Curriculum for M. Tech in Software Engineering for in-house Course

(Applicable from the academic session 2019-2020)

Curriculum Structure							
Semester-I							
Sl No.	**Category**	**Course Code**	**Course Name**	**Total Number of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Program Core I	PGSE-101	Mathematical foundations of Computer Science	3	0	0	**3**
2	Program Core II	PGSE-102	Advanced Data Structures	3	0	0	**3**
3	Program Elective-I	PGSE-103	Program Elective-I	3	0	0	**3**
4	Program Elective-II	PGSE-104	Program Elective-II	3	0	0	**3**
5		PGSE-105	Research Methodology and IPR	2	0	0	**2**
6	Audit Course 1		Audit Course 1	2	0	0	**0**
	Total Theory			**16**	**0**	**0**	**14**
Practical							
7	Laboratory I	PGSE-191	Advanced Data Structures	0	0	2	**2**
8	Laboratory II	PGSE-192	Laboratory II [from Elective –I]	0	0	2	**2**
	Total Practical			**0**	**0**	**4**	**4**
	Total of Semester-I			**16**	**0**	**4**	**18**
Semester-II							
Theory							
1	Program Core III	PGSE-201	Advances in Algorithms	3	0	0	**3**
2	Program Core IV	PGSE-202	Software Quality Management	3	0	0	**3**
3	Program Elective-III	PGSE-203	Program Elective-III	3	0	0	**3**
4	Program Elective-IV	PGSE-204	Program Elective-IV	3	0	0	**3**
5	Audit Course 2		Audit Course 2	2	0	0	**0**
	Total Theory			**14**	**0**		**12**
Practical							
6	Laboratory III	PGSE-292	Laboratory III (Advances in Algorithm)	0	0	2	**2**
7	Laboratory IV	PGSE-293	Laboratory IV (from Elective-III)	0	0	2	**2**
	Total Practical			**0**	**0**	**4**	**4**
Sessional							
8	Mini Project	PGSE-294	Mini Project with Seminar	0	0	3	**2**
	Total Sessional			0	0	3	**2**
	Total of Semester-II			**12**	**0**	**7**	**18**
Semester-III							
Theory*							
1	Program Elective-V	PGSE-301	Program Elective-V	3	0	0	**3**

2	Open Elective	PGSE-302	Open Elective	3	0	0	**3**
	Total Theory			**6**	**0**	**0**	**6**
Sessional							
3	Major Project	PGSE-391	Dissertation –I	0	0	20	**10**
				0	0	20	**10**
	Total of Semester-III						**16**
Semester-IV							
Sessional							
1	Major Project	PGSE-491	Dissertation -II	0	0	32	16
	Total of Semester-IV						**16**
Total Credits for the programme							**68**

- **Program Elective - I**
    - A. Machine Learning
    - B. Operating System Design
    - C. Object Oriented Design
    - D. Software Requirement Engineering
- **Program Elective - II**
    - A. Advances in Wireless and Mobile Networks
    - B. Software Testing Methodologies
    - C. Software Architecture
    - D. Data Analytics
- **Program Elective – III**
    - A. Artificial Intelligence
    - B. Software Development Tools
    - C. Advances in DBMS-
    - D. Object Oriented Software Engineering
    - E. Secure Software Design and Enterprise Computing
- **Program Elective – IV**
    - A. Software Design Techniques
    - B. Theory of Computation
    - C. Cloud Computing
    - D. Network Security
- **Program Elective - V**
    - A. Mobile Applications and Services
    - B. Optimization Techniques
    - C. IOT and its security

D. Digital Forensics
E. Software Automation

- **Open Elective (As per CSE)**
  A. Operations Research
  B. Cost Management of Engineering Projects
  C. Industrial Safety
  D. Composite Materials
  E. Waste to Wealth
  F. Industry Overview (Enterprise & Solution Architecture)

Audit course 1 & 2

A. English for Research Paper Writing
B. Disaster Management
C. Sanskrit for Technical Knowledge
D. Value Education
E. Constitution of India
F. Pedagogy Studies
G. Stress Management by Yoga
H. Personality Development through Life Enlightenment Skills.

Course Code	PGSE-101
Course Name	Mathematical Foundation of Computer Science
Credits	3
Pre-Requisites	Discrete Mathematics

COURSE OBJECTIVES Total Number of Lectures: 36

• To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
• To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
• To study various sampling and classification problems.

LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit1 Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Marko chains	6
Unit 2 Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood	6
Unit 3 Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of over-fitting model assessment.	6
Unit 4 Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition.	6

Specialized techniques to solve combinatorial enumeration problems	
Unit 5 Computer science and engineering applications. Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.	6
Unit 6 Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.	6

COURSE OUTCOMES

After completion of course, students would be able to:

1. To understand the basic notions of discrete and continuous probability.
2. To understand the methods of statistical inference, and the role that sampling distributions play in those methods.
3. To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.

References:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley.

Course Code	PGSE-102
Course Name	Advanced Data Structure
Credits	3
Pre-Requisites	Under graduate level Data structure knowledge

COURSE OBJECTIVES Total Number of Lectures: 36

● The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
● Students should be able to understand the necessary mathematical abstraction to solve problems.
● To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
● Student should be able to come up with analysis of efficiency and proofs of correctness.

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1 Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.	6
Unit 2 Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	6
Unit 3 Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	6
Unit 4 Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.	6

Unit 5 Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad-trees, k-D Trees.	6
Unit 6 Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem	6

COURSE OUTCOMES

After completion of course, students would be able to:

1. Understand the implementation of symbol table using hashing techniques.
2. Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
3. Develop algorithms for text processing applications.
4. Identify suitable data structures and develop algorithms for computational geometry problems.

References:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Course Code	PGSE-103A
Course Name	Machine learning
Credits	3
Pre-Requisites	Basic Mathematics, Algorithms

COURSE OBJECTIVES Total Number of Lectures: 36

• To explore supervised and unsupervised learning paradigms of machine learning.
• To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances
• To explore Deep learning technique and various feature extraction strategies

LECTURE WITH BREAKUP	**NUMBER OF LECTURE**
Unit1: ● Basic concepts of learning, Hypothesis Space, Basic statistics: Probability, Bayes Theorem, Naïve Bayes, Bayesian network ● Regression Analysis: Correlation, Bivariate and Multivariate regression, Types of regression – Linear, Logistic, Non-linear or Polynomial	6
Unit2: ● Supervised, Unsupervised, Semi-supervised learning, Instance-based learning, k-Nearest Neighbourhood, Ensemble methods – Bagging, Boosting and Stacking ● Support Vector Machine: Working principle, Linear Discriminant Analysis (LDA), Non-linearity and kernel methods	6
Unit 3: ● Decision Trees: Introduction and building, Algorithms used – ID3, Information Gain, Gini Index, Chi-square, Reduction in variance, Overfitting and Under fitting, L1 and L2 regularisation, Random Forest ● Dimensionality reduction: Principle Component Analysis (PCA), Independent Component Analysis (ICA), Singular Valued Decomposition (SVD)	6
Unit 4:	6

• Artificial Neural Network: Biological Neuron, MP Neuron, HEVNet, Perceptron, Multilayer Perceptron, Gradient descent, Back-propagation algorithm • Convolution Neural Network(CNN), Recurrent Neural Network(RNN), Long Short Term Memory Network(LSTM)	
Unit 5: • Clustering techniques: k-means, Mean-Shift Clustering, Density-Based Spatial Clustering of Applications with Noise (DBSCAN), Hierarchical clustering • Reinforcement Learning: The Learning Task, Q Learning, Algorithm, Non-deterministic Rewards and Actions	6
Unit 6: • Advanced topics: Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning, Inference in Graphical Models • Evaluating Machine Learning algorithms and Model Selection and real-life applications	6

COURSE OUTCOMES

After completion of course, students would be able to:

• Extract features that can be used for a particular machine learning approach in various real life applications.
• To mathematically analyse various machine learning approaches and paradigms.
• To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach

References:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4.Tom M. Mitchell, Machine Learning, McGraw-Hill,1997(freely available online)

Course Code	PGSE-103B
Course Name	Operating System Design
Credits	3
Pre-Requisites	Data Structure, Algorithms, Computer Architecture and Organization

COURSE OBJECTIVE Total Number of Lectures: 36

- The objective of the course is to provide introduction to operating system design and concept of process, process lifecycle and scheduling approaches

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems.	6
Unit 2: Process abstraction, Process management, system calls, Threads, symmetric multiprocessing and micro-kernels.	6
Unit 3: Scheduling: Uni-processor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies.	6
Unit 4: Memory management, Virtual memory concept, Virtual machines, I/O management, File and disk management, Operating system security.	6
Unit 5: Distributed Operating system: Architecture, Design issues, Distributed mutual exclusion, Distributed deadlock detection, shared memory, Distributed scheduling. Multiprocessor operating systems: architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance.	6
Unit 6: Recent trends in Operating system design and their applicability to HPC.	6

COURSE OUTCOMES

After completion of course, students would be able to:

1. Understanding advanced concepts in operating systems.
2. Learning principles of Distributed and multiprocessor operating systems

References:

1. Advanced concept in operating system: M. Singhal, N.G. Shivratri
2. Operating system internal and design principles: William Stallings
3. Distributed Operating systems by Andrew S. Tanenbam

M.Tech Computer Science & Engineering/Software Engineering

Object Oriented Design

Contact: 3L Credits: 3

Total Number of Lectures:

36

Course Code	PGSE-103C
Course Name	Object Oriented Design
Credits	3
Pre-Requisites	The fundamental point in learning programming is to develop the critical skills of formulating programmatic solutions for real problems. It will be based on basic knowledge of algorithms and object oriented programming language. Once the basic skill of writing programs using loop, methods and arrays will be clear then the student can develop object oriented software using class encapsulation and inheritance

Course Objectives **Total Number of Lectures - 36**

• To develop conceptual understanding of Object Oriented System.
• To understand how a real world problem can be mapped to object oriented problem domain.
• To solve different industry level problems & to learn its applications.

