# UNIVERSITY OF MUMBAI

## Bachelor of Engineering

**Information Technology (Second Year – Sem.VII & VIII)**

**Revised course (REV- 2012)**

**From Academic Year 2015 -16**

**Under**

## FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

## From Dean's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. S. K. Ukarande**
**Dean,**
**Faculty of Technology,**
**Member - Management Council, Senate, Academic Council**
**University of Mumbai, Mumbai**

## Preamble

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Information Technology of University of Mumbai, happy to state here that, Program Educational Objectives were finalized in a meeting where more than 30 members from different Institutes were attended, who were either Heads or their representatives of Information Technology Department. The Program Educational Objectives finalized for undergraduate program in Information Technology are listed below;

1. To prepare Learner's with a sound foundation in the basics of engineering fundamentals.
2. To prepare Learner's to use effectively modern programming tools to solve real life problems.
3. To prepare Learner's for successful career in Indian and Multinational Organisations and to excel in Postgraduate studies
4. To encourage and motivate Learner's for entrepreneurship.
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities in Learners.
6. To encourage Learner to use best practices and implement technologies to enhance information security and enable compliance, ensuring confidentiality, information integrity, and availability.

In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

**Dr. J. W. Bakal**
**Chairman, Board of Studies in Information Technology,**

## 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 |
| BEITC801 | Storage Network Management and Retrieval | 4 | | | 4 | | | 4 |
| BEITC802 | Big Data Analytics | 4 | | | 4 | | | 4 |
| BEITC803 | Computer Simulation and Modeling | 4 | | | 4 | | | 4 |
| BEITC804 | Elective -II | 4 | | | 4 | | | 4 |
| BEITL801 | Storage Network Management and Retrieval | | 2 | | | 1 | | 1 |
| BEITL802 | Big Data Analytics | | 2 | | | 1 | | 1 |
| BEITL803 | Computer Simulation and Modeling | | 2 | | | 1 | | 1 |
| BEITL804 | Elective -II | | 2 | | | 1 | | 1 |
| BEITP805 | 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) | |
|---|---|
| BEITC8041 | Enterprise Resource Planning |
| BEITC8042 | Wireless Sensor Networks |
| BEITC8043 | Geographical Information Systems |
| BEITC8044 | Robotics |
| BEITC8045 | Soft Computing |
| BEITC8046 | 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. | | | | | |
| BEITC801 | Storage Network Management and Retrieval | 20 | 20 | 20 | 80 | 3 | 25 | 25 | 150 |
| BEITC802 | Big Data Analytics | 20 | 20 | 20 | 80 | 3 | 25 | 25 | 150 |
| BEITC803 | Computer Simulation and Modeling | 20 | 20 | 20 | 80 | 3 | 25 | 25 | 150 |
| BEITC804 | Elective -II | 20 | 20 | 20 | 80 | 3 | 25 | 25 | 150 |
| BEITP805 | 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 |
| BEITC801 | 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 | | | | | |
| BEITC801 | 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.<br><br>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.<br><br>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 | STORGAE 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, Back up 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** |

