

| Course code | Course Name | L-T-P Credits | Year of Introduction |
|---|-----------------------------|---------------|----------------------|
| CS402 | DATA MINING AND WAREHOUSING | 3-0-0-3 | 2016 |
| <p>Course Objectives:</p> <ul style="list-style-type: none"> To introduce the concepts of data Mining and its applications To understand investigation of data using practical data mining tools. To introduce Association Rules Mining To introduce advanced Data Mining techniques | | | |
| <p>Syllabus:</p> <p>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.</p> | | | |
| <p>Expected Outcome:</p> <p>The Student will be able to :</p> <ol style="list-style-type: none"> identify the key process of Data mining and Warehousing apply appropriate techniques to convert raw data into suitable format for practical data mining tasks analyze and compare various classification algorithms and apply in appropriate domain evaluate the performance of various classification methods using performance metrics make use of the concept of association rule mining in real world scenario select appropriate clustering and algorithms for various applications extend data mining methods to the new domains of data | | | |
| <p>Text Books:</p> <ol style="list-style-type: none"> Dunham M H, "Data Mining: Introductory and Advanced Topics", Pearson Education, New Delhi, 2003. Jaiwei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Elsevier, 2006. | | | |
| <p>References:</p> <ol style="list-style-type: none"> M Sudeep Elayidom, "Data Mining and Warehousing", 1st Edition, 2015, Cengage Learning India Pvt. Ltd. Mehmed Kantardzic, "Data Mining Concepts, Methods and Algorithms", John Wiley and Sons, USA, 2003. Pang-Ning Tan and Michael Steinbach, "Introduction to Data Mining", Addison Wesley, 2006. | | | |

| Course Plan | | | |
|---------------------------------|--|--------------|-----------------------------|
| Module | Contents | Hours | End Sem Exam . Marks |
| I | Data Mining:- Concepts and Applications, Data Mining Stages, Data Mining Models, Data Warehousing (DWH) and On-Line Analytical Processing (OLAP), Need for Data Warehousing, Challenges, Application of Data Mining Principles, OLTP Vs DWH, Applications of DWH | 6 | 15% |
| II | Data Preprocessing: Data Preprocessing Concepts, Data Cleaning, Data integration and transformation, Data Reduction, Discretization and concept hierarchy. | 6 | 15% |
| FIRST INTERNAL EXAM | | | |
| III | Classification Models: Introduction to Classification and Prediction, Issues regarding classification and prediction, Decision Tree- ID3, C4.5, Naive Bayes Classifier. | 6 | 15% |
| IV | Rule based classification- 1R. Neural Networks-Back propagation. Support Vector Machines, Lazy Learners-K Nearest Neighbor Classifier. Accuracy and error Measures-evaluation. Prediction:-Linear Regression and Non-Linear Regression. | 6 | 15% |
| SECOND INTERNAL EXAM | | | |
| V | Association Rules Mining: Concepts, Apriori and FP-Growth Algorithm. Cluster Analysis: Introduction, Concepts, Types of data in cluster analysis, Categorization of clustering methods. Partitioning method: K-Means and K-Medoid Clustering. | 8 | 20 |
| VI | Hierarchical Clustering method: BIRCH. Density-Based Clustering –DBSCAN and OPTICS. Advanced Data Mining Techniques: Introduction, Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining. Text Mining. Graph mining:- Apriori based approach for mining frequent subgraphs. Social Network Analysis:- characteristics of social networks. Link mining:- Tasks and challenges. | 8 | 20 |
| END SEMESTER EXAMINATION | | | |