Course Outcome:

Upon successful completion of the course students should be able to:

1. Visualize a given problem scenario in terms of classes and objects.
2. Acquire the knowledge about different types of inheritance & polymorphism, interface, package, vector and wrapper class.
3. Apply object oriented programming concepts through Java for problem solving.
4. Acquire knowledge about threads, thread synchronization and applets and their life cycle.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: Object oriented concepts Difference between OOP and other conventional programming approaches– advantages and disadvantages. Class, object, message passing, inheritance, encapsulation, polymorphism, dynamic binding	**3**
Unit 2: Basic concepts of object oriented programming using Java Implementation of Object oriented concepts using Java. Basic concepts of java programming – advantages of java, byte-code & JVM, data types, operators, control statements & loops. How to create objects and classes. Memory management involved with object and class creation, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, command line arguments, basics of I/O operations – keyboard input using BufferedReader & Scanner classes.	**5**
Unit 3: Reusability properties Super class & subclasses including multilevel hierarchy, process of constructor chaining, dynamic method dispatch, use of abstract classes & methods, abstract class and abstract class hierarchy, Compile time polymorphism and runtime polymorphism	**5**
Unit 4: Array, String, Vector and Wrapper classes Creation of multi-dimensional arrays, Creation of vectors, Differences between arrays and vectors, methods of the Vector class, String and StringBuffer class, methods associated with the String and StringBuffer class, Utility of the wrapper classes, different types of wrapper classes	**4**
Unit 5: Interface and Package	**4**

How to create interfaces, what is an interface, differences between class and interface, Multiple inheritance using interface, using existing packages, Advantages of packages, Creation of user defined packages, importing packages, member access for packages, Different access specifiers.	
Unit 6: Exception handling Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes.	**4**
Unit 7: Multithreading Difference between process and threads, Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter- thread communication, deadlocks for threads, suspending & resuming threads.	**5**
Unit 8: Applet Programming Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets, concept of delegation event model and listener, I/O in applets.	**6**

Textbooks/References:

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India

2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill

3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH

4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING

5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson

6. Ivor Horton's Beginning Java 2 SDK – Wrox

7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Code	PGSE-103 D
Course Name	Software Requirement Engineering
Credits	3
Pre-Requisites	

Total: 36L

COURSE OBJECTIVE

• Elicit requirements using a variety of techniques
• Organize and prioritize requirements
• Apply analysis techniques such as needs analysis, goal analysis, and use case analysis
• Validate requirements according to criteria such as feasibility, clarity, freedom from ambiguity, etc.
• Represent functional and non-functional requirements for different types of systems using formal and informal techniques

	LECTURE WITH BREAKUP	**HOURS**
	Unit1: • Basics of requirements engineering o definition of requirements engineering o importance of requirements engineering o place of requirements engineering in development process o types of requirements: functional requirements, non-functional requirements, quality attributes o main requirements engineering activities, documents and processes	**6**
	Unit2: • Requirements inception and elicitation o product vision and project scope o traditional elicitation approaches (interviews, stakeholders study, workshops, ...) o scenario/use case approaches o prototyping o requirements negotiation and risk management	**6**

	Unit 3:
	
	• Requirements analysis and specification - modeling techniques
	  ○ inception vs. specification
	  ○ techniques for writing high-quality requirements
	  ○ documentation standards (e.g., IEEE 830-1998)
	  ○ goal-oriented modeling
	  ○ Structured analysis and other techniques
	  ○ UML v2 and URN notations
	  ○ external qualities management, contract specification
		6

	Unit 4:
	
	• Requirements verification, and validation
	  ○ detection of conflicts and inconsistencies, completeness
	  ○ techniques for inspection, verification and validation
	  ○ feature interaction analysis and resolution
		6

	Unit 5: • Requirements Engineering Processes: RE Evolutionary process, RE basic process, RE in software lifecycle, Process vs. product specifications	**6**
	Unit 6: • Case Study and scenario Analysis (use cases, episodes, scripts, completeness of scenarios, anti-goals)	**6**

Elective II:

Course Code	PGSE-104 A
Course Name	Advance Wireless and Mobile Networks
Credits	3
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 36

● The students should get familiar with the wireless/mobile market and the future needs and challenges.
● To get familiar with key concepts of wireless networks, standards, technologies and their basic operations.
● To learn how to design and analyze various medium access.
● To learn how to evaluate MAC and network protocols using network simulation software tools.
● The students should get familiar with the wireless/mobile market and the future needs and challenges.

LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit1: INTRODUCTION: WirelessNetworkingTrends,KeyWirelessPhysicalLayerConcepts,Multiple Access Technologies-CDMA,FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modeling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc. **WIRELESSLOCALAREANETWORKS:** IEEE 802.11WirelessLANsPhysical&MAClayer, 802.11 MACModes (DCF &PCF) IEEE802.11standards,Architecture&protocols,Infrastructurevs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues	6
Unit 2: WIRELESSCELLULARNETWORKS: 1Gand2G,2.5G, 3G,and4G,MobileIPv4,MobileIPv6,TCPover Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment	6

strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.	
Unit 3: WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview WIRELESS SENSOR NETWORKS Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.	6
Unit 4:WIRELESS PANs Bluetooth AND Zigbee, Introduction to Wireless Sensors,.	6
Unit 5:SECURITY Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.	6
Unit 6: ADVANCED TOPICS IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks	6

COURSE OUTCOMES

After completion of course, students would be able to:

1. Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases.
2. Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
3. Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks.
4. Design wireless networks exploring trade-offs between wire line and wireless links.
5. Develop mobile applications to solve some of the real world problems.

References

1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
3. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002
4. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 200

Course Code	PGSE-104B
Course Name	Software Testing Methodologies
Credits	3
Pre-Requisites	Software Engineering, Programming

Course Objective **Total Number of Lectures: 36**

• Understand the concepts of software testing objectives, process criteria, strategies
• Experience software testing topics such as object oriented software testing methods and component based software testing issues
• Identify the techniques and skills on how to use modern software testing tools to support software testing projects

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs. Flow graphs and Path testing	6
Unit 2: Transaction Flow Testing: Transaction flows, transaction flow testing techniques. Dataflow testing	6
Unit 3: Domain Testing: Domains and paths, Nice and ugly domains, domain testing, domains and interfaces testing, domain and interface testing	6
Unit 4: Paths, Path products and Regular expressions: Path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection Logic Based Testing: Overview, decision tables	6
Unit 5: State, State Graphs and Transition testing: State graphs, good and bad state	6

graphs, state testing, Testing tools.	
Unit 6: Relations among testing, reliability, availability, maintainability and quality assurance in a software project	6

Course Outcomes

After completion of course, students would be:

1. Understanding advanced concepts of Software Testing Methodologies
2. Learning principles of Software Testing techniques, tools and applications

References:

1. Boris Beizer, "Software Testing Techniques", Dreamtech, 2nd Edition.

2. Brian Marwick, "The Craft of Software Testing", Pearson Education.

3.Perry, "Effective methods of Software Testing", John Wiley, 2ndEdition, 1999.

Course Code	PGSE-104C
Course Name	SOFTWARE ARCHITECTURE
Credits	4
Pre-Requisites	

Course Objectives

To understand the relationships between system qualities and software architectures.
To study software architectural patterns and their relationship to system qualities
To know software architecture documentation and reuse

LECTURE WITH BREAKUP	**NUMBER OF LECTURE HOURS**
Unit 1:The architecture Business Cycle (ABC) – Roots of Software architecture - Software architecture definitions and importance – Architectures and quality attributes -Architectural Styles - Architectural views: Need for multiple views – Some representative views – Conceptual View – Module view – Process view – Physical view – Relating the views to each other – The Software Architecture analysis Method (SAAM)	8
Unit 2 :Life cycle view of architecture design and analysis – Eliciting quality attributes - QAW – Design of an architecture - the ADD method – Evaluating an architecture -ATAM method	7
Unit 3 : Documenting the architecture – principles of sound documentation – view types, styles, views – refinement, context diagrams, variability, software interfaces – documenting the behaviour – seven part template	7
Unit 4 : Architecture-based development Product lines – cost and benefits of product line approach – product line activities – practice areas – patterns – PLTP – phased approach for adopting product lines	7

Unit 5 :Case study of J2EE/EJB - Future of software architecture	7

REFERNCES/ Text Books

1. Software Architecture in Practice(3rd Ed): Len Bass, Pearson (2013)
2. Quantitative approaches for Evaluating Software Architectures:Frame Works and Models, G.Zayaraz : VDM Verlag (2010)
3. Documenting Software Architectures: Views and beyond (2nd Ed): Clements et al, AW (2010)
4. Software Product Line Engineering: Foundations, Principles and Techniques: Klaus Pohl et.al; Springer (2011)

Course Code	**PGSE-104D**
Course Name	**Data Analytics**
Credits	**3**
Pre-Requisites	**Algorithms and Data Structures:** Understand the concepts of data structures and algorithms. How algorithms work and how and why are they dependent on Data Structures. **Database** : Basic knowledge of DBMS **Mathematics:** Algebra, calculus, Statistics and probability

COURSE OBJECTIVES Total Number of Lectures: 36

• To explore the fundamental concepts of data analytics.
• To learn to analyze the big data using intelligent techniques.
• To understand the various search methods and visualization techniques.
• To learn to use various techniques for mining data stream.
• To understand the applications using Map Reduce Concepts.
• To optimize business decisions and create competitive advantage with Data analytics

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1:Introduction to Big Data Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.	**6**

Unit 2:Data Analytics Data Analytics – Overview, Data Life Cycle, Methodology, Core Deliverables, Key Stakeholders, Data Analyst, Data Scientist	**6**
Unit 3:Data Analytics Project Problem Definition, Data Collection, Cleansing data, Summarizing, Data Exploration, Data Visualization	**6**
Unit 4:Data Analytics Methods Introduction to R, Introduction to SQL, Charts & Graphs- Univariate Graphical Methods - Box-Plots, Histograms, Multivariate Graphical Methods, Data Tools, , Statistical Methods	**6**
Unit 5:Advanced Methods Machine Learning for Data Analysis, Naive Bayes Classifier, K-Means Clustering, Association Rules, Big Data Analytics - Decision Trees, Logistic Regression, Time Series, Text Analytics	**6**
Unit 6:Hadoop Introduction, Hadoop - Environment Setup, HDFS Overview, HDFS Operations, MapReduce – Introduction. Algorithm, Hadoop – Streaming, Hadoop - Multi-Node Cluster	**6**

COURSE OUTCOME

Upon successful completion of the course students should be able to:

1. Develop the ability to build and assess data-based models.
2. Apply data analytics concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively.
3. Develop relevant programming abilities.

