the basic constructs that underlie all programming languages</li> <li>To introduce the basics of programming language design and implementation</li> <li>To introduce the organizational framework for learning new programming languages.</li> </ul>			
<b>Syllabus:</b> 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, Co-routines; 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.			
<b>Expected Outcome:</b> The Students will be able to : <ol style="list-style-type: none"> <li>compare scope and binding of names in different programming languages</li> <li>analyze control flow structures in different programming languages</li> <li>appraise data types in different programming languages</li> <li>analyze different control abstraction mechanisms</li> <li>appraise constructs in functional, logic and scripting languages</li> <li>analyze object oriented constructs in different programming languages</li> <li>compare different concurrency constructs</li> <li>interpret the concepts of run- time program management</li> </ol>			
<b>Text book:</b> <ol style="list-style-type: none"> <li>Scott M L, Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers, 2009.</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>David A Watt, Programming Language Design Concepts, Wiley Dreamtech, 2004</li> <li>Ghezzi C and M. Jazayeri, Programming Language Concepts, 3rd Edn, Wiley.1997</li> <li>Kenneth C Loudon, Programming Languages: Principles and Practice, 3rd Edn., Cengage Learning, 2011.</li> <li>Pratt T W, M V Zelkowitz, and T. V. Gopal, Programming Languages: Design and Implementation, 4th Edn., Pearson Education, 2001</li> <li>R W Sebesta, Concepts of Programming Languages, 11th Edn., Pearson Education, 2015</li> <li>Ravi Sethi, Programming Languages: Concepts &amp; Constructs, 2nd Edn., Pearson Education, 2006</li> <li>Tucker A B and R E Noonan, Programming Languages: Principles and Paradigms, 2nd Edn,McGraw Hill, 2006.</li> </ol>			

<b>Course Plan</b>			
<b>Module</b>	<b>Contents</b>	<b>Hours</b>	<b>End Sem. Exam Marks</b>
<b>I</b>	Names, Scopes and Bindings:- Names and Scopes, Binding Time, Scope Rules, Storage Management, Binding of Referencing Environments. Control Flow: - Expression Evaluation, Structured and Unstructured Flow, Sequencing, Selection, Iteration, Recursion, Non-determinacy.	7	15 %
<b>II</b>	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 %
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	Subroutines and Control Abstraction: - Static and Dynamic Links, Calling Sequences, Parameter Passing, Generic Subroutines and Modules, Exception Handling, Co-routines.	7	15 %
<b>IV</b>	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 %
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Data Abstraction and Object Orientation:-Encapsulation, Inheritance, Constructors and Destructors, Aliasing, Overloading, Polymorphism, Dynamic Method Binding, Multiple Inheritance. Innovative features of Scripting Languages:-Scoping rules, String and Pattern Manipulation, Data Types, Object Orientation.	7	20 %
<b>VI</b>	Concurrency:- Threads, Synchronization. Run-time program Management:- Virtual Machines, Late Binding of Machine Code, Reflection, Symbolic Debugging, Performance Analysis.	7	20 %
<b>END SEMESTER EXAM</b>			

2014

## Question Paper Pattern (End semester exam)

1. There will be **FOUR** parts in the question paper – **A, B, C, D**
2. **Part A**
  - a. **Total marks : 40**
  - b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from **modules I & II**; **THREE** questions from **modules III & IV**; **FOUR** questions from **modules V & VI**).  
*All the TEN* questions have to be answered.
3. **Part B**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question *uniformly* covers **modules I & II**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
4. **Part C**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question *uniformly* covers **modules III & IV**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
5. **Part D**
  - a. **Total marks : 24**
  - b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question *uniformly* covers **modules V & VI**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
6. There will be **AT LEAST 50%** analytical/numerical questions in all possible combinations of question choices.