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 |
|--|--|----------------|----------------------|
| CS404 | Embedded Systems | 3-0-0-3 | 2016 |
| Course Objectives: <ul style="list-style-type: none"> To introduce the technologies behind embedded computing systems. To introduce and discuss various software components involved in embedded system design and development. To 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: The Student will be able to : <ol style="list-style-type: none"> demonstrate the role of individual components involved in a typical embedded system analyze the characteristics of different computing elements and select the most appropriate one for an embedded system model the operation of a given embedded system substantiate the role of different software modules in the development of an embedded system develop simple tasks to run on an RTOS examine the latest trends prevalent in embedded system design | | | |
| References: <ol style="list-style-type: none"> J Staunstrup and Wayne Wolf, Hardware / Software Co-Design: Principles and Practice, Prentice Hall. Jean J. Labrose, Micro C/OS II: The Real Time Kernel, 2e, CRC Press, 2002. Raj Kamal, Embedded Systems: Architecture, Programming and Design, Third Edition, McGraw Hill Education (India), 2014. Shibu K.V., Introduction to Embedded Systems, McGraw Hill Education (India), 2009. Steve Heath, Embedded System Design, Second Edition, Elsevier. Wayne Wolf , Computers as Components-Principles of Embedded Computer System Design, Morgan Kaufmann publishers, Third edition, 2012. | | | |
| Course Plan | | | |
| Module | Contents | Hours | End Sem. Exam Marks |
| I | Fundamentals of Embedded Systems- complex systems and microprocessors- Embedded system design process .Specifications- architecture design of embedded system- design of hardware and software components- structural and behavioural description. | 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, Concurrent Model, Object oriented model, UML | 9 | 15% |

| 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 | Networks – Distributed Embedded Architectures, Networks for embedded systems, Network based design, Internet enabled systems. Embedded Product Development Life Cycle – Description – Objectives -Phases – Approaches1. Recent Trends in Embedded Computing. | 6 | 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** 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 |
|---|--|-----------------|----------------------|
| CS462 | FUZZY SET THEORY AND APPLICATIONS | 3-0-0-3 | 2016 |
| Course Objectives: <ul style="list-style-type: none"> To introduce the theory of fuzzy sets. To discuss theoretical differences between fuzzy sets and classical sets. To discuss fuzzy logic inference To introduce fuzzy arithmetic concepts. To discuss 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: The Student will be able to : <ol style="list-style-type: none"> interpret fuzzy set theory and uncertainty concepts identify the similarities and differences between probability theory and fuzzy set theory and their application conditions apply fuzzy set theory in modeling and analyzing uncertainty in a decision problem apply fuzzy control by examining simple control problem examples | | | |
| Text Books: <ol style="list-style-type: none"> George J Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic : Theory and Applications", Prentice Hall NJ,1995. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Willey, 2010. | | | |
| References: <ol style="list-style-type: none"> E P Klement, R Mesiar and E. Pap, Triangular norms, Kluwer Academic Press, Dordrecht, 2000. H.J. Zimmermann, <i>Fuzzy Set Theory and its Applications</i>, Allied Publishers, New Delhi, 1991. Kevin M Passino and Stephen Yurkovich, <i>Fuzzy Control</i>, Addison Wesley Longman, 1998. M Grabisch et al., <i>Aggregation Functions</i>, Series - Encyclopedia Of Mathematics And Its Applications, Cambridge University Press, 2009 Michal Baczynski and Balasubramaniam Jayaram, <i>Fuzzy Implications</i>, Springer Verlag, Heidelberg, 2008. | | | |
| Course Plan | | | |
| Module | Contents | Hours | End 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- | 06 | 15% |

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|------------------------------------|---|----|-----|
| | conorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations | | |
| 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 <i>Advanced topics: Adaptive fuzzy inference systems: Adaptive networks - Architectures - Learning rules.</i> <i>Adaptive neuro-fuzzy inference systems (ANFIS) - Architectures - Hybrid learning rules.</i> | 08 | 20% |
| END SEMESTER EXAM | | | |