Textbooks/References:

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.

2. Tom White “Hadoop: The Definitive Guide” Third Edition, O’reilly Media, 2012.

3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012.

4. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP, 2012.

5. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley& sons, 2012.

6. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007.

7. Pete Warden, “Big Data Glossary”, O’Reilly, 2011.

8. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, 2nd Edition, Elsevier, Reprinted 2008.

9. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, “Intelligent Data Mining”, Springer, 2007.

10.Paul Zikopoulos, Dirkde Roos, Krishnan Parasuraman, Thomas Deutsch, James Giles , David Corrigan, “Harness the Power of Big Data The IBM Big Data Platform”, Tata McGraw Hill Publications, 2012.

11. Arshdeep Bahga, Vijay Madisetti, “Big Data Science & Analytics: A HandsOn Approach “,VPT, 2016

12. Bart Baesens “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)”, John Wiley & Sons,2014

Course Code	PGSE-191
Course Name	Advanced Data Structures
Credits	2
Pre-Requisites	Basic knowledge of C programming, Data structure and Unix Shell Commands,

Total Number of Lectures: 36P

LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit 1 Implementation of Stack and Queue.	3
Unit 2 Implementation of different hashing techniques and Skip Lists	6
Unit 3 Implementation of Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	9
Unit 4 Implementation of different Text Processing algorithms: Basic String Operations (concatenation of two string, pattern search) Implementation of Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries for Pattern Matching, The Huffman Coding Algorithm, Implementation of Longest Common Subsequence Problem (LCS).	9
Unit 5 Implementation of One Dimensional & Two Dimensional Range Search algorithm, Implementation of Priority Search Tree & searching on it, Quad trees, k-D Trees	9

References

1.Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.

2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Course Code	PGSE-192A
Course Name	Machine Learning
Credits	2 (36)P
Pre-Requisites	Python Programming and Basic Statistics

Total Number of Lectures: 36P

Sl. No.	**Assignments**
1	Write a program to demonstrate the working of decision trees algorithm. Use an appropriate dataset for building the decision tree and apply this knowledge to classify a new sample.
2	Write a program to demonstrate the working of support vector machine algorithm. Use an appropriate dataset and apply this knowledge to classify a new sample.
3	Write a program to implement k-Nearest Neighbour algorithm to classify a real life dataset. Print both correct and wrong predictions. Python ML library classes may be used for this problem.
4	Write a python program to implement random forest algorithm to classify real life dataset.
5	Write a python program to implement Naïve Bayes algorithm in real life dataset classification.
6	Write a python program to implement K-means algorithm on real life dataset.
7	Write a python program to implement linear and logistic regression in real life dataset.
8	Write a python program to implement deep learning in real life dataset.
9	Write a python program to implement PCA in real life dataset.
10	Project: Implement ML Techniques to solve problems in Bio-informatics

References

1. Machine Learning in Action - Peter Harrington
2. Programming Collective Intelligence: Building Smart Web 2.0 Applications - Toby Segaran
3. Machine Learning: An Algorithmic Perspective - Stephen Marsland

Course Code	PGSE-192B
Course Name	Operating Systems Design
Credits	2
Pre-Requisites	UG level Operating Systems

Total Number of Lectures: 36P

LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit 1 : Fundamentals of Operating System	6
Unit 2 : Shell scripting	9
Unit 3 : Familiarization with UNIX system calls for process management and inter-process communication	9
Unit 4: Experiments on process scheduling and other operating system tasks through simulation/implementation under a simulated environment	12

Text Books:

- Avi Silberschatz, Peter Galvin, Greg Gagne, Operating System Concepts, Wiley Asia Student Edition.
- William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India.

Reference Books:

1. Gary J. Nutt, Operating Systems: A Modern Perspective, Addison-Wesley.
2. Maurice Bach, Design of the Unix Operating Systems, Prentice-Hall of India.
3. Daniel P. Bovet, Marco Cesati, Understanding the Linux Kernel, O'Reilly and Associates.

Course Code	PGSE-192C
Course Name	Object Oriented Design
Credits	2
Pre-Requisites	Basic knowledge of programming concept, Data Structure and Algorithm

Course Objectives: Total Number of Lectures: 36P

- To develop conceptual understanding of Object Oriented System.
- To understand how a real world problem can be mapped to object oriented problem domain.
- To solve different industry level problems & to learn its applications.

List of Assignments:

1. Assignments on class, constructor, function overloading, constructor overloading
2. Assignments on inheritance, constructor chaining, run-time polymorphism
3. Assignments on arrays, Strings
4. Assignments on wrapper class, Vector
5. Assignments on developing interfaces-multiple inheritance, extending interfaces
6. Assignments on wrapper handling exceptions, creations of user defined exceptions
7. Assignments on creating and accessing packages
8. Assignments on multi-threaded programming, inter-thread communication, thread synchronization, deadlock
9. Assignments on applet programming

COURSEOUTCOMES

Upon successful completion of the course students should be able to:

1. Understand the object oriented approach of software development.
2. Learn about proper object oriented design principles while focusing on the reusability concept.
3. Implement a given design using Java

References

1. Rambaugh, James Michael, Blaha – "Object Oriented Modeling and Design" – Prentice Hall,

India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING
5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
6. Ivor Horton's Beginning Java 2 SDK – Wrox
7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Semester II:

Course Code	PGSE-201
Course Name	Advances in Algorithms
Credits	3
Pre-Requisites	UG level course in Algorithm Design and Analysis

COURSE OBJECTIVE Total Number of Lectures: 36

● To equip students with different design paradigms and data structures to solve advanced algorithmic problems.
● Students should be able to understand different classes of problems concerning their computational hardness.
● The students should be able to choose or design an efficient approximation algorithm to solve a computationally hard problem.

LECTURE WITH BREAKUP	**NO OF LECTURES**
Unit 1 Sorting: Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.	6
Unit 2 Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	5

Unit 3 Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	6
Unit 4 Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	9
Unit 5 Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest: Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm	6
Unit 6 Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	4

COURSE OUTCOMES

After completion of course, students would be able to:

● Analyze the complexity/performance of different algorithms.
● Determine the appropriate data structure for solving a particular set of problems.
● Categorize different problems in various classes according to their complexity and know how to approach towards computationally hard problems

References:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.
4. “Combinatorial Optimization: Algorithms and Complexity” by C.H. Papadimitriou, K. Steiglitz,

Course Code	PGSE -292
Course Name	Advances in Algorithms
Credits	2
Pre-Requisites	

Total: 36P

Lab assignmentsLanguage used: Python/C

1. Quick Sort, Randomized Quick Sort
2. Binary Tree, Heap sort
3. Merge sort
4. Kruskal Algorithm
5. Prims Algorithm
6. Breadth-first search (BFS)
7. Depth First Search (DFS)
8. Dijkstra's Algorithm
9. Longest Common Subsequence (LCS)
10. Floyd-Warshall Algorithm
11. Matrix Chain Multiplication
12. Ford-Fulkerson Algorithm
13. Simplex Algorithm
14. DFT
15. FFT

Course Code	PGSE- 202
Course Name	Software Quality Management
Credits	
Pre-Requisites	Software Engineering

Total: 36L

COURSE OBJECTIVES

• Understand the basic tenets of software quality and quality factors.
• Be exposed to the Software Quality Management (SQM) architecture and the details of SQM components.
• Understand of how the SQM components can be integrated into the project life cycle.
• Be familiar with the software quality infrastructure.
• Be exposed to the management components of software quality.

LECTURE WITH BREAKUP	**NUMBER OF LECTURE HOURS**
Unit 1:INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE Need for Software quality – Quality challenges – Software quality assurance (SQA) – Definition and objectives – Software quality factors- McCall's quality model – SQA system and architecture – Software Project life cycle Components – Pre project quality components – Development and quality plans.	7
Unit 2:SQA COMPONENTS AND PROJECT LIFE CYCLE Software Development methodologies – Quality assurance activities in the development process- Verification & Validation – Reviews – Software Testing – Software Testing implementations – Quality of software maintenance – Pre-Maintenance of software quality components – Quality assurance tools – CASE tools for software quality – Software maintenance quality – Project Management.	7
Unit 3:SOFTWARE QUALITY INFRASTRUCTURE	7

Procedures and work instructions – Templates – Checklists – 3S development – Staff training and certification Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control – Storage and retrieval.	
Unit 4:SOFTWARE QUALITY PROGRAM Software Quality Program Concepts – Establishment of a Software Quality Program – Software Quality Assurance Planning – An Overview – Purpose & Scope.	7
Unit 5 :UNIT V SOFTWARE QUALITY MMANAGEMENT STANDARDIZATION Software Standards–ISO 9000 Quality System Standards - Capability Maturity Model and the Role of SQM in Software Development Maturity – SEI CMM Level 5 –Comparison of ISO 9000 Model with SEI's CMM	8

COURSE OUTCOMES:

At the end of the course the students will be able to:

● Utilize the concepts in software development life cycle.
● Demonstrate their capability to adopt quality standards.
● Assess the quality of software product.
● Apply the concepts in preparing the quality plan & documents.

TEXT BOOK:

- Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009.

REFERENCES:

- Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press, 1997.
- Mordechai Ben-Menachem "Software Quality: Producing Practical Consistent Software", International Thompson Computer Press, 1997.

Elective III:

Course Code	PGSE-203A
Course Name	Artificial Intelligence
Credits	3
Pre-Requisites	Data Structures and Data Management or Data Structures

COURSE OBJECTIVES Total Number of Lectures: 36L

• To introduce to the field of Artificial Intelligence (AI).
• To solve real world problems for which solutions are difficult to express using the traditional algorithmic approach.
• To explore the essential theory behind methodologies for developing systems that demonstrates intelligent behaviour including dealing with uncertainty.

