

B.E. Engineering (Semester VIII)
Revised course for Information Technology from
Academic Year 2015 -16, (REV- 2012)

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ITC801	Storage Network Management and Retrieval	4			4			4
ITC802	Big Data Analytics	4			4			4
ITC803	Computer Simulation and Modeling	4			4			4
ITC804	Elective -II	4			4			4
ITL801	Storage Network Management and Retrieval		2			1		1
ITL802	Big Data Analytics		2			1		1
ITL803	Computer Simulation and Modeling		2			1		1
ITL804	Elective -II		2			1		1
ITP805	Project - II		**			6		6
	Total	16	08		16	10		26

****Workload of the teacher in semester VIII is equivalent to 12 hrs/week.**

Elective –I I (Semester VIII)	
ITC8041	Enterprise Resource Planning
ITC8042	Wireless Sensor Networks
ITC8043	Geographical Information Systems
ITC8044	Robotics
ITC8045	Soft Computing
ITC8046	Software Testing & Quality Assurance

Examination Scheme

Course Code	Course Name	Theory					Term work	Pract/ Oral	Total
		Internal Assessment			End sem exam	Exam duration (in Hrs)			
		TEST 1	TEST 2	AVG .					
ITC801	Storage Network Management and Retrieval	20	20	20	80	3	25	25	150
ITC802	Big Data Analytics	20	20	20	80	3	25	25	150
ITC803	Computer Simulation and Modeling	20	20	20	80	3	25	25	150
ITC804	Elective -II	20	20	20	80	3	25	25	150
ITP805	Project - II						50	50	100
	Total	80	80	80	320	12	150	150	700

Course Code	Course Name	Teaching Scheme (Hrs./Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC801	Storage Network Management and Retrieval	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ITC801	Storage Network Management and Retrieval	20	20	20	80	25	---	25	150

Course Objectives:

- a. Study and evaluate the need for Storage networking, current storage technologies: SAN, NAS, IP storage etc., which will bridge the gap between the emerging trends in industry and academics.
- b. Understanding and building Storage networks and its backup and recovery techniques.
- c. Study the information retrieval system as per different application in storage networks.

Course Outcomes:

- 1) Students will be able to evaluate storage architectures, including storage subsystems, SAN, NAS, and IP-SAN, also define backup, recovery.
- 2) Examine emerging technologies including IP-SAN.
- 3) Define information retrieval in storage network and identify different storage virtualization technologies.

Prerequisite: Computer Networks, Database Management Systems and Operating Systems

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
I	NEED FOR STORAGE NETWORK	INTRODUCTION:- Limitations of traditional server centric architecture,. Storage centric architecture and its advantages. BASICS OF STORAGE NETWORK:- Intelligent Storage Systems (ISS), Data protection (RAID implementation methods).RAID arrays ,Components, RAID technologies, RAID levels, RAID impact on disk, performance & RAID comparison.	10
II	STORAGE NETWORK ARCHITECTURE	SCSI, SAN: FC SAN FC Protocol Stack, IP Storage, Infiniband, Virtual Interfaces	08
III	ADVANCED STORAGE TECHNOLOGY	NETWORK ATTACHED STORAGE (NAS):- Local File systems, Network File systems and file servers, Shared Disk File systems: Case study, Comparison: NAS, FC SAN and iSCSI SAN. STORAGE VIRTUALIZATION:- Virtualization in I/O path, Limitations and requirements, Definition of Storage Virtualization, Storage virtualization on Block and file level, Storage virtualization on various levels of Storage network, Symmetric and Asymmetric Virtualization.	14
IV	STORAGE NETWORK BACKUP AND RECOVERY	BC Terminology, BC Planning Lifecycle, General Conditions for Backup, Recovery Considerations, Network Backup Services Performance Bottlenecks of Network Backup, Backup Clients, Backup file systems, Backup Databases, Next Generation Backup.	06

V	INFORMATION RETRIEVAL IN STORAGE NETWORK	Overview, Abstraction , Information System, Measures, from Data to Wisdom, Document and Query Form, Query structures, The matching process, Text analysis: Indexing, Matrix representation, Term extraction, Term association, , Stemming , Multilingual retrieval systems	10
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Text Books:

1. ULF Troppen, Rainer Erkens and Wolfgang Muller , “ Storage Networks Explained: Basic and Applications of Fibre Channel SAN, NAS and ISCSI and Infiniband “ , Wiley
2. EMC Educational Services, “Information Storage and Management”, wiley India
3. R. R. Korfhage, “Information Storage and Retrieval”, Wiley

References:

1. Richard Barker and Paul Massiglia, “ Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs” , Wiley.
2. Robert Spalding, “ Storage Networks: The Complete Reference”, Tata McGraw Hill
3. W. Curtis Preston, “Using SANs and NAS”, O’Reilly

Term work: based on Laboratory Practical’s/ Case studies and assignment

1. Term work shall consist of 10 practical implementation, case studies and study of simulators or tools available.
2. Study and implementation of simulation tool Navishpere and Unisphere related to storage network management.
3. Case study on Building and implementing SAN.
4. Study and implementation of any information retrieval tool.