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** 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 |
|---|-------------------------|-----------------|----------------------|
| CS464 | ARTIFICIAL INTELLIGENCE | 3-0-0-3 | 2016 |
| Course Objectives: <ul style="list-style-type: none"> To introduce basic principles that drive complex real world intelligence applications. To introduce and discuss the basic concepts of AI Techniques and Learning | | | |
| Syllabus: Introduction to AI, Solving Problems by Searching-uninformed, informed, heuristic, constraint Satisfaction problems -AI Representational Schemes-Learning-Advanced searches-Alpha beta pruning, Expert Systems-Natural Language Processing Concepts. | | | |
| Expected Outcome: The Student will be able to : <ol style="list-style-type: none"> appreciate the scope and limits of the artificial intelligence (AI) field assess the applicability, strengths, and weaknesses of the basic knowledge representation interpret the role of knowledge representation, problem solving, and learning explain various search algorithms (uninformed, informed, and heuristic) for problem solving comprehend the fundamentals of Natural Language Processing | | | |
| Text Books: <ol style="list-style-type: none"> E Rich, K Knight, Artificial Intelligence, 3/e, Tata McGraw Hil, 2009. George.F.Luger, Artificial Intelligence- Structures and Strategies for Complex Problem Solving, 4/e, Pearson Education. 2002. | | | |
| References: <ol style="list-style-type: none"> D. Poole and A. Mackworth. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010 Available online: http://artint.info/ Dan W Patterson, Introduction to Artificial Intelligence, Pearson, 2009 Deepak Khemeni, A First course in Artificial Intelligence, Tata McGraw Hill, 2013 Maja J. Mataric, Robotics Primer, MIT press, 2007 Patrick Henry Winston, Artificial intelligence, Addison wessley, 1992 Stefan Edelkamp, Stefan Schroedl, Heuristic Search: Theory and Applications, Morgan Kaufman, 2011. Stuart Jonathan Russell, Peter Norvig, Artificial intelligence, A modern approach, 3rd edition, pearson, 2010 | | | |

| Course Plan | | | |
|------------------------------------|--|-------|---------------------|
| Module | Contents | Hours | End Sem. Exam Marks |
| I | Introduction: What is AI, The foundations of AI, History and applications, Production systems. Structures and strategies for state space search. Informed and Uninformed searches. | 5 | 15% |
| II | Search Methods: data driven and goal driven search. Depth first and breadth first search, DFS with iterative deepening. Heuristic search-best first search, A * algorithm.AO* algorithm, Constraint Satisfaction. Crypt Arithmetic Problems | 8 | 15% |
| FIRST INTERNAL EXAMINATION | | | |
| III | AI representational schemes- Semantic nets, conceptual dependency, scripts, frames, introduction to agent based problem solving, Machine learning-symbol based-a frame work for symbol based learning. | 6 | 15% |
| IV | Advanced Search: Heuristics in Games, Design of good heuristic-an example. Min-Max Search Procedure, Alpha Beta pruning, | 6 | 15% |
| SECOND INTERNAL EXAMINATION | | | |
| V | Learning Concepts: Version space search. Back propagation learning. Social and emergent models of learning-genetic algorithm, classifier systems and genetic programming. | 9 | 20% |
| VI | Expert Systems: rule based expert systems. Natural language processing-natural language understanding problem, deconstructing language. Syntax stochastic tools for language analysis, natural language applications | 9 | 20% |
| END SEMESTER EXAM | | | |

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 |
|--|---|---------------|-----------------------|
| CS466 | DATA SCIENCE | 3-0-0-3 | 2016 |
| Course Objectives: <ul style="list-style-type: none"> To introduce fundamental algorithmic ideas to process data. To introduce and discuss techniques for applying hypotheses and data into actionable predictions. To introduce documentation and visualization techniques. | | | |
| Syllabus: Modern scientific, engineering, and business applications are increasingly dependent on data, existing traditional data 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: The Student will be able to : <ol style="list-style-type: none"> explain and discuss the significance of data science and its key functionalities discuss and demonstrate various models suitable for data science perform preliminary statistical analysis using R language on simple data sets perform python-based predication and filtering on simple data sets perform Hadoop and Map-Reduce for data analysis perform data visualization techniques at a basic level | | | |
| References: <ol style="list-style-type: none"> Boris Lublinsky, Kevin T. Smith. Alexcy Yakubovich, "Professional Hadoop Solutions", Wiley, 2015. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets". Cambridge University Press, 2014. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization and Statistics", Wiley, 2011. Nina Zumel, John Mount "Practical Data Science with R". Manning Publications. 2014. Sameer Madhavan , "Mastering Python for Data Science", Packt Publishing Limited, 2015. Tony Ojeda, Sean Patrick Murphy, Benjarnin Bengfort. Abhijit Dasgupta. "Practical Data Science Cookbook", Packt Publishing Limited, 2014. W. N. Venables. D. M. Smith and the R Core Team, "An Introduction to R", 2013. | | | |
| Course Plan | | | |
| Module | Contents | Hours | End 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 (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 40%** analytical/numerical questions in all possible combinations of question choices.