Course code	Course Name	L-T-P -Credits	Year of Introduction
CS405	COMPUTER SYSTEM ARCHITECTURE	3-0-0-3	2016
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To impart a basic understanding of the parallel architecture and its operations</li> <li>To introduce the key features of high performance computers</li> </ul>			
<b>Syllabus:</b> Basic concepts of parallel computer models, SIMD computers, Multiprocessors and multi-computers, Cache Coherence Protocols, Multicomputers, Pipelining computers and Multithreading.			
<b>Expected outcome :</b> The Students will be able to : <ol style="list-style-type: none"> <li>summarize different parallel computer models</li> <li>analyze the advanced processor technologies</li> <li>interpret memory hierarchy</li> <li>compare different multiprocessor system interconnecting mechanisms</li> <li>interpret the mechanisms for enforcing cache coherence</li> <li>analyze different message passing mechanisms</li> <li>analyze different pipe lining techniques</li> <li>appraise concepts of multithreaded and data flow architectures</li> </ol>			
<b>Text Book:</b> <ul style="list-style-type: none"> <li>K. Hwang and Naresh Jotwani, Advanced Computer Architecture, Parallelism, Scalability, Programmability, TMH, 2010.</li> </ul>			
<b>References:</b> <ol style="list-style-type: none"> <li>H P Hayes, Computer Architecture and Organization, McGraw Hill, 1978.</li> <li>K. Hwang &amp; Briggs , Computer Architecture and Parallel Processing, McGraw Hill International, 1986</li> <li>M J Flynn, Computer Architecture: Pipelined and Parallel Processor Design, Narosa Publishing House, 2012.</li> <li>M Sasikumar, D Shikkare and P Raviprakash, Introduction to Parallel Processing, PHI, 2014.</li> <li>P M Kogge, The Architecture of Pipelined Computer, McGraw Hill, 1981.</li> <li>P V S Rao , Computer System Architecture, PHI, 2009.</li> <li>Patterson D. A. and Hennessy J. L., Morgan Kaufmann , Computer Organization and Design: The Hardware/Software Interface, Morgan Kaufmann Pub, 4/e, 2010.</li> </ol>			

<b>Course Plan</b>			
<b>Module</b>	<b>Contents</b>	<b>Hours</b>	<b>End Sem. Exam Marks</b>
<b>I</b>	Parallel computer models - Evolution of Computer Architecture, System Attributes to performance, Amdahl's law for a fixed workload. Multiprocessors and Multicomputers, Multivector and SIMD computers, Architectural development tracks, Conditions of parallelism.	6	15%
<b>II</b>	Processors and memory hierarchy - Advanced processor technology- Design Space of processors, Instruction Set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar and vector processors, Memory hierarchy technology.	8	15%
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	Multiprocessors system interconnects - Hierarchical bus systems, Cross bar switch and multiport memory, Multistage and combining networks. Cache Coherence and Synchronization Mechanisms, Cache Coherence Problem, Snoopy Bus Protocol, Directory Based Protocol, Hardware Synchronization Problem	7	15%
<b>IV</b>	Message Passing Mechanisms-Message Routing schemes, Flow control Strategies, Multicast Routing Algorithms. Pipelining and Superscalar techniques - Linear Pipeline processors and Nonlinear pipeline processors	8	15%
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Instruction pipeline design, Arithmetic pipeline design - Super Scalar Pipeline Design	8	20%
<b>VI</b>	Multithreaded and data flow architectures - Latency hiding techniques, Principles of multithreading - Multithreading Issues and Solutions, Multiple context Processors, Fine-grain Multicomputer- Fine-grain Parallelism. Dataflow and hybrid architecture	8	20%
<b>END SEMESTER EXAM</b>			



### Question Paper Pattern ( End semester exam)

1. There will be **FOUR** parts in the question paper – **A, B, C, D**
2. **Part A**
  - a. **Total marks : 40**
  - b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from **modules I & II**; **THREE** questions from **modules III & IV**; **FOUR** questions from **modules V & VI**).  
*All the TEN* questions have to be answered.
3. **Part B**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question *uniformly* covers **modules I & II**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
4. **Part C**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question *uniformly* covers **modules III & IV**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
5. **Part D**
  - a. **Total marks : 24**
  - b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question *uniformly* covers **modules V & VI**.
  - c. *Any TWO* questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.
6. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS407	DISTRIBUTED COMPUTING	3-0-0-3	2016
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To introduce fundamental principles of distributed systems, technical challenges and key design issues.</li> <li>To impart knowledge of the distributed computing models, algorithms and the design of distributed system.</li> </ul>			
<b>Syllabus:</b> 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.			
<b>Expected Outcome</b> The Students will be able to : <ol style="list-style-type: none"> <li>distinguish distributed computing paradigm from other computing paradigms</li> <li>identify the core concepts of distributed systems</li> <li>illustrate the mechanisms of inter process communication in distributed system</li> <li>apply appropriate distributed system principles in ensuring transparency, consistency and fault-tolerance in distributed file system</li> <li>compare the concurrency control mechanisms in distributed transactional environment</li> <li>outline the need for mutual exclusion and election algorithms in distributed systems</li> </ol>			
<b>Text Books:</b> <ol style="list-style-type: none"> <li>George Coulouris, Jean Dollimore and Tim Kindberg , Distributed Systems: Concepts and Design, Fifth Edition , Pearson Education, 2011</li> <li>Pradeep K Sinha, Distributed Operating Systems : Concepts and Design, Prentice Hall of India</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>A S Tanenbaum and M V Steen , Distributed Systems: Principles and paradigms, Pearson Education, 2007</li> <li>M Solomon and J Krammer, Distributed Systems and Computer Networks, PHI</li> </ol>			
<b>Course Plan</b>			
Module	Contents	Hours	End 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	6	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	7	15%
SECOND INTERNAL EXAM			
V	Transactional concurrency control:- Transactions, Nested transactions-Locks-Optimistic concurrency control	7	20%
VI	Distributed mutual exclusion - central server algorithm - ring based algorithm- Maekawa's voting algorithm - Election: Ring -based election algorithm - Bully algorithm	7	20%
END SEMESTER EXAM			