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme Hrs./Week			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC802	Big Data Analytics	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ITC802	Big Data Analytics	20	20	20	80	25	---	25	150

Course Objectives:

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map-Reduce.
3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes: At the end of this course a student will be able to:

1. Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
2. Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
3. Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
4. Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Book	Hours
1	Introduction to Big Data	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Case Study of Big Data Solutions.	From Ref. Books	03
2	Introduction to Hadoop	What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; Physical Architecture; Hadoop limitations.	Hadoop in Practise Chapter 1	02
3	NoSQL	<ol style="list-style-type: none"> 1. What is NoSQL? NoSQL business drivers; NoSQL case studies; 2. NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns; 3. Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems 	No-SQL book	04
4	MapReduce and the New Software Stack	<p>Distributed File Systems : Physical Organization of Compute Nodes, Large-Scale File-System Organization.</p> <p>MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures.</p> <p>Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step.</p>	Text Book 1	06

5	Finding Similar Items	Applications of Near-Neighbor Search, Jaccard Similarity of Sets, Similarity of Documents, Collaborative Filtering as a Similar-Sets Problem . Distance Measures: Definition of a Distance Measure , Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance.	Text Book 1	03
6	Mining Data Streams	The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Query, Issues in Stream Processing. Sampling Data in a Stream : Obtaining a Representative Sample , The General Sampling Problem, Varying the Sample Size. Filtering Streams: The Bloom Filter, Analysis. Counting Distinct Elements in a Stream The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements . Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.	Text Book 1	06
7	Link Analysis	PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector. Topic sensitive Page Rank, link Spam, Hubs and Authorities.	Text Book 1	05
8	Frequent Itemsets	Handling Larger Datasets in Main Memory Algorithm of Park, Chen, and Yu, The Multistage Algorithm, The Multihash Algorithm. The SON Algorithm and MapReduce Counting Frequent Items in a Stream Sampling Methods for Streams, Frequent Itemsets in Decaying Windows	Text Book 1	05
9	Clustering	CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm, Initializing & Merging Buckets,	Text	05

		Answering Queries	Book 1	
10	Recommendation Systems	A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.	Text Book 1	04
11	Mining Social-Network Graphs	Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities, SimRank, Counting triangles using Map-Reduce	Text Book 1	05

Text Books:

1. Anand Rajaraman and Jeff Ullman “**Mining of Massive Datasets**”, Cambridge University Press,
2. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly “**Making Sense of NoSQL**” – A guide for managers and the rest of us, Manning Press.

References:

1. Bill Franks , “**Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics**”, Wiley
2. Chuck Lam, “**Hadoop in Action**”, Dreamtech Press
3. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, “**Big Data for Dummies**”, Wiley India
4. Michael Minelli, Michele Chambers, Ambiga Dhiraj, “**Big Data Big Analytics: Emerging Business Intelligence And Analytic Trends For Today's Businesses**”, Wiley India
5. Phil Simon, “**Too Big To Ignore: The Business Case For Big Data**”, Wiley India
6. Paul Zikopoulos, Chris Eaton, “**Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data**’, McGraw Hill Education.
7. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, “**Professional Hadoop Solutions**”, Wiley India.

Oral Exam:

An oral exam will be held based on the above syllabus.

Term work:

Assign a case study for group of 2/3 students and each group to perform the following experiments on their case-study; Each group should perform the exercises on a large dataset created by them.

Term work: (15 marks for programming exercises + 10 marks for mini-project)

Suggested Practical List: Students will perform at least 8 programming exercises and implement one mini-project. The students can work in groups of 2/3.

1. Study of Hadoop ecosystem
2. 2 programming exercises on Hadoop
3. 2 programming exercises in No SQL
4. Implementing simple algorithms in Map- Reduce (3) - Matrix multiplication, Aggregates, joins, sorting, searching etc.
5. Implementing any one Frequent Itemset algorithm using Map-Reduce
6. Implementing any one Clustering algorithm using Map-Reduce
7. Implementing any one data streaming algorithm using Map-Reduce
8. Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web)
 - a) Twitter data analysis
 - b) Fraud Detection
 - c) Text Mining etc.

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme (Hrs./Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC803	Computer Simulation and Modeling	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ITC803	Computer Simulation and Modeling	20	20	20	80	25	25	---	150

Course Objectives:

This course presents an introduction to discrete event simulation systems. Emphasis of the course will be on modeling and the use of simulation languages/software to solve real world problems in the manufacturing as well as services sectors. The course discusses the modeling techniques of entities, queues, resources and entity transfers in discrete event environment. The course will teach the students the necessary skills to formulate and build valid models, implement the model, perform simulation analysis of the system and analyze results properly.