| Course code | Course Name | L-T-P -Credits | Year of Introduction |
|--|-----------------|----------------|----------------------|
| CS468 | CLOUD COMPUTING | 3-0-0-3 | 2016 |
| Course Objectives: <ul style="list-style-type: none"> To impart the fundamentals of virtualization techniques. To introduce concepts and security issues of cloud paradigm. 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: The Student will be able to : <ol style="list-style-type: none"> identify the significance of implementing virtualization techniques. interpret the various cloud computing models and services compare the various public cloud platforms and software environments. apply appropriate cloud programming methods to solve big data problems. appreciate the need of security mechanisms in cloud illustrate the use of various cloud services available online. | | | |
| Text Book: <ul style="list-style-type: none"> 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: <ol style="list-style-type: none"> Alex Amies, Harm Sluiman, Qiang Guo Tong and Guo Ning Liu: Developing and Hosting Applications on the cloud, IBM Press, 2012. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud (Theory in Practice)”, O’Reilly Publications, 2009. 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 James E. Smith and Ravi Nair: Virtual Machines: Versatile Platforms for Systems and Processes, Morgan Kaufmann, ELSEVIER Publication, 2006. John W Rittinghouse and James F Ransome , “Cloud Computing: Implementation – Management – and Security”, CRC Press, 2010. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, Pearson Education, 2009. Richard N. Katz, “The Tower and The Cloud”, Higher Education in the Age of Cloud Computing, 2008. Toby Velte, Anthony Velte and Robert Elsenpeter: “Cloud Computing – A Practical Approach”, TMH, 2009. | | | |

| Course Plan | | | |
|------------------------------------|--|--------------|----------------------------|
| Module | Contents | Hours | End Sem. Exam Marks |
| 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 –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 . | 6 | 20% |
| END SEMESTER EXAM | | | |

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 50%** analytical/numerical questions in all possible combinations of question choices.

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|--|---|-----------------|----------------------|
| CS472 | PRINCIPLES OF INFORMATION SECURITY | 3-0-0-3 | 2016 |
| Course Objectives <ul style="list-style-type: none"> To introduce fundamental concepts of security. To introduce and discuss the relevance of security in operating system, web services etc. To introduce fundamental concepts 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, Cell phone security, Secure Electronic transactions, Web Services security | | | |
| Expected Outcome: The Student will be able to : <ol style="list-style-type: none"> appreciate the common threats faced today interpret the foundational theory behind information security design a secure system identify the potential vulnerabilities in software appreciate the relevance of security in various domains develop secure web services and perform secure e-transactions | | | |
| Text Books: <ol style="list-style-type: none"> Bernard Menezes, Network security and Cryptography, Cengage Learning India, 2010. M Bishop, Computer Security: Art and Science, Pearson Education, 2003. | | | |
| References: <ol style="list-style-type: none"> E Whiteman and J Mattord, Principles of information security 4th edn, Cengage Learning V K Pachghare, Cryptography and information security, PHI Behrousz A Forouzan, D Mukhopadhyay, Cryptography and network Security, McGraw Hill W Mao, Modern Cryptography: Theory & Practice, Pearson Education, 2004. C P. Fleeger and S L Fleeger, Security in Computing, 3/e, Pearson Education, 2003. | | | |
| Course Plan | | | |
| Module | Contents | Hours | End Sem. Exam Marks |
| 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 | 7 | 15% |