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation networks, Radial basis function networks, and recurrent networks.	7
Unit 2: Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.	5
Unit 3: Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search. Adversarial search. Minimax search procedure, alpha-beta pruning. Optimisation and search such as stochastic annealing and genetic algorithm.	7

Unit 4: Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.	7
Unit 5: Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.	5
Unit 6: Recent trends in Fuzzy logic, Knowledge Representation.	5

COURSE OUTCOMES

After completion of course, students would be able to:

1. To demonstrate knowledge of the fundamental principles of intelligent systems.
2. To analyse and compare the relative merits of a variety of AI problem solving techniques.
3. To use different state-of-the-art machine learning techniques to solve real world problems.

References:

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.

Course Code	PGSE-203 B
Course Name	Software Development Tools
Credits	3
Pre-Requisites	Data Structures and Programming

Course Objectives: **Total Number of Lectures: 36 L**

● The student will gain practical knowledge on methods, practice, languages and tools to develop a software project of medium size using the Object Oriented paradigm. This knowledge will be acquired in practice through the realization of a project in a working team.
● Analysing, Designing, Implementing and Testing programs using Object Oriented Technologies, in order to produce maintainable, high-quality, software applications
● Applying Software Engineering good practices, methods, notations and tools for the development of software applications inside a working team

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Requirements elicitation for medium-size applications , Requirements representation analysis using flow-oriented and scenario-oriented notations	**6**
Unit 2: Architectural high-level design of software applications, Structural and behavioural design of software applications, using the Object Oriented Paradigm	8
Unit 3: Implementation of a medium-size software application using Java, working in a team, Design of test suites guaranteeing a certain level of confidence in the software quality , Good practices in Software Engineering, and testing tools like JUnit	**8**
Unit 4: Integration testing, system testing and acceptance testing	**8**
Unit 5: The tools to be used are the development environments (typically under Eclipse), modeling, execution, testing and analysis of the software applications	**6**

COURSE OUTCOME

At the end this course students will be able to learn followings:

• Ability to develop, maintain and assess software systems that satisfy all user requirements
• Solutions that behave reliably and efficiently, are accessible to development and maintenance
• Development of software that comply with quality standards, applying theories, principles, methods, tools and practice

References:

1. Software Architecture: Foundations, Theory, and Practice. R. N. Taylor, N.Medvidovic, E. M. Dashofy, E. M. Dashofy. Wiley, 2010. INF/681.3.06/TAY
2. Designing the User Interface Strategies for effective human-computer interaction. Shneiderman, Ben. Pearson Education, 2005. INF/C5610/SHN
3. Software requirements styles and techniques.Lauesen, Soren. Addison-Wesley, 2002. INF/C6000/LAU.

Course Code	PGSE-203C
Course Name	Advances in DBMS
Credits	3
Pre-Requisites	Basic database concepts &exposure to any database package.

COURSE OBJECTIVE Total Number of Lectures: 36

This module aims to give students in depth information about system implementation techniques, data storage, representing data elements, database system architecture, the system catalog, query processing and optimization, transaction processing concepts, concurrency control techniques, database recovery techniques, database security and authorization, enhanced data models for advanced applications, temporal databases, deductive databases, database technology for decision support systems, distributed databases and client server architecture, advanced database concepts, and emerging technologies and

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Review of DBMS concepts & Relational Data Model : Review of database concepts, Normal Forms, DBMS architecture, data modeling using ER and extended ER, data base access methods, static and dynamic hashing, indexing technique for files including B-Tree and B + tree data structures. The Relational model and Relational DBMS: integrity constraints, updation operations, operations of relational algebra, overview of the SQL language, Relational schema design. Relational calculus and an overview of the QBE language, Case study: Oracle/DB2/MS-SQL.	6
Unit 2: Data Base Design DBMS system architecture; centralized and client server architecture; physical database design issues, Formalisms, normalization including functional and other types of dependencies and normal forms for relations, Multi-valued and join dependencies and 4NF, Join Dependency and 5NF, Inclusion Dependencies and Template Dependency, PJNF/DKNF, Techniques used for processing and optimizing queries specified in HL database log SQL query option.	6
Unit 3: Transactions and Concurrency Control : Anomalies in transactions, Serialisability, recoverability, Concurrency Control, Two-phased locking and requirements to avoid all types of anomalies, lock-based	

time-stamp and validation based protocols, Distributed concurrency control, database failures and recovery, log-based, shadow paging, buffer management.	6
Unit 4: Database Security and Authorization Database Security issues, Levels of database security, access control, Security mechanisms; multilevel database security; confidentiality and integrity requirements, Examples of e security	6
Unit 5: Distributed and Scalable Databases Distributed database concepts, distributed DBMS architecture distributed database design, top-down and bottom design, fragmentation, fragment allocation, Basic distributed query processing, transaction management in distributed database, distributed concurrency control, reliability issues in distributed DBMS. Big Data: concepts and alternative technologies -Map Reduce ,Pig Latin	6
Unit 6: **Emerging Trends and Example DBMS Architectures:** Recent approaches, models and current trends in improving the performance of Database, 1. Multimedia database 2. Geography databases, Gnome databases 3. Spatial database 4. Mobile databases 5. Web databases (JDBC, ODBC) 6. Personal databases 7. Digital libraries 8. Data grids 9. Wireless networks and databases	**6**

COURSE OUTCOMES

After completion of course, students would be:

1. Able to understand relational database management systems, normalization to make efficient retrieval from database and query.
2. Apply normalization techniques. Understand how transactions are processed in a database. Discuss/explain the concepts of Distributed Databases and Data Warehousing.
3. Discuss/explain some database security issues. Discuss/explain the different techniques in Concurrency Control. Tune and Optimize some Database Applications

References:

1. Database System Concepts – Abraham Silberschatz, H F Korth and S Sudarshan, McGraw Hill.
2. Database Design and Relational Theory: Normal Forms and All That Jazz by C.J.Date
3. Fundamentals of Database Systems – 5th Edition by R.Elmasri, S. Navathe
4. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez, Prentice Hall
5. An Introduction to Database Systems – Date, C.J., Addison-Wesley
6. A First Course in Database Systems – Ullman, Jeffrey D.; Widom, Jennifer, Prentice Hall International, Inc.

Course Code	PGSE-203D
Course Name	Object Oriented Software Engineering
Credits	3
Pre-Requisites	Basic knowledge of Object Oriented Design and Software Engineering

COURSE OBJECTIVES Total Number of Lectures: 36

• To be able to fundamentally understand the Object Oriented Software Engineering concepts and terminology.
• To develop a full command of UML and its syntax and produce different UML models.
• To understand how a real world problem can be mapped to object oriented problem domain.
• To design and develop the solution of different industry level problems.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to object oriented systems, Classes, Objects, Characteristics of Objects, What is Object Oriented Development, Stages of Object Oriented Methodology, Differences from Functional Methodology, Object Modeling Technique: Object Model, Dynamic Model, Functional Model	**[3]**
Unit 2: Object Modeling : Class and Object Diagrams, Links and Association, Aggregation- different types of aggregates, Generalization and Inheritance, Grouping Constructs, Abstract Class, Metadata, Class	**[4]**

descriptors, Candidate Keys, Constraints	
Unit 3 : Elements of Object Model; Major Elements – Abstraction, Encapsulation, Modularity, Hierarchy; Minor Elements – Typing, Concurrency, Persistence; Message Passing, State, Behaviour and Identity of Object, Class Relationship and Object Relationship	**[4]**
Unit 4 : Unified Process (UP), UP phases: Inception, Elaboration, Construction and Transition, Unified Process Work Products, Agile Process, Principles behind the Agile manifesto, Characteristics of Agile Software development, Agile Process Models	**[4]**
Unit 5 : Introduction to UML, UML Goals and Scopes, Model, System, Architecture, Architectural Views, Use Cases and functional requirements, Identifying and writing Use Cases, Modeling a System's Logical Structure using Classes and Class Diagrams, Modeling a System's Behavioural view using Sequence Diagram, Collaboration Diagram, State Diagram, Modeling System Workflows using Activity Diagrams, Modeling a System's Implementation view using Component Diagram, Modeling a System's Environment view using Package diagram, Deployment Diagrams.	**[14]**
Unit 6 : UML Metamodel: Design and Architectural Patterns.	**[7]**

COURSE OUTCOMES

After completion of course, students would be able to:

1. Explain the core concepts of the object oriented methodology and object modeling.

2. Illustrate the different elements of the object models and clearly explain the Unified Process and Agile Process.
3. Exercise the specialised knowledge, skill and judgment needed to design and develop complex software systems using UML with the efficient utilization of Design and Architectural Patterns

Textbooks/References:

1. Object Oriented Modelling and Design – Rambaugh, James Michael, Blaha – Prentice Hall, India

2. Object Oriented System Development – Ali Bahrami – Mc Graw Hill

3. Object Oriented Analysis and Design with Applications, 2nd ed., Grady Booch, Redwood City, Calif: Benjamin Cummings, 1994

4. Object-Oriented Software Engineering, Ivar Jacobson, Addison Wesley, 1992, ISBN: 0201544350

5. The Unified Modeling Language Reference Manual , James Rumbaugh et. al., Addison Wesley, 1991, ISBN: 020130998X

6. The Unified Software Development Process , Ivar Jacobson et. al., Addison Wesley, 1999, ISBN: 0201571692

7. UML Distilled, Martin Fowler et. al., Addison Wesley, 1999, ISBN: 0201325632

8. Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and iterative development, by Craig Larman, Pearson Education. (1998)

Course Code	PGSE-203E
Course Name	Secure Software Design & Enterprise Computing
Credits	3
Pre-Requisites	

Total: 36

Course Objective

• To fix software flaws and bugs in various software.
• To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
• Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
• Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **Secure Software Design** Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.	**6**
Unit 2: **Enterprise Application Development** Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system,	6

Present software solution.	
Unit 3: **Enterprise Systems Administration** Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).	**6**
Unit 4: Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.	**6**
Unit 5: Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.	**6**
Unit 6: Case study of DNS server, DHCP configuration and SQL injection attack.	**6**

Course Outcomes
After completion of course, students would be:

1. Differentiate between various software vulnerabilities.
2. Software process vulnerabilities for an organization.
3. Monitor resources consumption in a software.
4. Interrelate security and software development process.