The “theory” of simulation involves probability and statistics, thus a good background in probability and statistics is a required prerequisite

Course Outcomes:

- Understand the meaning of simulation and its importance in business, science, engineering, industry and services
- Identify the common applications of discrete-event system simulation.
- Practice formulation and modeling skills.

- Understand simulation languages
- Ability to analyze events and inter-arrival time, arrival process, queuing strategies, resources and disposal of entities
- An ability to perform a simulation using spreadsheets as well as simulation language/package
- Ability to generate pseudorandom numbers using the Linear Congruential Method
- Ability to perform statistical tests to measure the quality of a pseudorandom number generator
- Ability to define random variate generators for finite random variables
- Ability to analyze and fit the collected data to different distributions

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1	UNIT - I Introduction to simulation	Introduction to Simulation. Simulation Examples. General Principles	15
2	UNIT - II Mathematical & Statistical Models in Simulation	Statistical Models in simulation. Queuing Models	8
3	UNIT - III Random Numbers	Random Number Generation. Testing random numbers (Refer to Third edition) Random Variate Generation: Inverse transform technique, Direct Transformation for the Normal Distribution, Convolution Method, Acceptance-Rejection Technique (only Poisson Distribution).	9
4	UNIT – IV Analysis of simulation data	Input Modeling Verification, Calibration and Validation of Simulation Models Estimation of absolute performance.	12
5	UNIT V	Case study	

	Application	<ul style="list-style-type: none"> • Processor and Memory simulation • Manufacturing & Material handling 	4
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Text Books:

Discrete Event System Simulation; Third Edition, Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, Prentice-Hall

Discrete Event System Simulation; Fifth Edition, Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, Prentice-Hall

References:

1. System Modeling & Analysis; Averill M Law, 4th Edition TMH.
2. Principles of Modeling and Simulation; Banks C M , Sokolowski J A; Wiley
3. System Simulation ; Geoffrey Gordon ; EEE
4. System Simulation with Digital Computer; Narsing Deo, PHI

Term work:

Laboratory work: 10 marks

Mini Simulation Project presentation: 10 marks

Attendance / Quiz: 5 marks

Suggested Practical List (If Any):

Perform simulation exercises given in the text book (third edition) using spreadsheets and/or simulation language/package

- Queue- single server, multi-server, classic case- dump truck
- Inventory – Lead time=0, lead time fixed, lead time probabilistic
- Reliability problem
- Tutorials on statistical models
- Random number generate and test
- Goodness of fit test
- Output analysis – Point estimate and Confidence Interval

Simulation: Real World Examples – can be in the field of business, transportation, medical, computing, manufacturing and material handling- Presentation to be taken.

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme (Hrs./Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC8041	Enterprise Resource Planning	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test 1	Test 2	Avg. of 2 Tests						
ITC8041	Enterprise Resource Planning	20	20	20	80	25	---	25	150	

Course Objectives: This course presents an introduction to ERP and related technologies. The course discusses ERP Manufacturing Perspective and ERP modules. The course will teach the learners the ERP implementation lifecycle, emphasis on ERP benefits and introduces the ERP tools.

Course Outcomes: The learner will be familiar with ERP and related technologies like Business Processing Reengineering (BPR), Supply Chain Management (SCM), Customer Relationship Management (CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System etc. The learner should gain the knowledge on ERP tools and ERP benefits.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	Introduction to ERP	Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model	04
2.	ERP and Related Technologies	Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System	06
3.	ERP Manufacturing Perspective	MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP - Distributed Requirement Planning, PDM - Product Data Management	06
4.	ERP Modules	Finance, Plant Maintenance, Quality Management, Materials Management	06
5.	Benefits of ERP	Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality, Costs, Improved Information Accuracy and Design-making Capability	06
6.	ERP Implementation Lifecycle	Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode)	06
7.	ERP case Studies	E-Commerce to E-business E-Business structural transformation, Flexible Business Design, Customer Experience, Create the new techno enterprise, New generation e-business leaders, memo to CEO, Empower your customer, Integrate Sales and Service, Integrated Enterprise applications	06
8.	E-Business	Enterprise resource planning the E-business Backbone Enterprise architecture, planning, ERP usage in Real	08

	Architecture	world, ERP Implementation, Future of ERP applications, memo to CEO ,E-Procurement, E-Governance, Developing the E-Business Design	
9.	Introduction to ERP tools	JD Edwards-Enterprise One Microsoft Dynamics-CRM Module	04

Text Books:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal , Galgotia.