### Question Paper Pattern

- There will be **FOUR** parts in the question paper - **A, B, C, D**
- Part A**
  - Total marks : 40**
  - TEN** questions, each have **4 marks**, covering **all the SIX modules (THREE** questions from **modules I & II; THREE** questions from **modules III & IV; FOUR** questions from **modules V & VI**).  
*All the TEN* questions have to be answered.
- Part B**
  - Total marks : 18**
  - THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question *uniformly* covers **modules I & II**.
  - Any TWO** questions have to be answered.
  - Each question can have *maximum THREE* subparts.
- Part C**
  - Total marks : 18**
  - THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question *uniformly* covers **modules III & IV**.
  - Any TWO** questions have to be answered.
  - Each question can have *maximum THREE* subparts.
- Part D**
  - Total marks : 24**
  - THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question *uniformly* covers **modules V & VI**.
  - Any TWO** questions have to be answered.
  - Each question can have *maximum THREE* subparts.
- There will be **AT LEAST 50%** analytical/numerical questions in all possible combinations of question choices.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS409	CRYPTOGRAPHY AND NETWORK SECURITY	3-0-0-3	2016
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To introduce fundamental concepts of symmetric and asymmetric cipher models.</li> <li>To introduce fundamental concepts of authentication.</li> <li>To introduce network security and web security protocols.</li> </ul>			
<b>Syllabus:</b> 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.			
<b>Expected Outcome:</b> The Students will be able to : <ol style="list-style-type: none"> <li>summarize different classical encryption techniques</li> <li>identify mathematical concepts for different cryptographic algorithms</li> <li>demonstrate cryptographic algorithms for encryption/key exchange</li> <li>summarize different authentication and digital signature schemes</li> <li>identify security issues in network, transport and application layers and outline appropriate security protocols</li> </ol>			
<b>Text Books:</b> <ol style="list-style-type: none"> <li>Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw-Hill. 2010</li> <li>William Stallings, Cryptography and Network Security, Pearson Education, 2014</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>B. Schneier , Applied Cryptography, Protocols, Algorithms, and Source Code in C, 2 nd Edn, Wiley, 1995.</li> <li>Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, PHI, 2002</li> </ol>			
<b>Course Plan</b>			
Module	Contents	Hours	End Sem. Exam Marks
I	Symmetric Cipher Models- Substitution techniques- Transposition techniques- Rotor machines-Steganography. Simplified DES- Block Cipher principles- The Data Encryption Standard, Strength of DES- Differential and linear Cryptanalysis. Block Cipher Design principles- Block Cipher modes of operations.	7	15 %
II	IDEA: Primitive operations- Key expansions- One round, Odd round, Even Round- Inverse keys for decryption. AES: Basic Structure- Primitive operation- Inverse Cipher- Key Expansion, Rounds, Inverse Rounds. Stream Cipher –RC4.	7	15 %
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	Public key Cryptography: - Principles of Public key Cryptography Systems, Number theory- Fundamental Theorem of arithmetic, Fermat's Theorem, Euler's Theorem, Euler's Totient Function, Extended Euclid's Algorithm, Modular arithmetic. RSA algorithm- Key Management - Diffie-Hellman Key Exchange, Elliptic curve cryptography	7	15 %
<b>IV</b>	Authentication requirements- Authentication functions- Message authentication codes- Hash functions- SHA -1, MD5, Security of Hash functions and MACs- Authentication protocols-Digital signatures-Digital signature standards.	7	15 %
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	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 %
<b>VI</b>	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 %
<b>END SEMESTER EXAM</b>			

