Third Semester				
Sl. No.	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	CSM351 CSM352 CSM353	**Program Elective - V** GPU Computing/ Cloud Computing/ Distributed Databases	3-0-0	3
2	CSM361 CSM362 CSM363 CSM364 CSM365	**Open Elective** Business Analytics / Industrial Safety / Operations Research / Project Management/ Smart Grid	3-0-0	3
3	CSM301	Dissertation-I / Industrial Project	0-0-20	10
Total Credits				16

***Students going for Industrial Project/Thesis will complete these courses through MOOCs.**

CSM351	GPU Computing (3-0-0)	3 Credits

Course Objective:

- To learn parallel programming with Graphics Processing Units (GPUs).

Unit – I : **(13 Hours)**

Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC,

Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs

Unit – II : **(7 Hours)**

Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic

Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Unit – III : **(10 Hours)**

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU

Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Unit – IV : **(8 Hours)**

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Unit – V : **(5 Hours)**

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning

Unit – VI : **(5 Hours)**

Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

Course Outcome:

After completion of course, students would be:

- Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs.

References:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

CSM352	Cloud Computing (3-0-0)	3 Credits

Course Objective:

1. The student will also learn how to apply trust-based security model to real-world security problems.
2. An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
3. Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Unit – I : **(4 Hours)**

Introduction to Cloud Computing: Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing

Unit – II : **(11 Hours)**

Cloud Computing Architecture: Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model

Cloud Deployment Models: Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

Unit – III : **(10 Hours)**

Security Issues in Cloud Computing

Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security

Identity and Access Management: Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud,

Cloud Authorization Management

Unit – IV : **(11 Hours)**

Security Management in the Cloud: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS

Privacy Issues : Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

Unit – V : **(8 Hours)**

Audit and Compliance

Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

Unit –VI : **(4 Hours)**

Advanced Topics : Recent developments in hybrid cloud and cloud security.

Course Outcomes:

After completion of course, students would be able to:

1. Identify security aspects of each cloud model
2. Develop a risk-management strategy for moving to the Cloud
3. Implement a public cloud instance using a public cloud service provider
4. Apply trust-based security model to different layer

References:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009

CSM353	Distributed Databases (3-0-0)	3 Credits

Course Objective:

- The objective of course is to provide insight to distributed database, normalization techniques and integrity rules. It also includes parallel database systems along with object oriented models.

Unit – I : **(11 Hours)**

Introduction: Distributed Data processing, Distributed database system (DDBMS),

Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization,
Integrity rules, Relational Data Languages, Relational DBMS.

Unit – II : **(8 Hours)**

Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture. Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic Integrity Control.

Unit – III : **(9 Hours)**

Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing.
Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction. Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms.

Unit – IV : **(7 Hours)**

Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture.

Unit – V : **(8 Hours)**

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management. Database Interoperability: Database Integration, Query processing.

Unit – VI : **(5 Hours)**

Recent approaches, models and current trends in improving the performance of Distributed Database.

Course Outcome:

After completion of course, students would be:

- Abe to understand relational database management systems, normalization to make efficient retrieval from database and query.

References:

1. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez
2. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata McGraw Hill.

CSM361	Business Analytics (3-0-0)	3 Credits

Course Objectives:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc..

Unit – I : **(7 Hours)**

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.

Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

Unit – II : **(8 Hours)**

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit – III : **(9 Hours)**

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Unit – IV : **(10 Hours)**

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling.

Unit – V : **(10 Hours)**

Finalizing Requirements: Presenting Requirements, Socializing Requirements and

Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

Unit – VI : **(4 Hours)**

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Course Outcome:

After completion of course, students would be:

- Able to have knowledge of various business analysis techniques.

References:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

CSM362	Industrial Safety (3-0-0)	3 Credits

Unit – I : **(7 Hours)**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit – II : **(8 Hours)**

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment..

Unit – III : **(9 Hours)**

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit – IV : **(10 Hours)**

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and

electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit – V : **(10 Hours)**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

CSM363	Operations Research (3-0-0)	3 Credits

Unit – I : **(7 Hours)**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit – II : **(8 Hours)**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming..

Unit – III : **(9 Hours)**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit – IV : **(10 Hours)**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit – V : **(10 Hours)**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Course Outcomes:

After completion of course, students would be:

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

CSM364	Project Management (3-0-0)	3 Credits

CSM365	Smart Grid (3-0-0)	3 Credits

Course Objectives:

1. Understand concept of smart grid and its advantages over conventional grid.
2. Know smart metering techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its solution through smart grid.

Unit – I : **(7 Hours)**

Introduction to Smart Grid, Evolution of Electric Grid. • Concept of Smart Grid, Definitions, Need of Smart Grid. • Concept of Robust &Self-Healing Grid, Present development & International policies in Smart Grid.

Unit – II : **(8 Hours)**

Introduction to Smart Meters, Real Time Prizing, Smart Appliances. • Automatic Meter Reading (AMR). • Outage Management System (OMS). • Plug in Hybrid Electric Vehicles(PHEV). • Vehicle to Grid, Smart Sensors. • Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

Unit – III : **(9 Hours)**

Geographic Information System (GIS). • Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro. • Compressed Air Energy Storage. • Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

Unit – IV : **(10 Hours)**

Concept of micro-grid, need & applications of micro-grid. Formation of micro-grid, Issues of interconnection. Protection & control of micro-grid. Plastic & Organic solar cells, Thin film solar cells. Variable speed wind generators, fuel-cells, micro-turbines. Captive power plants, Integration of renewable energy sources.

Unit – V : **(10 Hours)**

Power Quality & EMC in Smart Grid. Power Quality issues of Grid connected Renewable Energy Sources. Power Quality Conditioners for Smart Grid. Web based Power Quality monitoring, Power Quality Audit

Unit – VI : **(4 Hours)**

Advanced Metering Infrastructure (AMI), Home Area Network (HAN). Neighbourhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication. Wireless Mesh Network.Basics of CLOUD Computing &Cyber Security for Smart Grid. Broadband over Power line (BPL). IP based protocols

Course Outcome:

After completion of course, students would be:

- Appreciate the difference between smart grid & conventional grid. 2. Apply smart metering concepts to industrial and commercial installations. 3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements. 4. Come up with smart grid solutions using modern communication technologies

References:

1. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE,2011.
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press, 2009. Model Curriculum of Engineering & Technology PG Courses [Volume-I] [237]
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, “Smart Grid: Technology and Applications”, Wiley 2012.
4. Stuart Borlas’e, “Smart Grid:Infrastructure, Technology and solutions “CRC Press.
5. A.G.Phadke , “Synchronized Phasor Measurement and their Applications”,Springer.