Reference Books:

1. Guide to Planning ERP Application, Annetta Clewto and Dane Franklin, McGraw-Hill, 1997
2. The SAP R/3 Handbook, Jose Antonio, McGraw – Hill
3. E-Business Network Resource planning using SAP R/3 Baan and Peoplesoft : A Practical Roadmap For Success By Dr. Ravi Kalakota

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme (Hrs/Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC8042	Wireless Sensor Networks	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test 1	Test 2	Avg. of 2 Tests						
ITC8042	Wireless Sensor Networks	20	20	20	80	25	---	25	150	

Course Objectives:

1. To understand the concepts of sensor networks and study the architecture of WSN.
2. To understand applications of WSN.
3. To discuss the challenges in designing MAC and routing protocols for wireless sensor networks.
4. To study different operating systems and look at performance issues.
5. To understand WSN Standards and future trends in WSN.
5. To study Challenges of Security in Wireless Sensor Networks and Protocols and Mechanisms for Security.

Course Outcomes:

1. Students shall be able to understand and study the functionalities, applications and architecture of WSN.
2. Students shall be able to describe the challenges in designing various protocols for wireless sensor networks.

3. Students shall be able to understand the current technology trends for the implementation and deployment of wireless sensor networks.
4. Students shall gain an understanding of WSN Standards and future trends in WSN.
5. Students shall be able to understand security aspects like Privacy issues, attacks and countermeasures.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	Overview and Introduction of Wireless Sensor Network	Background of Sensor Network Technology; Types of Application; Challenges for WSNs: Characteristics requirements, Required mechanism; Basic Sensor Network Architectural Elements; Sensor Network scenarios: Types of sources and sinks, single-hop versus multi hop networks, Multiple sinks and sources, three types of mobility; Some examples of sensor nodes: Mica Mote family, EYES nodes, BT nodes.	6
2.	Applications of Wireless Sensor Network	Category 1(C1WSNs), Category 2(C2WSNs), Range of Applications, Examples of Category 1 WSN (C1WSNs) Applications, and Examples of Category 2 WSN(C2WSNs) Applications.	4
3.	MAC Protocols	Fundamentals of (wireless) MAC protocols, Requirements and design considerations for MAC Protocols in WSN, Low duty cycle protocols and wakeup concepts, STEM,S-MAC, Mediation device protocol, Wakeup radio concepts, Contention- based protocols, CSMA protocols, PAMAS, Schedule-based protocols, LEACH, SMACS, Traffic-adaptive medium access protocol(TRAMA),IEEE 802.15.4 MAC protocol, Slotted CSMA-CA protocol	9

4.	Network and Transport layer Protocol.	Network layer : Data Dissemination and Gathering, Routing Challenges and Design Issues, Routing Strategies: Flooding and it's variants, Power-Efficient Gathering in Sensor Information Systems, Geographical routing, Transport layer : Transport protocol Design issues, Examples of Existing Transport Control Protocols: CODA, ESRT, RMST, PSFQ, GARUDA, ATP; Performance of Transport Control Protocols :Congestion, packet loss recovery.	7
5.	Operating Systems , Performance and Traffic Management Issues	Operating System Design Issues, Examples of Operating Systems: TinyOS, Mate, MagnetOS, MANTIS,OSPM,EYES OS, SenOS, EMERALDS, PicOS , WSN Design Issues, Performance Modeling of WSNs	7
6.	WSN standards and Future trends in wireless sensor networks	Wireless sensor network standards-IEEE 802.15.4 Low rate WPAN standard, The ZIGBEE alliance etc. Future trends in wireless sensor networks: Wireless Multimedia Sensor Networks, Sensor Network Applications in Challenging Environments.	6
7	Security	Fundamentals of Network Security ,Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and ZigBee Security	9

Text Books:

1. HOLGER KARL,ANDREAS WILLIG., *“Protocols, and Architectures: For Wireless Sensor Networks”*, Wiley Student Edition
2. Kazem Sohraby, Daniel Minoli, Taieb Znati., *“Wireless Sensor Networks: Technology, Protocols, and Applications”*, Wiley Student Edition.
3. Walteneus Dargie and Christian Poellabauer., *“Fundamentals of Wireless Sensor Networks-Theory & Practice”*, John Wiley publication, 2010.
4. J. Zheng and A. Jamalipour, *“Wireless Sensor Networks : A Networking Perspective “* John Wiley publication,2009

References:

1. Edgar H. Callaway Jr., "*Wireless Sensor Networks - Architectures and Protocols*", AUERBACH Publications, CRC Press, 2004.
2. Feng Zhao, Leonidas Guibas, "*Wireless Sensor Networks: An Information Processing Approach*", Morgan Kaufmann Series in Networking 2004.

Term work: Term work shall consist of at least 06 experiments from the suggested list & 04 assignments based on the syllabus.

Distribution of marks for term work shall be as follows.

1. Attendance (Theory & Practical) :05 marks
2. Laboratory Work (Experiment & Journal):15 marks
3. Assignment : 05 marks.