References:
1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

Laboratory IV (from Elective-III): PGSE- 293

Course Code	PGSE-293A
Course Name	Artificial Intelligence Lab
Credits	2
Pre-Requisites	Basic Knowledge about Coding

COURSE OBJECTIVES Total Number of Lectures: 36P

- To understand how to draw logical inferences.
- To solve uncertain real-world problems using fuzzy sets.
- To explore foundations of neural networks.
- To deal with optimization problems using genetic algorithms.

LECTURE WITH BREAKUP

Unit 1:

Basic Understanding of Prolog Programming to infer logical conclusions.

Unit 2:

Write a program in MATLAB to plot various membership functions.

Use Fuzzy toolbox to model tip value based on service and food quality. Implement FIS Editor.

Unit 3:

Generate AND, NOT function using McCulloch-Pitts neural net by MATLAB program.

Write a MATLAB program for Perceptron net for an AND function with bipolar inputs and targets.

Unit 4:

Write a MATLAB Program on Basic Operations of Genetic Algorithm.

COURSE OUTCOMES

After completion of course, students would be able to:

1. To demonstrate knowledge of the fundamental principles of first order logic.

2. To analyse uncertainties using fuzzy logic.
3. To use different neural networks to classify different patterns.
4. To implement optimization using genetic algorithms.

Course Code	PGSE-293B
Course Name	Software Development Tools
Credits	2
Pre-Requisites	

LECTURE BREAKUP
Unit 1 : Requirements 1.1. Elicitation. 1.2. Notations. 1.2.1. Flow-oriented. 1.2.2. Scenario-oriented. 1.2.3. Mockups.
Unit 2 : Design 2.1. Architectural. 2.2. Detailed
Unit 3 : Implementation and Unit Testing 3.1. Java programming techniques. 3.2. Unit Testing. JUnit. 3.3. Increments and regression testing.
Unit 4 : Testing 4.1. Integration Testing. 4.2. System Testing. 4.3. Acceptance Testing.

COURSE OUTCOME:
Depending on the development phase of the session,students will:

1. Understand the explanations on the techniques to be employed
2. Work in groups to apply those techniques to the project development,
3. Make reports on the obtained results. In some sessions, it may be required to execute the application and discuss the results, write mini project reports etc

.

References:

1. Pruebas de software y JUnit: un análisis en profundidad y ejemplos prácticos.Bolaños, Sierra, Alarcón. Prentice-Hall, 2008. INF/681.3.06/BOL
2. Unit Testing in Java: How Tests Drive the Code. Link. Morgan Kaufmann; 1 edition, 2003.
3. Test Driven: TDD and Acceptance TDD for Java Developers. Koskela. Manning Publications, 2007.

Course Code	PGSE-293 C
Course Name	Laboratory for Advances in DBMS
Credits	2
Pre-Requisites	Basic database concepts & exposure to any database package.

COURSE OBJECTIVE : Total Number of Lectures: 36P

• To explore the features of a Database Management Systems
• To interface a database with front end tools
• To understand the internals of a database system

LECTURE WITH BREAKUP	**NO. OF LECTURES**
• Basic SQL • Intermediate SQL • Advanced SQL	6
• ER Modeling • Database Design and Normalization	6
• Accessing Databases from Programs using JDBC • Building Web Applications using PHP & MySQL	6
• Indexing and Query Processing • Query Evaluation Plans • Concurrency and Transactions	6
• Practice on Normalization – using any database perform various normal forms. • Practice on transaction processing	6

o Big Data Analytics using Hadoop	6

COURSE OUTCOMES

After completion of course, students would be:

- Ability to use databases for building web applications.
- Gaining knowledge about the internals of a database system.

References:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 6th edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 4th Edition, Pearson/Addision wesley, 2007
3. Sql/Pl Bayross, Ivan BPB

Course Code	PGSE-293 D
Course Name	Object Oriented Software Engineering Practical
Credits	2
Pre-Requisites	

Total Number of Lectures: 36P

Design and develop different models using OMT notation and UML for systems and implement those systems:

1. Design a Library Management System following the Object Oriented approach using UML and implement the system.
2. Design a Hospital Management System following the Object Oriented approach using UML and implement the system.
3. Design a Rail Reservation System following the Object Oriented approach using UML and implement the system.
4. Design a Hotel Booking System following the Object Oriented approach using UML and implement the system.
5. Design an Online Shopping System following the Object Oriented approach using UML and implement the system.
6. Design a Flight Reservation System following the Object Oriented approach using UML and implement the system.
7. Design an Online Examination System following the Object Oriented approach using UML and implement the system.

COURSE OUTCOMES

After completion of course, students would be able to:

1. Understand the object oriented approach of software development.
2. Learn about proper object oriented software engineering principles while focusing on the reusability concept.
3. Exercise the specialised knowledge, skill and judgment needed for the object oriented design and development of complex software systems using UML.

References:

1. Object Oriented Modelling and Design – Rambaugh, James Michael, Blaha – Prentice Hall, India

2. Object Oriented System Development – Ali Bahrami – Mc Graw Hill

3. Object Oriented Analysis and Design with Applications, 2nd ed., Grady Booch, Redwood City, Calif: Benjamin Cummings, 1994

4. Object-Oriented Software Engineering, Ivar Jacobson, Addison Wesley, 1992, ISBN: 0201544350

5. The Unified Modeling Language Reference Manual , James Rumbaugh et. al., Addison Wesley, 1991, ISBN: 020130998X

6. The Unified Software Development Process , Ivar Jacobson et. al., Addison Wesley, 1999, ISBN: 0201571692

7. UML Distilled, Martin Fowler et. al., Addison Wesley, 1999, ISBN: 0201325632

8. Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and iterative development, by Craig Larman, Pearson Education. (1998)

9. The complete reference-Java2 – Patrick Naughton, Herbert Schildt – TMH

10. Core Java For Beginners – R.K Das – VIKAS PUBLISHING

11. Java How to Program – 6th Ed.– Deitel and Deitel – Pearson

12. Beginning Java 2 SDK – Ivor Horton -Wrox

13. Programming With Java: A Primer – 3rd Ed. – E. Balagurusamy – TMH

Course Code	PGSE-293 E
Course Name	Secure Software Design & Enterprise Computing Laboratory IV (from program Elective III)
Credits	2
Pre-Requisites	Software Engineering, Security fundamentals

LECTURE WITH BREAKUP	**NUMBER OF LECTURE**
Unit 1 : Security programming practices, Security testing techniques implementation.	6
Unit 2 : Design and implementation of a directory-based server infrastructure in a heterogeneous systems environment	6
Unit 3 : Security techniques to protect system against SQL injection attack, Secure mobile application development etc	9
Unit 4 : Simulation tools to design and develop secure software	9

Reference study resources:

1. https://www.us-cert.gov/bsi/articles/knowledge/sdlc-process/secure-software-development-life-cycle-processes

2. Practical Enterprise Software Development Techniques: Tools and Techniques for Large Scale Solutions, by Edward Crookshanks

Course Code	PGSE-204A
Course Name	Software Design Techniques
Credits	3
Pre-Requisites	Software Engineering

COURSE OBJECTIVES Total Number of Lectures: 36

● To gain knowledge on the challenges of advanced software design and various issues relating to software design. ● To understand the tools and techniques for the automatic analysis and evaluation of software. ● To introduce various software design techniques. ● To acquire knowledge on the various Architectural styles and patterns.
● To give hands on experience on tools and techniques for design practices. ● To highlight various design methods used for solving real life problems
● To impart advanced concepts of software engineering design and development. ● To provide in depth knowledge on the application of software engineering CASE tools and their relevance to industry practices. ● To pursue research in software modelling and design for solving complex problems.

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit1 PRINCIPLES AND MOTIVATIONS: DEFINITIONS AND NEED FOR ENGINEERED APPROACH TO SOFTWARE DEVELOPMENT; SOFTWARE DEVELOPMENT PROCESS MODELS FROM THE POINTS OF VIEW OF TECHNICAL DEVELOPMENT AND PROJECT MANAGEMENT: WATERFALL, RAPID PROTOTYPING, INCREMENTAL DEVELOPMENT, SPIRAL MODULE	6
Unit 2 MODELS, AND EMPHASIS ON COMPUTER-ASSISTED ENVIRONMENTS. INTRODUCTION TO MODELING TOOLS BASICS OF OBJECT-ORIENTED APPROACH, OBJECT-ORIENTED	6

PROGRAMMING AND LANGUAGES, OMT, VISUAL MODELING, UML, RATIONAL ROSE TOOL	
Unit 3 SPECIFICATION; DATA, FUNCTION, AND EVENT-BASED MODELING; SOME OF THE POPULAR METHODOLOGIES SUCH AS YOURDON'S SAD, SSADM ETC; CASE TOOLS-CLASSIFICATION, FEATURES, STRENGTHS AND WEAKNESSES; ICASE; CASE STANDARDS.	6
Unit 4 SOFTWARE PROJECT MANAGEMENT, PRINCIPLES OF SOFTWARE PROJECTS MANAGEMENT; ORGANIZATIONAL AND TEAM STRUCTURE; PROJECT PLANNING; PROJECT INITIATION AND PROJECT TERMINATION; TECHNICAL, QUALITY, AND MANAGEMENT PLANS; PROJECT CONTROL; COST ESTIMATION METHODS - FUNCTION POINTS AND COCOMO.	6
Unit 5 OBJECT MODELING AND DESIGN CLASSES, OBJECTS, RELATIONSHIPS, KEY ABSTRACTIONS, COMMON MECHANISMS, DIAGRAMS, CLASS DIAGRAMS, ADVANCED CLASSES, ADVANCED RELATIONSHIPS, INTERFACES, TYPES, ROLES, PACKAGES, INSTANCES, OBJECT DIAGRAMS, INTERACTIONS, USE CASES, USE CASE DIAGRAMS, INTERACTION DIAGRAMS, ACTIVITY DIAGRAMS, EVENTS AND SIGNALS, STATE MACHINES, PROCESSES, THREADS, STATE CHART DIAGRAMS, COMPONENTS, DEPLOYMENT, COLLABORATIONS, PATTERNS AND FRAMEWORKS, COMPONENT DIAGRAMS, SYSTEMS AND MODELS, CODE GENERATION AND REVERSE ENGINEERING.	6
Unit 6 CASE TOOLS/STUDIES: Concepts, use and application. [5L]	6

COURSE OUTCOMES

After completion of course, students would be able to:

- Apply the principles behind software patterns to design real time applications.
- Acquire practical competence in the usage and application of tools to support automated software analysis.
- Adopt different architectural styles for designing a system.
- have the knowledge and skills in the processes and practices adopted in software development
- be able to undertake need based research focus on issues related to industries.