| | | | |
|------------------------------------|---|---|-----|
| II | Security policies and models: confidentiality policies, Bell-LaPadula model, Integrity policies, Biba model, Clark-Wilson models, Chinese wall model, waterfall model | 7 | 15% |
| FIRST INTERNAL EXAMINATION | | | |
| III | Software vulnerabilities: Buffer and stack overflow, Cross-site scripting(XSS) , and vulnerabilities, SQL injection and vulnerabilities , Phishing. | 6 | 15% |
| IV | Malware: Viruses, Worms and Trojans. Topological worms. Internet propagation models for worms. | 6 | 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. | 8 | 20% |
| VI | Secure Electronics transactions: Framework, strength and weakness, Security in current applications : Online banking , Credit Card Payment Systems. Web Services security: XML, SOAP, SAML, RFID | 8 | 20% |
| END SEMESTER EXAM | | | |

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 are 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 | Credits | Year of Introduction | | | | | | |
|--|----------------------------------|---------|----------------------|------------------------------|----------------------------------|---------------------------|-----------------------------|--|-----------------------------|
| **492 | PROJECT | 6 | 2016 | | | | | | |
| Prerequisite : Nil | | | | | | | | | |
| Course Objectives | | | | | | | | | |
| <ul style="list-style-type: none"> • To apply engineering knowledge in practical problem solving • To foster innovation in design of products, processes or systems • To develop creative thinking in finding viable solutions to engineering problems | | | | | | | | | |
| Course Plan | | | | | | | | | |
| <p>In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester</p> <p>Review and finalization of the approach to the problem relating to the assigned topic</p> <p>Preparing a detailed action plan for conducting the investigation, including team work</p> <p>Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed</p> <p>Final development of product/process, testing, results, conclusions and future directions</p> <p>Preparing a paper for Conference presentation/Publication in Journals, if possible</p> <p>Preparing a report in the standard format for being evaluated by the dept. assessment board</p> <p>Final project presentation and viva voce by the assessment board including external expert</p> | | | | | | | | | |
| Expected outcome | | | | | | | | | |
| <p>The students will be able to</p> <ul style="list-style-type: none"> iii. Think innovatively on the development of components, products, processes or technologies in the engineering field iv. Apply knowledge gained in solving real life engineering problems | | | | | | | | | |
| Evaluation | | | | | | | | | |
| Maximum Marks : 100 | | | | | | | | | |
| <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">(i) Two progress assessments</td> <td style="width: 50%;">20% by the faculty supervisor(s)</td> </tr> <tr> <td>(ii) Final project report</td> <td>30% by the assessment board</td> </tr> <tr> <td>(iii) Project presentation and viva voce</td> <td>50% by the assessment board</td> </tr> </table> | | | | (i) Two progress assessments | 20% by the faculty supervisor(s) | (ii) Final project report | 30% by the assessment board | (iii) Project presentation and viva voce | 50% by the assessment board |
| (i) Two progress assessments | 20% by the faculty supervisor(s) | | | | | | | | |
| (ii) Final project report | 30% by the assessment board | | | | | | | | |
| (iii) Project presentation and viva voce | 50% by the assessment board | | | | | | | | |
| <p><i>Note:</i> All the three evaluations are mandatory for course completion and for awarding the final grade.</p> | | | | | | | | | |