**Question Paper Pattern (End semester exam)**

1. There will be **FOUR** parts in the question paper – **A, B, C, D**
2. **Part A**
  - a. **Total marks : 40**
  - b. **TEN** questions, each have **4 marks**, covering **all the SIX modules (THREE** questions from **modules I & II; THREE** questions from **modules III & IV; FOUR** questions from **modules V & VI)**. **All** questions have to be answered.
3. **Part B**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly** covers **modules I & II**.
  - c. **Any TWO** questions have to be answered.
  - d. Each question can have **maximum THREE** subparts.
4. **Part C**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question **uniformly** covers **modules III & IV**.
  - c. **Any TWO** questions have to be answered.
  - d. Each question can have **maximum THREE** subparts.
5. **Part D**
  - a. **Total marks : 24**
  - b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question **uniformly** covers **modules V & VI**.
  - c. **Any TWO** questions have to be answered.
  - d. Each question can have **maximum THREE** subparts.
6. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS467	MACHINE LEARNING	3-0-0-3	2016

**Course Objectives:**

- To introduce the prominent methods for machine learning
- To study the basics of supervised and unsupervised learning
- To study the basics of connectionist and other architectures

**Syllabus:**

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

**Expected Outcome:**

The Students will be able to :

- i. differentiate various learning approaches, and to interpret the concepts of supervised learning
- ii. compare the different dimensionality reduction techniques
- iii. apply theoretical foundations of decision trees to identify best split and Bayesian classifier to label data points
- iv. illustrate the working of classifier models like SVM, Neural Networks and identify classifier model for typical machine learning applications
- v. identify the state sequence and evaluate a sequence emission probability from a given HMM
- vi. illustrate and apply clustering algorithms and identify its applicability in real life problems

**References:**

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

**Course Plan**

Module	Contents	Hours	End Sem. Exam Marks %
I	Introduction to Machine Learning, Examples of Machine Learning applications - Learning associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis (VC) Dimension	6	15

II	Probably Approximately Learning (PAC), Noise, Learning Multiple classes, Model Selection and Generalization, Dimensionality reduction- Subset selection, Principle Component Analysis	8	15
<b>FIRST INTERNAL EXAM</b>			
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	8	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.	6	15
<b>SECOND INTERNAL EXAM</b>			
V	Kernel Machines- Support Vector Machine- Optimal Separating hyper plane, 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	8	20
VI	Unsupervised Learning - Clustering Methods - K-means, Expectation-Maximization Algorithm, Hierarchical Clustering Methods , Density based clustering	6	15
<b>END SEMESTER EXAM</b>			

### Question Paper Pattern

1. There will be **FOUR** parts in the question paper – **A, B, C, D**
2. **Part A**
  - a. **Total marks : 40**
  - b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from **modules I & II**; **THREE** questions from **modules III & IV**; **FOUR** questions from **modules V & VI**).  
*All the TEN* questions have to be answered.
3. **Part B**
  - a. **Total marks : 18**
  - b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question *uniformly* covers **modules I & II**.
  - c. **Any TWO** questions have to be answered.
  - d. Each question can have *maximum THREE* subparts.

4. Part C

a. Total marks : 18

b. *THREE* questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question *uniformly* covers **modules III & IV**.

c. *Any TWO* questions have to be answered.

d. Each question can have *maximum THREE* subparts.