References:

1. ROGER PRESSMAN; SOFTWARE ENGINEERING - A PRACTITIONER'S APPROACH, MCGRAW HILL, NEW YORK.

2. IAN SOMMERVILLE; SOFTWARE ENGINEERING, ADDISON-WESLEY PUBLISHING COMPANY, ENGLAND

3. PANKAJ JALOTE; AN INTEGRATED APPROACH TO SOFTWARE ENGINEERING, NAROSA PUBLISHING HOUSE, NEW DELHI.

4. GRADY BOOCH, JAMES RUMBAUGH, IVAR JACOBSON, THE UNIFIED MODELING LANGUAGE USER GUIDE, PEARSON EDUCATION, NEW YORK.

5. Paul Clements, Rick Kazman, "Software Architecture in Practice – Len Bass", 2nd Edition, Pearson Education, 2003.

6. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal, "Pattern-Oriented Software Architecture, A System of Patterns", 2nd Edition, Volume 1, John Wiley and Sons, 2008.

7. Mary Shaw and David Garlan,"Software Architecture- Perspectives on an Emerging Discipline", Prentice-Hall of India, 2007.

Course Code	PGSE-204B
Course Name	Theory of Computation
Credits	3
Pre-Requisites	

Total: 36L
Course Objective:

• Be able to construct finite state machines and the equivalent regular expressions
• Be able to prove the equivalence of languages described by finite state machines and regular expressions.
• Be able to construct pushdown automata and the equivalent context free grammars.
• Be able to prove the equivalence of languages described by pushdown automata and context free grammars
• Be able to construct Turing machines and Post machines.
• Be able to prove the equivalence of languages described by Turing machines and Post machines Students will learn about a variety of issues in the mathematical development of computer science theory, particularly finite representations for languages and machines, as well as gain a more formal understanding of algorithms and procedures

LECTURE WITH BREAKUP	**NUMBER OF LECTURE**
Unit 1 : Models of Computation: Models of computation - classification, properties and equivalences.	**6**
Unit 2 : Languages & Automata Theory: Chomsky Hierarchy of Grammars and the corresponding acceptors, Finite Representation of Languages, Properties of the Languages Accepted by Finite Automata – Finite Automata and Regular Expressions – Proofs those Languages Are and Are Not Regular, Free languages, Context-free grammars, formal definition of a Context-free grammar, Examples of context-free grammars, Designing context-free grammars, Ambiguity, Chomsky normal form, Pushdown Automata, Examples	**8**

of pushdown Automata, Equivalence with context-free grammars, Non-context-free languages, The pumping lemma for context-free languages, Turing Machines, Recursive and Recursively Enumerable Languages; Operations on Languages, closures with respect to the operations.	
Unit 3 : Turing Machine: Unsolvable Problems. Definition, notation and Example of Turing Machine (TM). Programming techniques computable languages and functions, Church Turing hypothesis, Universal TM, Random Access TM, Multi-tape TM, Equivalence of One-Tape and Multi-tape TM's, Nondeterministic TMs, Conversion of RE to TM, Multi-stack PDA & TM.	**8**
Unit 4 : Computability and Decidability: Church-Turing Thesis, Decision Problems, Decidability and un-decidability, unsolvable problems; Halting Problem of Turing Machines; Problem reduction (Turing and mapping reduction), Intractability (Hierarchy Theorems), Mapping reductions, More undecidable languages, Rice theory, Reductions using controlled executions, RE Completeness, Reductions using computation histories. Linear Bounded Automata, Unrestricted grammars.	**8**
Unit 5 : Computational Complexity: Resource-constrained computation. Time Complexity- notion of complexity classes, classes P NP, NP-complete, Boolean satisfiability, NP-Completeness of CSAT and 3SAT, NP- Hard, Cook, Levin Theorem. The concept of reduction, coNP, polynomial Hierarchy. Some natural NP-complete problems, Space Complexity-Savich's Theorem, The class PSPACE, Optimization, search, and decision problems, Approximate solutions to optimization problems	**6**

BOOKS FOR STUDY:

TEXT BOOKS

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", second Edition, Pearson Education, 2007.
2. P, Linz , "An Introduction to Formal Languages and Automata" Forth Edition, Narosa Publication House.

REFERNCES

1. H.R. Lewis and C.H. Papadimitriou, “Elements of the theory of Computation”, Second Edition,
Pearson Education, 2003.
2. Thomas A. Sudkamp,” An Introduction to the Theory of Computer Science, Languages and Machines”, Third Edition, Pearson Education, 2007.
3. Raymond Greenlaw an H.James Hoover, “ Fundamentals of Theory of Computation, Principles
and Practice”, Morgan Kaufmann Publishers, 1998.
4. Micheal Sipser, “Introduction of the Theory and Computation”, Thomson Brokecole, 1997.
5. J. Martin, “Introduction to Languages and the Theory of computation” Third Edition, Tata Mc Graw Hill, 2007

Course Code	**Program Elective-IV PGSE-204C**
Course Name	**Cloud Computing**
Credits	**3**
Pre-Requisites	**Basic knowledge of Operating System, Distributed and Parallel Computing systems**

COURSE OBJECTIVES Total Number of Lectures: 36

• Students should be able to understand the evolution of Cloud Computing from the existing technologies.
• To develop conceptual understanding of Cloud Computing and have knowledge on the various issues in Cloud Computing.
• To be familiar with the emerging technologies as the next generation computing paradigms.
• To understand how a real world problem can be mapped to the Cloud Computing domain and to solve different industry level problems.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: INTRODUCTION Introduction to Cloud Computing ; Definition of Cloud ; Evolution of Cloud Computing; Underlying Principles of Parallel and Distributed Computing; Parallel and Distributed Systems; Distributed Computing System Models – Minicomputer Model, Workstation Model, Workstation-	[6]

Server Model, Processor-Pool Model, Hybrid Model; Network Operating Systems and Distributed Operating Systems; Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning; Conventional Computing vs. Cloud Computing; Benefits and Disadvantages of Cloud Computing	
Unit 2 : CLOUD ENABLING TECHNOLOGIES Service Oriented Architecture; Web Services; Publish-Subscribe Model; Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices –Virtualization Support and Disaster Recovery.	[4]
Unit 3 : CLOUD ARCHITECTURE, SERVICES Layered Cloud Architecture Design ; NIST Cloud Computing Reference Architecture; Cloud Deployment Models: Public, Private, Community and Hybrid Clouds; Public Clouds vs. Private Clouds ; Cloud Service Models : laaS – PaaS – SaaS ; Architectural Design Challenges ;	[6]
Unit 4 : RESOURCE MANAGEMENT, LOAD BALANCING AND TASK SCHEDULING	[5]

Inter Cloud Resource Management ; Resource Provisioning and Resource Provisioning Methods ; Load Balancing in Cloud, Task Scheduling in Cloud Environment, VM Migration; Global Exchange of Cloud Resources ;	
Unit 5 : SECURITY IN CLOUD Security Overview ; Cloud Security Challenges ; Cloud Forensics	[5]
Unit 6 : CLOUD TECHNOLOGIES AND ADVANCEMENTS Hadoop; MapReduce ; Virtual Box ; Google App Engine ; Programming Environment for Google App Engine ; Open Stack ;	[2]
Unit 7 : MOBILE CLOUD COMPUTING, FOG, EDGE AND DEW COMPUTING Offloading in MCC, Load balancing, Crowdsensing, Trust management in MCC; Architecture , Algorithm and application of Fog, Edge and Dew computing for IoT , IoV, AI based Mobile Edge computing; Challenges and Issues;	[8]

COURSE OUTCOMES
After completion of course, students would be able to:

1. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing, Cloud Architecture and

Enabling Technologies.
2. Illustrate the fundamental concepts of resource allocation, load balancing, task scheduling and security issues in Cloud Computing.
3. Learn about the Advances in Cloud Technologies and emerging areas of research.

Textbooks/References:

1. Anthony T.Velte, Toby J.Velte and Robert E, Cloud Computing – A Practical Approach, TMH 2010

2. Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011

3. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009

4. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009

Course Code	PGSE-203 D
Course Name	Network Security
Credits	3
Pre-Requisites	Computer Networks, Web Programming

COURSE OBJECTIVES Total Number of Lectures: 36

• To learn the basics of security and various types of security issues.
• To study different cryptography techniques available and various security attacks.
• Explore network security and how they are implemented in real world.
• To get an insight of various issues of Web security and biometric authentication.

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: **Introduction to Computer Security** Need for security. Data security: Review of cryptography. Different types of attacks, Key range, Examples	3
Unit 2: **Symmetric Key and Asymmetric Key Cryptography-** Introduction, Algorithm, Modes, DES, AES, RSA, Digital Signature, Digital Certificate etc.	5
Unit 3:	5

Internet Security Protocols Introduction, IP Level Security (IPSec), Transport Layer Security(TLS),SHTTP,SET,SSL, Application layer Security(PGP), 3D secure protocol , Email security, WAP Security (IEEE 802.11 security)	
Unit 4: **User Authentication & Non repudiation** Authentication and–non repudiation basics, Passwords, Authentication tokens, Biometric Authentication, Kerberos KDC, Security Handshake Pitfalls, SSO, Attacks on Authentication schemes	5
Unit 5: **Network security, Firewalls and VPN** Introduction, Network security: Firewalls (Types Configuration), Proxy-Servers, Network intrusion detection, DMZ and VPN	5
Unit 6: **Web security** SQL injection, XSS, etc. Software security and buffer overflow. Malware types and case studies.	5
Unit 7: **Security in Wireless Networks, Internet of Things:** Attack models, protocols, applications	4
Unit 8: **Other Modern topics**: Intrusion Detection System (IDS), ECC, Basics of Cryptocurrency Block Chain	4

COURSE OUTCOMES

After completion of course, students would be able to:

1. To have an understanding of basics of security and issues related to it.
2. Understanding of biometric techniques available and how they are used in today's world.