The final certification and acceptance of Term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Suggested Practical List :

1. Installation of OMNET ++.
2. Installation & configuration of TinyOS.
3. Implementation of any two routing algorithms using JAVA
4. Implementation of any two programs on Tiny OS.
5. Study of any of the WSN operating systems.

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme (Hrs./Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Term Work /Practical	Tutorial	Total
ITC8043	Geographical Information Systems	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment		End Sem. Exam					
		Test 1	Test 2						
ITL8043	Geographical Information Systems	20	20	80	25	---	25	150	

Course Objective:

- To provide an understanding of the basic concepts and uses of GIS technology
- To develop an ability to analyze, interpret geospatial data
- To provide an understanding of the basic principles of Remote Sensing and its use in GIS
- To provide a research platform for students in the area of GIS adapting to ever changing Technologies

Course Outcomes:

After completing this course, students will be able to:

- Apply the knowledge of science for real world applications in GIS
- Design and conduct experiments as well as analyze, interpret the geospatial data using GIS tools
- Function with multidisciplinary Teams.
- Use the techniques, skills and modern engineering tools necessary for engineering practice.
- Adapt to Open source standards

DETAILED SYLLABUS:

Module No.	Unit No.	Details of Topic	Hrs.
1.0		Fundamentals of GIS	06
	1.1	Introduction, Definition of GIS, Evolution of GIS , components of GIS,	
	1.2	Geospatial Data, Geographic Coordinate System, Map Projections, Commonly Used Map Projections, UTM grid system, Map Scale	
	1.3	Cartographic Symbolization, Types of Maps, Typography, Map Design, Map Production	
2.0		Data Management, Models and Quality Issues	06
	2.1	Vector Model : Topology, Non topological Vector models, Attribute Data in GIS, Attribute Data Entry, Vector Data Query, Manipulation of Fields and Attribute Data	
	2.2	Raster Data Model : Elements of Raster Data Model, Types of Raster Data, Raster Data Structure, Raster Data Query, Data Compression, Data Conversion, Integration of Raster and Vector data	
	2.3	Data input and editing, Data quality Issues: Accuracy, Consistency, Precision and Resolution, Completeness; sources of error in GIS	
3.0		GIS Data Exploration Analysis and Visualization	2+2+4+4=12
	3.1	Data exploration: Descriptive statistics, Graphs, Dynamic Graphics	
	3.2	Vector Data Analysis: Buffering, Overlay, Distance Measurement, Pattern Analysis, Map Manipulation	
	3.3	Raster Data Analysis: Local Operations, Neighborhood Operations, Zonal Operations, Data Extraction, Data Generalization, Comparison of Vector and Raster Based Data	
	3.4	Spatial Interpolation: Elements of Spatial Interpolation, Global methods, Local Methods, Kriging, Comparison of Spatial Interpolation Methods	
4.0		Terrain mapping, Geocoding and Segmentation	04
	4.1	Terrain Mapping and Analysis: Data for Terrain Mapping and Analysis: DIM, TIN, Terrain Mapping, Slope and Aspect, Surface Curvature, Raster versus TIN	
	4.2	Geocoding and Dynamic Segmentation: Geocoding, Applications of Geocoding, Dynamic Segmentation, Applications of Dynamic Segmentation	

5.0		Remote Sensing Fundamentals	12
	5.1	Remote Sensing: Basic Principles, Electromagnetic Remote Sensing, Energy Sources, Energy Interactions with Surface Materials, , Energy Interactions with Earth's Atmosphere, Spectral Reflectance Curves	
	5.2	Microwave Remote Sensing, The Radar Principle, Factors Affecting Microwave Measurements, Radar Wavebands, SLAR Systems, SAR, Interpreting SAR Images, Geometrical Characteristics, Remote Sensing, Platform and Sensors, Satellite System Parameters, Sensor Parameters, Imaging Sensor Systems, Earth Resources Satellites, Meteorological Satellites. Data Formats, Standard Products	
	5.3	Visual Image Interpretation: Information Extraction By human and Computer, Remote sensing Data Products, Image Interpretation, Elements of Image Interpretation	
6.0		Project Management	04
	6.1	Planning of Project , Implementation of Project, Management of Project, Case study	
7.0		Modern trends and Applications of GIS	04
	7.1	Multimedia GIS, Internet GIS, Mobile GIS ,Applications of GIS in Urban and municipal area	

Recommended Books

1. Kang-tsung Chang, "Introduction to Geographical Information Systems", Tata McGraw Hill, Third Edition, 2003
2. M. Anji Reddi, "Remote Sensing and Geographical Information Systems", B. S. Publications, Second Edition, 2001
3. Basudeb Bhatta ,Remote Sensing and GIS ,Oxford University Press,2nd Edition
4. Ian Heywood, Sarah Cornelius & etal., "An Introduction to Geographical Information Systems", 2nd Edition, Pearson Education
5. A.M. Chandra and S.K. Ghosh, Remote Sensing and Geographical Information Systems , Narosa Publishing House Pvt ltd.
6. Peter A Burrough and McDonell, "Principles of Geographical Information Systems", Oxford University Press, 1998.
7. M. N. DeMers, "Fundamentals of Geographic Information Systems", 3rd edition, Wiley.
8. George B Korte, "The GIS Book", Onword press, Thomson Learning, 5th Edition, 2003
9. Tor Bernhardsen, "Geographic Information Systems – An Introduction", 3rd edition, Wiley Publications

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of the syllabus. The average marks of both the tests will be considered as final IA marks.

