



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3730208

Semester – III

Subject Name: Cloud Computing

Type of course:

Prerequisite: operating system, networking

Rationale: Organizations look for cloud solutions rather than investing and maintaining infrastructure on their part. Since the Cloud structure is complex, investigations are necessary from security perspective. Organizations are looking for Cloud service providers which are stable, secure and offer more than one layer of security for their client's data. This course will help in implementing cloud architecture, analyzing the security issues, writing incidence report and deploying the security architecture for cloud platform.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	Introduction to Cloud Computing Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing	4
2	Unit 2: 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	11
3	Unit 3: 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	10



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	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	
4	Unit 4: 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	11
5	Unit 5: 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	8
6	Unit 6: Introduction to hybrid cloud Hybrid cloud management, Managing the Hybrid workloads, Development and Deployment in Hybrid cloud.	4

Reference Books:

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

3) Hybrid Cloud For Dummies 2nd Edition

by Judith S. Hurwitz , Marcia Kaufman , Fern Halper , Daniel Kirsch

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Implement a public cloud instance using a public cloud service provider	50



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CO-2	Develop a risk-management strategy for moving to the Cloud	20
CO-3	Identify security aspects of each cloud model	20
CO-4	Apply trust-based security model to different layer	10

List of Experiments:

1. Install public cloud. Analyze how handling in public cloud differs from private cloud?
2. Implement phishing attack on cloud.
3. Write a case study of incidence reporting in case of breach of cloud security.
4. Use the services offered by Azure, AWS and GOOGLE. Compare them.
5. Use open source tool to evaluate performance of cloud platform.
6. Prepare a case study of security policy or service level agreement is signed by cloud service provider.
7. Prepare a case study of facebook, twitter data which is stored on cloud. Write a program to inject malware in this data.
8. Implement attribute based encryption algorithm for cloud.
9. Implement compartmentalization techniques, the provider can use to prevent access into virtual container of one customer by other customers.
10. Implement identity management mechanism in cloud.

Major Equipment:

Computer systems having following minimum technical configurations

Processor:i3 or i5 or higher

RAM : minimum 4 GB

HDD : 1 TB

Internet and wifi connectivity

Licence Window/Linux operating system

List of Open Source Software/learning website:

<https://npte;.ac.in>



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3732307

Semester – III

Subject Name: IOT and Smart Cities

Type of course: Master Of Engineering

Prerequisite: Fundamentals of Internet & computer network, wireless sensor network, Internet technology Applications, Basic City development aspects, System of City Metropolitan Governance System parts

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Sr. No.	Syllabus Content	No. of Hours
1	The Internet of Things: An Overview & Design Principles for Connected Devices: The Flavor of the Internet, The Internet of Things, The Technology Of the Internet of Things, Calm and Ambient Technology, Web Thinking for Connected Devices: Small Pieces, loosely joined First Citizens on the Internet	6
2	Thinking about prototyping & Prototyping Embedded Devices: Prototypes and Productions, Changing Embedded platforms. Electronics Sensors, Actuators. Embedded Computing Basics, Developing on Arduino & Developing on the Raspberry Pi, Developing on BeagleBone Black,	06
3	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	06
4	The Imperative for Smart Cities: A New Vision, What Is Smart?, A Sensitive Relationship , What Do We Really Want from the Smart City? ,Managing the Shift, Designing for People	4
5	Technology, Innovation, and the Problem with People & A New Perspective on Smart Cities: Sensors to Services, What If My World Goes Down?, The Surprisingly Familiar Sensor, The Internet of Things ,The Smart City as Mediator. The Efficient, Effective, and Optimal City?, Smart City Design Goals, Engineering New Models for Investing in the Smart City, Context-Sensitive Technology Services, What About the Start-Up?	6
6	Why Design Thinking?, Design Thinking Applied, Smart City Technologies: Thinking About Thinking, How Does This Working Definition Work? How the Best Technology Fails and Where the Better Solution Wins, Rational Implementation. Ways That Design Thinking Has Been Used in Cities, When Urban Design Rises Above Imposition, Smart City Technologies Should Focus on Improving Human Society ,The Approach to Bringing New Technologies to the Smart City Is Time-Tested	6
7	Smart City Planning and Management & The Fundamentals of Smart Infrastructure:	10



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Smart Cities and Their Role in the Creation of a National Identity, The Energy Opportunity, The Building Opportunity: New Models, New Ways Forward, The Urban Life Force: Transportation as Animating Principle, Innovative Transportation Services Transportation Analytics, The Most Powerful Sensor in the City Is in Your Pocket , Smart City Analytics: Analytical Models, The Analytics of Things, The Analytical Intersection of Human and Machine