| Course Code | Course Name | L-T-P | Credits | Year of Introduction |
|---|---|-------|-----------------|----------------------|
| BT362 | Sustainable Energy Processes | 3-0-0 | 3 | 2016 |
| Prerequisite: Nil | | | | |
| Course Objectives | | | | |
| <ul style="list-style-type: none"> To introduce the current and potential future energy systems, covering resources, extraction, conversion, and applications, with emphasis on meeting regional and global energy needs in a sustainable manner. | | | | |
| Syllabus | | | | |
| Classification of energy, extraction, conversion, and applications of solar energy, wind energy, ocean energy, biomass energy, fuel cells and hydro-dynamic systems, merits and demerits of various energy systems, energy storage. | | | | |
| Expected outcome | | | | |
| Students who successfully complete this course should be able to | | | | |
| <ol style="list-style-type: none"> Identify global and Indian energy sources. Explain capture, conversion and application of solar and wind energy. Explain conversion of biomass to energy. Explain the capture of energy from oceans. Explain fuel cells and energy storage routes. | | | | |
| Reference Books | | | | |
| <ol style="list-style-type: none"> Bansal N K, Kleemann M, Michael Meliss, <i>Renewable Energy Sources & Conversion Technology</i>, Tata McGraw Hill publishing Company, New Delhi, 1990. Boyle, Godfrey, <i>Renewable Energy</i>, 3/e, Oxford University Press, 2012. S P Sukhatme, <i>Solar Energy - Principles of Thermal Collection and Storage</i>, 2/e, Tata McGraw- Hill Publishing company, New Delhi, 1996. Pramod Jain, <i>Wind Energy Engineering</i>, McGraw Hill, 2011. Donald L Klass, <i>Biomass for Renewable Energy, Fuels and Chemicals</i>, Academic Press, 1998. | | | | |
| Course Plan | | | | |
| Module | Contents | Hours | Sem. Exam Marks | |
| I | General classification of energy. Conventional and non-conventional. Renewable and non-renewable. Global and Indian energy sources. Global and Indian energy consumption. Problems of fossil fuels. Environmental aspects of energy utilization. Energy and sustainable development. Energy planning. Renewable energy sources, potentials, achievements and applications. | 7 | 15% | |
| II | Solar energy. Solar radiation. Solar thermal systems. Flat plate and concentrating collectors. Solar desalination. Solar pond. Solar cookers. Solar dryers. Solar thermal electric power plant. Solar photovoltaic conversion. Semiconductor and thin film technology. Solar cells. Solar photovoltaic power generation. Hybrid systems. Merits and limitations of solar energy. | 7 | 15% | |
| FIRST INTERNAL EXAM | | | | |

| | | | |
|---------------------------------|---|---|-----|
| III | Wind energy. Availability of wind energy, Site characteristics, Wind turbine types-horizontal axis and vertical axis-design principles of wind turbine. Wind power plants, Wind energy storage. Safety and environmental aspects. Merits and limitations of wind energy. | 7 | 15% |
| IV | Biomass energy. Biomass resources, Biomass conversion technologies-direct combustion, pyrolysis, biomass gasification. Biogas production. Biomethanation as an aid to environment improvement. Bioethanol, biodiesel and biobutanol production. Hydrogen as fuel. Biohydrogen production. Storage of hydrogen. | 7 | 15% |
| SECOND INTERNAL EXAM | | | |
| V | Energy from the oceans. Ocean thermal electric conversion. Tidal energy conversion. Geothermal energy conversion. Hydro power-global and Indian scenario. Positive and negative attributes of hydropower. Electricity from hydropower. Small hydropower. | 7 | 20% |
| VI | Fuel cells. Alkaline fuel cells. Phosphoric acid fuel cell. Molten carbonate fuel cell. Solid oxide fuel cell, Solid polymer electrolyte fuel cell. Magneto-hydrodynamic systems. Electric vehicles. Energy storage routes like thermal, chemical, mechanical, electrical storage. Batteries. | 7 | 20% |
| END SEMESTER EXAMINATION | | | |

QUESTION PAPER PATTERN:

Maximum Marks: 100

Exam Duration: 3 hours

The question paper consists of Part A, Part B and Part C.

Part A consists of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer two questions ($15 \times 2 = 30$ marks).

Part B consists of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer two questions ($15 \times 2 = 30$ marks).

Part C consists of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer two questions ($20 \times 2 = 40$ marks).

For each question there can be a maximum of 4 subparts.