Term Work:

Term Work shall consist of at least 10 programs based on the above syllabus using any suitable software.

Distribution of marks for term work shall be as follows:

1. Attendance (Theory and Practical): 05 Marks
2. Laboratory work (Performing Experiments and Journal): 20 Marks

The final certification and acceptance of TW ensures the satisfactory performance of laboratory Work and Minimum Passing in the term work.

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme (Hrs./Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Term Work /Practical	Tutorial	Total
ITC8044	Robotics	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment		End Sem.					
		Test 1	Test 2	Exam					
ITL8044	Robotics	20	20	80		25	---	25	150

Course Objectives: The Lerner is introduced to the fundamentals and kinematics of Robots. The topics like Differential motions & velocities, Trajectory Planning, Mobile Robot Motion Planning etc. are discussed.

Course Outcomes: At the end of this course, learners will be able to

- Understand kinematics and dynamics of stationary and mobile robots
- Understand trajectory planning for rigid robot and mobile robots
- Implement trajectory generation and path planning algorithms
- Work in interdisciplinary projects

Detailed Syllabus:

1. Fundamentals	Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications	03 Hrs	Chapter 1 – Text Book 1
2. Kinematics of Robots	Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation, Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Case studies	07 Hrs	Chapter 2 – Text Book 1
3. Differential motions and velocities	Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian	06 Hrs	Chapter 3 – Text Book 1
4. Dynamic Analysis of	Lagrangian mechanics, Moments of	07 Hrs	Chapter 4 –

Forces	Inertia, Dynamic equations of robots, Transformation of forces and moment between coordinate frames		Text Book 1
5. Trajectory Planning	Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories	07 Hrs	Chapter 5 – Text Book 1
6. Mobile Robot Motion Planning	Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug	04 Hrs	Chapter 2 – Text Book 2
7. Potential Functions and Visibility Graphs	Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods	08 Hrs	Chapter 4 & 5 – Text Book 2
8. Coverage Planning	Cell Decomposition, Localization and Mapping	06 Hrs	Chapter 6, 9 – Text Book 2

Text Books

1. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011
2. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, “Principles of Robot Motion – Theory, Algorithms and Implementations”, Prentice-Hall of India, 2005.

Reference Books

1. Mark W. Spong & M. Vidyasagar, “Robot Dynamics & Control”, Wiley India Pvt. Ltd., Second Edition, 2004
2. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
3. Aaron Martinez & Enrique Fernandez, “Learning ROS for Robotics Programming”, Shroff Publishers, First Edition, 2013.

Term Work:

Term Work shall consist of at least 10 programs based on the above syllabus using any suitable software.

Distribution of marks for term work shall be as follows:

1. Attendance (Theory and Practical): 05 Marks
2. Laboratory work (Performing Experiments and Journal): 20 Marks

The final certification and acceptance of TW ensures the satisfactory performance of laboratory Work and Minimum Passing in the term work.

List of Experiments:

Note: At least one experiment shall be performed from every group. Total number of experiments should be 10.

1. Forward kinematics of n-DOF robot arm – Simulation – (maximum 2 experiments)
2. Inverse Kinematics of n-DOF robot arm – Simulation (maximum 2 experiments)
3. Dynamic modeling of n-DOF robot arm & Simulation (maximum 2 experiments)
4. Trajectory planning of n-DOF robot arm (maximum 2 experiments)
5. Simulation of Bug1, bug2 and tangent bug algorithms (maximum 3 experiments)
6. Simulation of Potential field, voronoi graph, and visibility graph methods (maximum 3 experiments)

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme (Hrs/Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC8045	Soft Computing	04	02	---	04	01	---	05

Subject Code	Subject Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test 1	Test 2	Avg. of 2 Tests						
ITC8045	Soft Computing	20	20	20	80	25	---	25	150	

Course Objectives:

AIM: To introduce the techniques and methodologies of soft computing and adaptive neuro-fuzzy inferencing systems which differ from conventional AI and computing in terms of its tolerance to imprecision and uncertainty.

- To introduce the ideas of soft computational techniques based on human experience.
- To generate an ability to design, analyze and perform experiments on real life problems using various Neural Learning Algorithms.
- To conceptualize fuzzy logic and its implementation for various real world applications.
- To apply the process of approximate reasoning using Neuro-Fuzzy Modeling.
- To provide the mathematical background to carry out optimization using genetic algorithms.