Reference Books

1. Building Smart Cities , Analytics ,ICT, and Design Thinking, Carol L. Stimmel, CRC Press, <https://arthurlimantara.files.wordpress.com/2017/03/building-smart-cities.pdf>
2. Designing the Internet of Things , Adrian McEwen & Hakim Cassimally, Willey Reprint 2017
3. Vijay Madiseti and Arshdeep Bahga, “**Internet of Things (A Hands-on-Approach)**”,
4. 1st Edition, VPT, 2014.
5. Francis daCosta, “**Rethinking the Internet of Things: A Scalable Approach to Connecting Everything**”, 1st Edition, Apress Publications, 2013
6. Cuno Pfister, Getting Started with the Internet of Things, O’Reilly Media, 2011, ISBN: 978-1-4493-9357-1
7. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “**From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence**”, 1st Edition, Academic Press, 2014.
8. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013, ISBN: 978-87-92982-96-4 (EBook), ISBN: 978-87-92982-73-5 (Print)

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	12	12	20	08	08

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Course Outcome:

After learning the course, the student will be able:

1. Understand Internet and web connect of things and devices
2. Understand the vision of IoT from Smart City point of view
3. Create the prototype application of IoT.
4. Analyze state of the art ,Urbanized Utility Apps. and Transport Services like Smart parking etc.
5. Develop application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.



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List of Experiments:

1. Define and Explain Eclipse IoT Project.
2. List and summarize few Eclipse IoT Projects.
3. Sketch the architecture of IoT Toolkit and explain each entity in brief.
4. Demonstrate a smart object API gateway service reference implementation in IoT toolkit.
5. Write and explain working of an HTTP- to-CoAP semantic mapping proxy in IoT toolkit.
6. Describe gateway-as-a-service deployment in IoT toolkit.
7. Explain application framework and embedded software agents for IoT toolkit.
8. Explain working of Raspberry Pi.
9. Connect Raspberry Pi with your existing system components.
10. Give overview of Zetta.
11. Develop small application to sense car number plate NPR app.

Major Equipment:

Sensors such as RTD, Thermister, LED , Lamps, Motors, Raspberry pi, Arduino, BeagleBone Black

List of Open Source Software/learning website:

- <https://github.com/connectIOT/iottoolkit>
- <https://www.arduino.cc/>
- <http://www.zettajs.org/>
- Contiki (Open source IoT operating system)
- Arduino (open source IoT project)
- IoT Toolkit (smart object API gateway service reference implementation)
- Zetta (Based on Node.js, Zetta can create IoT servers that link to various devices and sensors)



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3732308

Semester – III

Subject Name : Mobile Applications and Services

Type of course:

Prerequisite: Wireless Communication and Mobile Computing

Rationale: In the digital age, Mobile applications are used widely with the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS. This course explores emerging technologies and tools used to design and implement feature-rich mobile applications for smart phones and tablets. It also take into account both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	Unit 1: Introduction:Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User	5
2	Unit 2: More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, . Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider	6
3	Unit 3: Communications via Network and the Web:State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony Notifications and Alarms:Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics	8



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4	Unit 4: Putting It All Together : Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia	7
5	Unit 5: Platforms and Additional Issues : Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking , Active Transactions, More on Security, Hacking Android	7
6	Unit 6: Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT	3

Reference Books:

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	identify the target platform and users and be able to define and sketch a mobile application	20
CO-2	understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap	50
CO-3	Design and develop a mobile application prototype in one of the platform (challenge project)	30

List of Experiments:

1. Implement on mobile platform a simple calculator. Use different layouts to show buttons of calculator.
2. Implement an Android application that converts Fahrenheit to Celsius and Celsius to Fahrenheit.
3. Implement an Android application that takes rupees as input and gives spinner control with options Euro, Frank and Dollar and converts them accordingly.
4. Implement an Android application, that takes user personal details as input. Store them in database and when user enters his mobile number retrieve all information.
5. Implement an Android Application that creates a menu with following options.



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Display menu items for example – List the choice of food items

Display list of selected items

Calculate the bill.

6. Implement an Android Application that rotates a red ball in clockwise direction for 1 minute and after that yellow ball in the anticlockwise direction.
7. Write a program on mobile platform to transfer file from one mobile to another mobile. Upload this application on app store.
8. Write an application on mobile platform that continuously tracks the location of the mobile phone.
9. Write an app on mobile platform to read contact details from mobile phone and send it via internet to a particular Email address.
10. Write an application for generating a grid of 10x10 squares with alternate red and yellow color. Perform testing on the application.