3. Security issues in web and how to tackle them.
4. Learn mechanisms for transport and network security
5. Learn security attacks, attack models, protocols, applications in Wireless networks, IoT .

Text:

1. Cryptography and Network Security Practice and Principles: William Stallings Pearson 2020
2. Cryptography and Network Security- Atul Kahate : 4th Edition McGraw-Hill 2019
3. Cryptography and Network Security- Forouzan : 3rd edition McGraw-Hill

References:

1. W. R. Cheswick and S. M. Bellovin. Firewalls and Internet Security.
2. Wesley, 1994.2. W. Stallings. Cryptography and Network Security. Prentice Hall, 1999.
3. B. Schneier. Applied Cryptography. Wiley, 1999.
4. Cryptography and security: Shyamala, Harini, Padmabhabhan Wiley 2011

Course Code	Program Elective-V PGSE-301A
Course Name	Mobile Applications and Services
Credits	3
Pre-Requisites	Wireless Communication and Mobile Computing

Total Number of Lectures:36

COURSE OBJECTIVE
• This course presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.
• It explores emerging technologies and tools used to design and implement feature-rich mobile applications for smartphones and tablets
• It also takes into account both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile

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

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

COURSE OUTCOMES

On completion of the course the student should be able to

1. Identify the target platform and users and be able to define and sketch a mobile application
2. Understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap
3. Design and develop a mobile application prototype in one of the platform (challenge project)

References:

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

Course Code	PGSE-301B
Course Name	Optimization Techniques
Credits	3
Pre-Requisites	Linear Algebra and Numerical Methods

Total: 36L

COURSE OBJECTIVE

• The objective of this course is to provide insight to the mathematical formulation of real world problems.
• To optimize these mathematical problems using nature based algorithms. And the solution is useful specially for NP-Hard problems.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Engineering application of Optimization, Formulation of design problems as mathematical programming problems	6
Unit 2: General Structure of Optimization Algorithms, Constraints, The Feasible Region	6
Unit 3: Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.	6
Unit 4: Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.	6
Unit 5: Real life Problems and their mathematical formulation as standard programming problems	6

Unit 6: Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.	6

COURSE OUTCOMES

After completion of course, students would be:

1. Formulate optimization problems.
2. Understand and apply the concept of optimality criteria for various types of optimization problems.
3. Solve various constrained and unconstrained problems in Single variable as well as multivariable.
4. Apply the methods of optimization in real life situation.

References:

1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.
2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.
5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493-1914-3.
6. H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank;
Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.
8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

Course Code	PGSE-301C
Course Name	IoT and its security, Program Elective V
Credits	3
Pre-Requisites	Wireless Networks , Cryptography & Network Security

Total: 36L

COURSE OBJECTIVES:

• Extensive and detailed overview of relevant topics on Wireless Sensor Network, Sensors, Cloud, Smart Applications etc. to provide with the fundamental concepts and knowledge building related to emerging technology.
• Architecture, Algorithms, Applications and Security issues and challenges of Interne of Things technology.
• Enables students to get acquainted with practical IoT based smart application development interfaced with other required disciplines such as hardware, embedded Operating system, Database, intelligent algorithms such as ML, AI etc.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **General Overview:** IoT and cyber-physical systems, IoT security (vulnerabilities, attacks, and countermeasures), security engineering for IoT development, IoT security lifecycle.	**3**
Unit 2: Architecture and Applications: smart transportation, smart cities, smart living, smart energy, smart health etc. : architecture, functioning, privacy, security	**6**
Unit 3: Protocols: Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases.	**6**
Unit 4:Vulnerabilities, Attacks, and Countermeasures & Security Engineering for IoT Development:threats, vulnerability, and risks , Today's IoT attacks, Security in agile developments, Focusing on the IoT device in operation, Safety and security	**6**

design, Processes and agreements, Technology selection – security products and services	
Unit 5: The IoT Security Lifecycle: The secure IoT system implementation lifecycle Operations and maintenance, Implementation and integration, Dispose	**6**
Unit 6: Cryptographic Fundamentals for IoT Security Engineering: Types and uses of cryptographic primitives in the IoT, Encryption and decryption, Hashes, Digital signatures, Cryptographic module principles , Cryptographic key management fundamentals, Examining cryptographic controls for IoT protocols, Future directions of the IoT and cryptography	**6**
Unit 7: Identity , Access , Privacy Management Solutions forthe IoT: An introduction to identity and access management for the IoT ,The identity lifecycle, Authentication credentials, IoT IAM infrastructure, Authorization and access control, Privacy challenges introduced by the IoT	**3**

COURSE OUTCOME:

At the end this course students will be able to learn followings:

1. High quality works highlighting security issues,
2. Explain the state-of-the-art methodologies in security
3. Model threats and countermeasures
4. Discuss corresponding case studies in areas of IoT, cloud computing and software-defined networks.

References:

1. B. Rusell and D. Van Duren, "Practical Internet of Things Security," Packt Publishing, 2016.
2. A. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton University Press, 2016.
3. A. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies," O'Reilly, 2014.5.T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambridge University Press, 2011.

4. Mandler, B., Barja, J., Mitre Campista, M.E., Cagá ová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing

Course Code	**Program Elective-IV PGSE-301D**
Course Name	**Digital Forensics**
Credits	**3**
Pre-Requisites	**Cybercrime, Computer Networks, Network Security, Cloud Computing**

COURSE OBJECTIVES **Total Number of Lectures: 36**

• Provides an in-depth study of the rapidly changing and fascinating field of digital forensics.
• Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
• Knowledge on E-evidence collection and preservation, digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation
• Knowledge on Network Forensics, Mobile Forensics, IoT Forensics, Cloud Forensics

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: INTRODUCTION Introduction to Computer Forensics:- Definition of Computer Forensics and Its Importance; Computer Forensics Vs. Computer Security; History of Digital forensics; What is digital data – types of data, sources of data; Preservation of evidence; General Challenges posed by digital evidence; Guidelines for successful computer forensics; Tasks of a Computer Forensics Specialist; Issues faced by computer forensics examiners	5
Unit 2 : DIGITAL FORENSICS Objectives of Digital forensics; Process of Digital forensics; Types of Digital Forensics; Challenges faced by Digital Forensics; Advantages of Digital forensics; Disadvantages of Digital Forensics; Chain of Custody; Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.	4
Unit 3 : CYBER CRIME INVESTIGATION TOOLS AND TECHNIQUES What is a cybercrime investigation; Who conducts cybercrime investigations; Cybercrime investigation techniques; cybercrime investigation and forensic tools; The Nature of Digital Evidence; Types of Digital Evidence; Extraction Techniques; Seizing Electronic Evidence - Principles; How Digital Devices are Collected; Digital Evidence preservation; Authority for Seizing Evidence; Crimes and Digital Evidence;	4
Unit 4:ELECTRONIC CRIME SCENE INVESTIGATION	6

Handling Digital Evidence at the Scene; Electronic Devices: Types, Description, and Potential Evidence; Investigative Tools and Equipment; Securing and Evaluating the Scene; Documenting the Scene; Evidence Collection; Packaging, Transportation and Storage of Digital Evidence; Electronic Crime and Digital Evidence Considerations by Crime Category	
Unit 5 : NETWORK FORENSICS Introduction to Network Forensics; Handling Evidence; Cryptographic Hashes; Chain of Custody; Incident Response; The Need for Network Forensic Practitioners; Short introduction to some well-known tools - Packet capturing tools: tcpdump, dumpcap, A simple pattern matching engine: ngrep; A flow capture & analysis tool: Argus, Network intrusion detection system example: Snort, The full-scale analysis tool: Wireshark	4
Unit 6 : MOBILE FORENSICS Importance of Mobile Forensics; Types of evidence; Mobile Forensics Process; Non-invasive vs. Invasive Forensics; Tools & Techniques commonly Used in Mobile Forensics	4
Unit 7 : IoT FORENSICS Digital Forensics and IoT Forensics; Why and where do we need IoT Forensics; IoT Forensics Challenges; IoT Forensics Approaches & Frameworks; Open issues in the IoT Forensics	4
Unit 8 : CLOUD FORENSICS Cloud Forensics: What is it? Digital Forensics and Cloud Forensics, Dimensions involved in Cloud Forensics; Digital Forensics in Cloud	5

Environment; Cloud Forensics Challenges; Opportunities of Cloud Forensics	

COURSE OUTCOMES
After completion of course, students would be able to:

1. Analyze the various mechanism of computer forensics.
2. Employ various computer tools and processes to investigate cyber-crime scene
3. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation

Textbooks/References:

Text Books:

1. Computer Forensics and cybercrimes: An introduction by Marjie T. Britz, Pearson Education, India.2013
2. Investigating the Cyber Breach: The digital forensics guide for the network engineer by Joseph Muniz and Aamir Lakhani, Pearson Education India.2018

Reference Books:

1. John Sammons, The Basics of Digital Forensics, Elsevier, 2014.
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications, 2015.
3. Bayuk, J. (2010). CyberForensics: Understanding information security investigations. Springer Science & Business Media.
4. Casey, E. (2009). Handbook of digital forensics and investigation. Academic Press.
5. Casey, E. (2011). Digital evidence and computer crime: Forensic science, computers and the internet. Academic Press.

6. EC-Council. (2016). Computer forensics: Investigating network intrusions and cybercrime (CHFI). Cengage Learning.
7. Holt, T. J., Bossler, A. M., & Seigfried-Spellar, K. C. (2015). Cybercrime and digital forensics: An introduction. Routledge.
8. Nelson, B., Phillips, A., & Steuart, C. (2014). Guide to computer forensics and investigations. Cengage Learning.
9. Rajaraman, V. (2008). Computer basics and C programming. PHI Learning Pvt.
10. Robertazzi, T. (2011). Basics of computer networking. Springer Science & Business Media.
11. Santanam, R., Sethumadhavan, M., & Virendra, M. (2010). Cyber security, cyber crime and cyber forensics: Applications and perspectives: Applications and perspectives. IGI Global.
12. Wempen, F. (2014). Computing fundamentals: Introduction to computers. John Wiley & Sons.