Course Outcomes:

Student should be able to mimic human like thought process on deterministic machines and apply it to different real world problems faced in the professional front.

DETAILED SYLLABUS:

Sr.No.	Module	Detailed Content	Hours
1	Introduction to Soft Computing	Neural Networks: Definition, Advantages, Applications, Scope. Fuzzy logic: Definition, Applications. Hybrid System: Definition, Types of Hybrid Systems, Applications. Genetic Algorithms: Definition, Applications.	2
2	Neural Networks	Fundamental Concepts and Models of Artificial Neural Systems: Biological Neurons and Their Artificial Models, Models of Artificial Neural Networks, Neural Processing, Learning and Adaptation, Neural Network Learning Rules and Comparison. Linearly and Non-Linearly Separable Pattern Classification. Perceptron Convergence Theorem. Multi-layer Feedforward Network: Delta Learning Rule for Multiperceptron Layer, Generalized Delta Learning Rule, Feedforward Recall and Error Back-propagation Training, Learning Factors, Character Recognition Application. Associative Memory: Hopfield Network, Bidirectional Associative Memory. Radial Basis Function Networks.	20
3	Fuzzy Set Theory	Brief Review of Conventional Set Theory, Introduction to Fuzzy Sets, Properties of Fuzzy Sets, Operations on Fuzzy Sets, Membership Functions. Fuzzy Extension Principle, Fuzzy Relations, Projection and Cylindrical Extension of Fuzzy Relations, Fuzzy Max-Min and Max-Product Composition. Fuzzy Knowledge Based Systems with Applications, Defuzzification Methods, Fuzzy Composition Rules, Architecture of Mamdani Type Fuzzy Control Systems.	16
4	Hybrid Systems	ANFIS: Adaptive Neuro-Fuzzy Inference Systems: Introduction, ANFIS Architecture, and Hybrid Learning Algorithm.	4
5	Genetic Algorithms	What are Genetic Algorithms? Why Genetic Algorithms? Biological Background: The Cell, Chromosomes, Genetics, Reproduction, Natural Selection, Traditional Optimization and Search Techniques, Genetic Algorithm and Search space: Simple GA, General GA, Operators in GA, Encoding, Selection, Crossover, Mutation, Stopping Condition for GA flow, Constraints in GA, Problem solving using GA, Classification of GA.	6

Text Books:

1. Jacek M. Zurada, "Introduction to Artificial Neural Systems," Jaico Publishing House.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications," 3rd ed. Wiley India.
3. S. N. Sivanandam and S. N. Deepa, "Principles of Soft Computing," 2nd ed. Wiley India.
4. Jang J.S.R, Sun C. T. and Mizutani E., "Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence," PHI.

References:

1. Laurene Fausett, "Fundamentals of Neural Networks – Architectures, Algorithms, And Applications," Pearson Education.
2. Hagan T. Martin, H. B. Demuth, and Mark Beale, "Neural Network Design," Thomson Learning.
3. Satish Kumar, "Neural Networks – A classroom Approach," 2nd ed. Tata McGraw Hill.
4. Kishan Mehrotra, Chilukuri. K. Mohan, and Sanjay Ranka, "Elements of Artificial Neural Networks," 2nd ed. Penram Int. Publishing India.
5. H. J. Zimmermann, "Fuzzy Set Theory and its Applications," Allied Publishers Ltd.
6. Driakov D. Hellendoorn H. and Reinfrank M., "An Introduction to Fuzzy Control," Narosa Publishing House.

Term work:

Term work will be based on Practical and Assignments covering the topics of the syllabus.

Suggested Practical List (If Any):

1. Fuzzy membership function
2. Fuzzy Extension principle
3. Fuzzy controller
4. Perceptron Learning rule
5. Delta Learning Rule
6. Associative Memory
7. Genetic Algorithm
8. Competitive Learning

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC8046	Software Testing & Quality Assurance	04	02	---	04	01	--	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ITC8046	Software Testing & Quality Assurance	20	20	20	80	25		25	150

Course Objectives: The students will learn

- I. Basic software debugging methods.
- II. White box and Black box testing methods
- III. Writing the testing plans
- IV. Different testing tools

Course Outcomes:

After completion of course the students will able to:

- 1:** Identify the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.
- 2:** Implement various test processes for quality improvement
- 3:** Apply the software testing techniques in commercial environments
- 4:** Provides practical knowledge of a variety of ways to test software and an understanding of some of the trade-offs between testing techniques.
- 5:** Familiar with the open source testing tools.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Unit-I Testing Methodology	Introduction, Goals of Software Testing, Software Testing Definitions, Model for Software Testing, Effective Software Testing vs Exhaustive Software Testing, Software Failure Case Studies, Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology, Verification and Validation, Verification requirements, Verification of high level design, Verification of low level design, validation.	10
	Unit II Testing Techniques	Dynamic Testing : Black Box testing: boundary value analysis, equivalence class testing, state table based testing, cause-effect graphing based testing, error guessing. White box Testing Techniques: need, logic coverage criteria, basis path testing, graph matrices, loop testing, data flow testing, mutation testing. Static Testing. Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing. Regression Testing: Progressive vs. Regressive, regression testing produces quality software, regression testability, objectives of regression testing, regression testing types, define problem, regression testing techniques.	12
	Unit III Managing the Test Process	Test Management: test organization, structure and of testing group, test planning, detailed test design and test specification. Software Metrics: need, definition and classification of software matrices. Testing Metrics for Monitoring and Controlling the Testing Process: attributes and corresponding metrics, estimation model for testing effort, architectural design, information flow matrix used for testing, function point and test point	10

		analysis. Efficient Test Suite Management: minimizing the test suite and its benefits, test suite minimization problem, test suite prioritization its type , techniques and measuring effectiveness.	
	Unit IV Test Automation	Automation and Testing Tools: need, categorization, selection and cost in testing tool, guidelines for testing tools. Study of testing tools: WinRunner, QTP, LoadRunner, TestDirector and IBM Rational Functional Tester, Selenium etc.	8
	Unit V Testing for Specialized Environment	Testing Object Oriented Software: OOT basics, Object-oriented testing. Testing Web based Systems: Web based system, web technology evaluation, traditional software and web based software, challenges in testing for web based software, testing web based testing, Testing a data warehouse	5
	Unit VI Quality Management	Software Quality Management, McCall's quality factors and Criteria, ISO 9126 quality characteristics, ISO 9000:2000,software quality management	3

Text Books:

1. Software Testing Principles and Practices Naresh Chauhan Oxford Higher Education
2. Effective Methods for Software Testing , third edition by Willam E. Perry, Wiley Publication
3. Software Testing and quality assurance theory and practice by Kshirasagar Naik, Priyadarshi Tripathy , Wiley Publication
4. Software Testing Concepts and Tools by Nageswara Rao Pusuluri , dreamtech press

References:

1. Foundation of Software Testing 2 e , by Aditya P. Mathur , Pearson publication

2. Software Testing Tools by Dr. K.V.K.K. Prasad , dreamtech press
3. Software Testing Principles, techniques and tools by M.G. Limaye , Mc Graw Hill publication

Term work:

Term work will be based on Practical and Assignments covering the topics of the syllabus.

Suggested Practical List:

1. Write programs in C Language to demonstrate the working of the following
a. constructs: i) do...while ii) while....do iii) if...else iv)switch v) for
2. A program written in C language for Matrix Multiplication fails. Introspect the causes for its failure and write down the possible reasons for its failure.
3. Take any system (e.g. ATM system) and study its system specifications and report the various bugs.
4. Write the test cases for any known application (e.g. Banking application)
5. Create a test plan document for any application (e.g. Library Management System)
6. Design Test case using boundary value analysis by taking quadratic equation problem.
7. Design a test cases using equivalent class partitioning taking triangle problem
8. Study of any testing tool (e.g. Win runner)
9. Study of any web testing tool (e.g. Selenium)
10. Study of any test management tool (e.g. Test Director)
12. Study of any open source-testing tool (e.g. Test Link)

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

Course Code	Course Name	Teaching Scheme (Hrs./Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
BEITP805	Project II	---	**	---	---	06	---	06

****Work load of the teacher in semester VIII is equivalent to 12 hrs/week.**

Course Code	Course Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical	Oral	Total
		Internal assessment			Avg. of 2 Tests					
		Test 1	Test 2							
ITP706	Project I	---	---	---	---	50	---	50	100	

Course Objectives:

1. Implimentaion of the topic selected in Project-I.
2. Initiating the learners to technical writing and documentation for reuse.
3. Developing proficiency in carrying out critical analysis, review and study of existing literature on technological experimentation and finding out of scholastic investigation

Outcomes: The learner should be able to:

1. Demonstrate the product that is implemented.
2. Produce the proper documentation of the work.
3. Able to work in team and communicate with peers.
4. Develop skills required by the industry.

Guidelines for Project

- Students should do literature survey/visit industry/analyze current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by experimental/simulation methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Project II

- Project II should be assessed based on following points
 - Quality of problem selected
 - Clarity of Problem definition and Feasibility of problem solution
 - Relevance to the specialization / Industrial trends
 - Clarity of objective and scope
 - Quality of work attempted
 - Validation of results
 - Quality of Written and Oral Presentation
- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Project II should be assessed through a presentation jointly by Internal and External Examiners approved by the University of Mumbai
- Students should be motivated to publish a paper based on the work in Conferences/students competitions