Major Equipment:

Computer systems having following minimum technical configurations

Processor:i3 or i5 or higher

RAM : minimum 4 GB

HDD : 1 TB

Internet and wifi connectivity

Licence Window/Linux operating system

List of Open Source Software/learning website:

nptel.ac.in



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3730005

Semester III

Business Analytics

Type of Course:

Prerequisite:

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Sr. No.	Topics	Teaching Hours
1	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	9
2	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology	8
3	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization	9
4	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model	10
5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making	8
6	Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism	4

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics by James Evans, persons Education



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Master of Engineering

Subject Code: 3730005

Course Outcomes:

After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Students will demonstrate knowledge of data analytics	
CO-2	Students will demonstrate the ability of think critically in making decisions based on data and deep analytics	
CO-3	Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making	
CO-4	Students will demonstrate the ability to translate data into clear, actionable insights	

GTUQuestionPapers.com



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3730006

Semester III

Industrial Safety

Type of Course:

Prerequisite: Nil

Rationale: Safety is major issue in any industry; awareness about safety helps students from any major accidents, Different rules regulation of safety helps students apply it in industry for performance and productivity improvements. Knowledge of Maintenance, its type and application gives better work environments and helps industry from major shutdown. Different maintenance tools and techniques for different situation and industry equipment's helps students to apply it in real life industry problems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE Viva (V)	PA (I)		
3	0	0	3	70	30	0	0	100

Sr. No.	Topics	Teaching Hours
1	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.	08
2	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	08
3	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	10
4	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	09
5	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	10



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Master of Engineering

Subject Code: 3730006

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	10
Comprehension	20
Application	25
Analysis	25
Evaluate	10
Create	10

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

Course Outcomes:

After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Understand Importance of Safety and Important related Acts.	20
CO-2	Apply Maintenance techniques as per requirements and able to compare for with different technique for better performance.	30
CO-3	Understand wear and corrosion, its causes and remedial actions for preventions.	30
CO-4	Demonstrate fault tracing, its methods and application.	20



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code:3730007

Semester III

Operation Research

Type of Course: Open Elective

Prerequisite: Nil

Rationale: Operation research techniques are useful for solving real life Industrial problem, Problems can be of Manufacturing, Service and supply related. Different techniques help for optimization of linear as well as non - linear type problem.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Sr. No.	Topics	Teaching Hours
1	Linear Programming Problems: Formulation of a LPP, - graphical solution, simplex method, duality in LPP, sensitivity analysis, Integer linear programming, revised simplex method, parametric linear programming, Dynamic programming under certainty, Dynamic programming approach for solving LPP.	12
2	Project Management , Inventory Control and Decision Making: CPM, PERT, Project time cost trade off, Resource allocation, Deterministic inventory control models, Probabilistic inventory control models, Decision making process, Decision making under uncertainty, Decision making under risk, Decision tree analysis, Theory of games, Pure strategies, Mix strategies, Solutions method games without saddle points.	10
3	Classical Optimization Methods: Single variable optimization, Constrained and unconstrained multi-variable optimization, Direct substitution method, Lagrange's method of multipliers, Kuhn-Tucker conditions	06
4	Non-linear Programming: Constrained Optimization Techniques Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden section method Unconstrained Optimization Techniques Direct Search Methods: Random search methods, Grid search method, Univariate method, Constrained Optimization Techniques Direct Methods: Random search method, Sequential linear programming.	10
5	Evolutionary Algorithms An overview of evolutionary algorithms, Simulated annealing algorithm, Genetic algorithm, Particle swarm optimization	04

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
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Recall	10
Comprehension	10
Application	25
Analysis	25
Evaluate	20
Create	10

References:

1. J. K. Sharma, Operation Research, Theory and Application, Macmillan Publishers India Ltd, 2013
2. H.A. Taha, Operations Research, An Introduction, PHI, 2008
3. S.S.Rao, Engineering Optimization Theory and Practice, New Age International (P) Ltd, Publishers.
4. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes:

After learning the course:

Sr. No.	CO statement	Marks % weightage
CO-1	Students should able to apply the Linear programming techniques to solve problems of real life applications and carry out post optimality analysis.	30
CO-2	Students should able to apply the concepts of non-linear programming and apply them for real life problems.	30
CO-3	Students should able to obtain quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.	20
CO-4	Students should able to implement various scientific tools and models that are available in the subject to take decisions in a complex environment.	20