**Text Books:**


1. ULF Troppen, Rainer Erkens and Wolfgang Muller , " Storage Networks Explained: Basic and Applications of Fibre Channel SAN, NAS and ISCSI and Infifniband " , 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 |
| BEITC802 | 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 | | | | | |
| BEITC802 | 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<br>Chapter 1 | **02** |
| 3 | NoSQL | 1. What is NoSQL? NoSQL business drivers; NoSQL case studies;<br>2. NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns;<br>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 | **Distributed File Systems :** Physical Organization of Compute Nodes, Large-Scale File-System Organization.<br>**MapReduce:** The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures.<br>**Algorithms Using MapReduce**:<br>Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations, Computing Selections by MapReduce,<br>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. | **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 .<br>**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 Querie, Issues in Stream Processing.<br>**Sampling Data in a Stream** : Obtaining a Representative Sample , The General Sampling Problem, Varying the Sample Size.<br>**Filtering Streams**:<br>The Bloom Filter, Analysis.<br>**Counting Distinct Elements in a Stream**<br>The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements .<br>**Counting Ones in a Window**:<br>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.<br>Topic sensitive Page Rank, link Spam, Hubs and Authorities. | **Text Book 1** | **05** |
| 8 | Frequent Itemsets | **Handling Larger Datasets in Main Memory**<br>Algorithm of Park, Chen, and Yu, The Multistage Algorithm, The Multihash Algorithm.<br>**The SON Algorithm and MapReduce**<br>**Counting Frequent Items in a Stream**<br>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 |
| BEITC803 | 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 | | | | | |
| BEITC803 | 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<br>Introduction to simulation | Introduction to Simulation.<br>Simulation Examples.<br>General Principles | **15** |
| 2 | UNIT - II<br>Mathematical & Statistical Models in Simulation | Statistical Models in simulation.<br>Queuing Models | **8** |
| 3 | UNIT - III<br>Random Numbers | Random Number Generation.<br>Testing random numbers (Refer to Third edition)<br>Random Variate Generation: Inverse transform technique, Direct Transformation for the Normal Distribution, Convolution Method, Acceptance-Rejection Technique (only Poisson Distribution). | **9** |
| 4 | UNIT – IV<br>Analysis of simulation data | Input Modeling<br>Verification, Calibration and Validation of Simulation Models<br>Estimation of absolute performance. | **12** |
| 5 | UNIT V | Case study | |

| | | | |
|---|---|---|---|
| | Application | • Processor and Memory simulation<br>• Manufacturing & Material handling | **4** |

**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 |
| BEITC8041 | 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 | | | | | |
| BEITC8041 | 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<br>Integrated Management Information, Business Modeling, Integrated Data Model | 04 |
| 2. | ERP and Related Technologies | Business Processing Reengineering(BPR), Data Warehousing, Data Mining,<br>On-line Analytical Processing(OLAP), Supply Chain Management (SCM),<br>Customer Relationship Management(CRM), MIS - Management Information<br>System, DSS - Decision Support System, EIS - Executive Information System | 06 |
| 3. | ERP Manufacturing Perspective | MRP - Material Requirement Planning, BOM - Bill Of Material, MRP -<br>Manufacturing Resource Planning, DRP - Distributed Requirement Planning,<br>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<br>E-Business structural transformation, Flexible Business Design, Customer Experience, Create the new techo 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<br>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 Clewwto 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 |
| BEITC8042 | 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 | | | | | |
| BEITC8042 | 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 :<br>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,<br>Transport layer :<br>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,<br>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. Waltenegus 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 |
| BEITC8043 | 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 | | | | | |
| BEITL8043 | 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 |
| BEITC8044 | Robotics | 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 | | | | | |
| BEITL8044 | 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

a. Understand kinematics and dynamics of stationary and mobile robots
b. Understand trajectory planning for rigid robot and mobile robots
c. Implement trajectory generation and path planning algorithms
d. 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 |
| BEITC8045 | 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 | | | | | |
| BEITC8045 | 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, LearningFactors,CharacterRecognitionApplication. **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, Neural 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 |
| BEITC8046 | 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 | | | | | |
| BEITC8046 | 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.<br><br>White box Testing Techniques: need, logic coverage criteria, basis path testing, graph matrices, loop testing, data flow testing, mutation testing. Static Testing.<br><br>Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing.<br><br>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.<br><br>Software Metrics: need, definition and classification of software matrices.<br><br>Testing Metrics for Monitoring and Controlling the Testing Process: attributes and corresponding matrics, estimation model for testing effort, architectural design, information flow matrix used for testing, function point and test point | **10** |

| | | | |
|---|---|---|---|
| | | analysis.<br><br>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.<br><br>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 | | | | Term Work | Practical | Oral | Total |
| | | Internal assessment | | | End Sem. Exam | | | | |
| | | Test 1 | Test 2 | Avg. of 2 Tests | | | | | |
| BEITP706 | 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