5. Part D

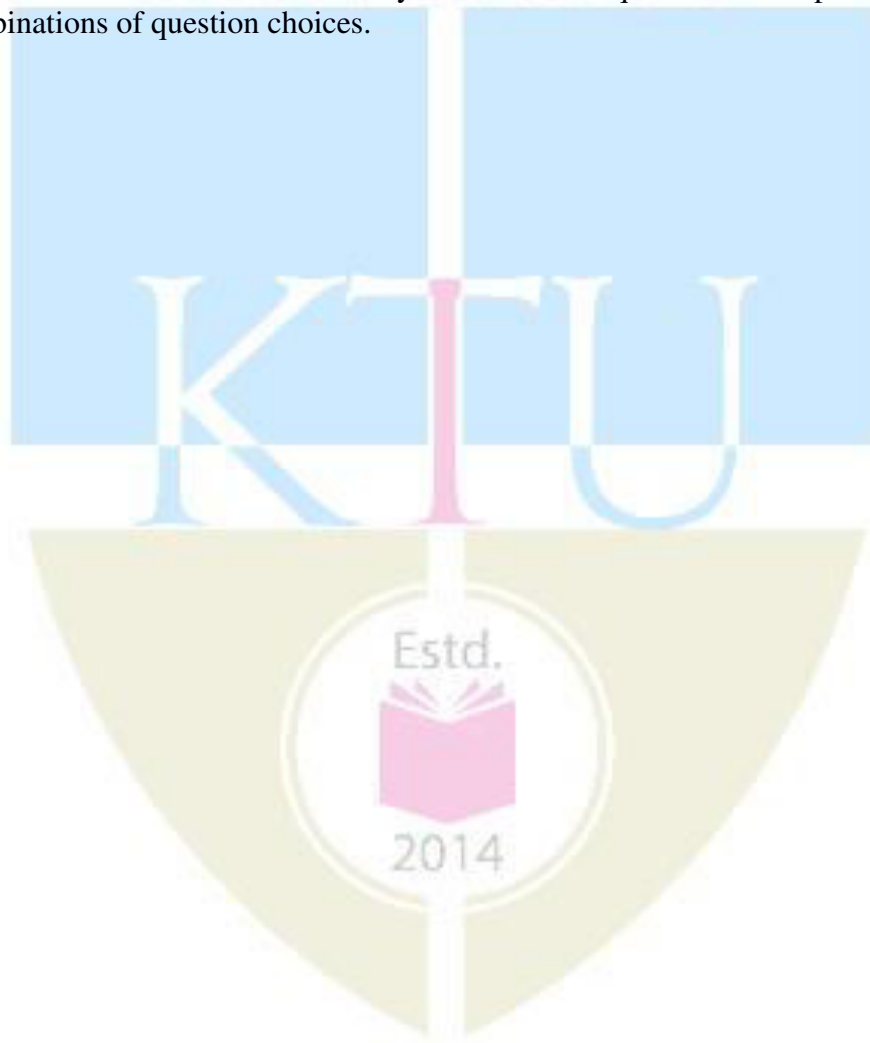
a. Total marks : 24

b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question *uniformly* covers **modules V & VI**.

c. *Any TWO* questions have to be answered.

d. Each question can have *maximum THREE* subparts.

6. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.





Course code	Course Name	L-T-P - Credits	Year of Introduction
CS431	COMPILER DESIGN LAB	0-0-3-1	2016
<b>Pre-requisite</b> : CS331 System Software Lab			
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To implement the different Phases of compiler.</li> <li>• To implement and test simple optimization techniques.</li> <li>• To give exposure to compiler writing tools.</li> </ul>			
<b>List of Exercises/Experiments :</b> <ol style="list-style-type: none"> <li>1. Design and implement a lexical analyzer for given language using C and the lexical analyzer should ignore redundant spaces, tabs and new lines.</li> <li>2. Implementation of Lexical Analyzer using Lex Tool</li> <li>3. Generate YACC specification for a few syntactic categories. <ol style="list-style-type: none"> <li>a) Program to recognize a valid arithmetic expression that uses operator +, -, * and /.</li> <li>b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.</li> <li>c) Implementation of Calculator using LEX and YACC</li> <li>d) Convert the BNF rules into YACC form and write code to generate abstract syntax tree</li> </ol> </li> <li>4. Write program to find <math>\epsilon</math> - closure of all states of any given NFA with <math>\epsilon</math> transition.</li> <li>5. Write program to convert NFA with <math>\epsilon</math> transition to NFA without <math>\epsilon</math> transition.</li> <li>6. Write program to convert NFA to DFA</li> <li>7. Write program to minimize any given DFA.</li> <li>8. Develop an operator precedence parser for a given language.</li> <li>9. Write program to find Simulate First and Follow of any given grammar.</li> <li>10. Construct a recursive descent parser for an expression.</li> <li>11. Construct a Shift Reduce Parser for a given language.</li> <li>12. Write a program to perform loop unrolling.</li> <li>13. Write a program to perform constant propagation.</li> <li>14. Implement Intermediate code generation for simple expressions.</li> <li>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.</li> </ol>			
<b>Expected Outcome:</b> The Student will be able to : <ol style="list-style-type: none"> <li>i. Implement the techniques of Lexical Analysis and Syntax Analysis.</li> <li>ii. Apply the knowledge of Lex &amp; Yacc tools to develop programs.</li> <li>iii. Generate intermediate code.</li> <li>iv. Implement Optimization techniques and generate machine level code.</li> </ol>			