Course Code	**PGSE-302A**
Course Name	**Operations Research (Open Elective)**
Credits	
Pre-Requisites	

COURSE OBJECTIVETOTAL NUMBER OF LECTURES: 36

The aim of the course is to build capabilities in the students to analyse different situations in the industrial and business scenario involving limited resources and to find the optimal solution within the constraints.

LECTURES WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	**7**
Unit 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	**7**
Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	**7**
Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	**7**
Unit 5: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	**8**

Course Outcomes

After completion of the course, students would be able to:

1. Apply the dynamic programming to solve problems of discrete and continuous variables.
2. Apply the concept of non-linear programming.
3. Carry out sensitivity analysis.
4. Model the real world problem and simulate it.

References:

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

Course Code	**PGSE-302B**
Course Name	**Cost Management of Engineering Projects**
Credits	**3**
Pre-Requisites	

Total: 36 L

Unit 1 : Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making	**6**
Unit 2 :Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.	**6**
Unit 3: Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram.	**6**
Unit 4: Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.	**6**
Unit 5: Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	**6**
Unit 6: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	**6**

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References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Code	**PGSE-303C**
Course Name	**Industrial Safety**
Credits	**3**
Pre-Requisites	**Basic Engineering systems Engineering Chemistry and Engineering Physics**

Total: 36L

COURSE OBJECTIVES:

• Be exposed to the basic rudiments of the Industrial Safety
• To understand the modeling aspects behind Industrial Safety
• To understand why industrial safety is required
• Be exposed to different Industrial Safety methods

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit-1: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/ procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc. Safety color codes. Fire prevention and firefighting, equipment and methods.	6
Unit-2: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	6
Unit-3: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication	8

methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, Model Curriculum of Engineering & Technology PG Courses [Volume-I] [37] principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	
Unit-4: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	8
Unit-5: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/ procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance	8

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Explain the fundamentals of Industrial Safety.
2. Link data mining with business intelligence.
3. Apply various modeling techniques related to Industrial Safety.
4. Explain the different delivery process related to Industrial Safety.
5. Apply Industrial Safety methods to various situations.

6. Decide on appropriate technique for Industrial Safety

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.

2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.

4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Code	**PGSE-302D**
Course Name	**Composite Materials**
Credits	**3**
Pre-Requisites	

Total number of lectures: 36L

LECTURE WITH BREAKUP	
Unit 1: Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	**6**
Unit 2 :reinforcements: Preparation-layup, curing, properties and applications of glass fibers,carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particlereinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.Isostrain and Isostress conditions.	**8**
Unit 3 : Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carboncomposites: Knitting, Braiding, Weaving. Properties and applications.	**7**
Unit 4 : Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compressionmoulding – Reaction injection moulding. Properties and applications.	**7**
Unit 5 : Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum straincriteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots;stress concentrations.	**8**

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course Code	PGSE-302E
Course Name	Waste to energy
Credits	3
Pre-Requisites	Renewable Energy Sources, Physics, Environmental studies

Total Lecture: 36L

COURSE OBJECTIVE

• To classify solid waste sources.
• To identify methods of solid waste disposal.
• To study various energy generation methods
• To analyze biogas production methods and recycling of e-waste.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 **Solid Waste Sources-** solidwastesources**,** types**,** composition**,** properties**,** Globalwarming**,** MunicipalSolidWaste**:** Physical**,** Chemicalandbiologicalproperties**,** wastecollectionand**,** Transferstations**,** wasteminimizationandrecyclingofmunicipalwaste **,** segregationofwaste**,** sizereduction**,** managingwaste**.** StatusofbiotechnologiesforgenerationofEnergyfromwastetreatmentandDisposalAerobicompositing**,** incineration**,** furnacetypeanddesign**,** medicalwaste**/**pharmaceuticalwastetreatmenttechnologies**,** incineration**,** Environmentalimpacts**,** measurestomitigateenvironmentaleffectsdue **to** incineration**.**	6

Unit 2 **Land Fill method of Solid waste disposal:** Land fill classification, types, methods and sitting consideration, layout and preliminary design of landfills: composition, characteristics, generation, movement and control of landfill leach ate and gases, Environmental monitoring system for land fill gases.	6
Unit 3 **Energy Generation from waste Bio-chemical convention :** Sources of energy generation, anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, Anaerobic Digestion.	8
Unit 4 Biogas production, Land fill gas generation and utilization, Thermo-chemical convention: Sources of energy generation, Gasification of waste using Gasifiers, Briquetting, Utilization and advantages of briquetting, Environmental benefits of Bio- chemical and Thermo-chemical convention.	8
Unit 5 E-waste: e-waste in the global content- Growth of Electrical and Electronics Industry in India- Environmental concerns and health hazard – Recycling e-waste: a thriving economy of the unorganized sector – Global trade in hazardous waste – impact of hazardous e-waste in India. Management of e-waste : e-waste legislation, Government regulations on e-waste management – International experience- need for stringent health safeguards and environmental protection laws of India.	8

COURSE OUTCOME

1. Understand technologies for generation of energy from solid waste.
2. Compare methods of solid waste disposal.
3. Identify sources of energy from bio-chemical convention.
4. Analyze methods for management of e-waste

Text Books:

1. Nicholas p. Cheremisinoff, Handbook of Solid Waste Management and Waste Minimization Technologies. An In print of Elsevier, New Delhi (2003).
2. P. Aarne veiling, William A. Nortel and Debra R. Reinhart, Solid Waste Engineering, Thomson Asia Pte Ltd. Singapore(2002).
3. M. Dutta, B.P. Parida, B.K Guha and T.R. Surkrishnan, Industrial Solid Waste Management and Landfilling practice, Narousa Publishing House, New Delhi(1999).
4. "E-waste in India: Research unit, Raiya Sabha Secretariat, New Delhi(1999).
5. Amalendu Bagchi, Design, construction and Monitoring of Landfills, John Wiley and sons, New York(1994).
6. C. S Rao, Environmental Pollution Control Engineering, Wiley Eastern Ltd. New Delhi(1995).
7. M. L. Davis and D.A. Cornwell, Introduction to environmental engineering, Mc Graw Hill International Edition, Singapore(2008).
8. Sofer, Samir S.(ed), Zaborsky, R. (ed), " Biomass convention process for Energy and Fuels", New York, Plenum Press, (1981).
9. S.K Agarwal, Industrial Environment Assessment and Strategy, APH Publishing Corporation New Delhi(1996).

References:

1. C Parker and T Roberts (Ed), Energy from Waste – An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
2. KL Shah, Basics of Solid and Hazardous Waste Management Technology, Prentice Hall, 2000 3. M Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
3. G Rich et.al, Hazardous Waste Management Technology, Podvan Publishers, 1987

Google Books:

1. e-waste Management: From waste to Resource Klaus Hieronymi, Ramzy kahnat, Eric Williams, Technology and Engineering-2013 publisher: Earthscan 2013.
2. E-waste poses a Health Hazard: Sairudeen Pattazhy.
3. What is the impact of E-waste: Tamara Thompson.

Web links:

1. www.unep.org
2. www.routledge.com

Audit course 1 & 2

Course Code	Audit Course I(A)
Course Name	ENGLISH FOR RESEARCH PAPER WRITING
Credits	0
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 12

• Understand that how to improve your writing skills and level of readability
• Learn about what to write in each section
• Understand the skills needed when writing a Title
• Ensure the good quality of paper at very first-time submission

LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	2
Unit 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.	2
Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	2
Unit 4: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	2

Unit 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	2
Unit 6: Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission	2

References

1. Goldbort R (2006) Writing for Science, Yale University Press(available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Hand book of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Code	Audit Course I(B)
Course Name	DISASTER MANAGEMENT
Credits	0
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 12

• Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
• Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
• Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	2
Unit 2: Repercussions of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	2
Unit 3: Disaster Prone Areas in India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special	2

Reference To Tsunami; Post-Disaster Diseases And Epidemics	
Unit 4: Disaster Preparedness and Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	2
Unit 5: Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	2
Unit 6: Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	2

References

1. R. Nishith, Singh A K, "Disaster Management in India : Perspectives, issues and strategies' New Royal book Company.

2. Sahni, Pardeep Et.Al.(Eds.),"Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

Course Code	Audit Course I(C)
Course Name	SANSKRIT FOR TECHNICAL KNOWLEDGE
Credits	0
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 12

● To get a working knowledge in illustrious Sanskrit, the scientific language in the world
● Learning of Sanskrit to improve brain functioning
● Learning of Sanskrit to develop the logic in mathematics, science & other subjects
● enhancing the memory power
● The engineering scholars equipped with Sanskrit will be able to explore the
● huge knowledge from ancient literature

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: Alphabets in Sanskrit, Past/Present/Future Tense, simple Sentences	4
Unit 2: Order, Introduction of roots, Technical information about Sanskrit Literature	4
Unit 3: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	4

COURSEOUTCOMES

Students will be able to

● Understanding basic Sanskrit language
● Ancient Sanskrit literature about science & technology can be understood
● Being a logical language will help to develop logic in students

Reference

1. "Abhyaspustakam"– Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition "Suresh Soni, Ocean books(P)Ltd., New Delhi.

Course Code	Audit Course I(D)
Course Name	VALUE EDUCATION
Credits	0
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 12

• Understand value of education and self-development
• Imbibe good values in students
• Let the should know about the importance of character

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles and Value judgments.	3
Unit 2: Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline	3
Unit 3: Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.	3

Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature	
Unit 4: Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	3

COURSE OUTCOMES

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

Reference

1. Chakroborty, S. K. “Values andEthics for organizations Theory and practice”, Oxford University Press, New Delhi.

Course Code	Audit Course I(E)
Course Name	CONSTITUTION OF INDIA
Credits	0
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 12

Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)	2
Unit 2: Philosophy of the Indian Constitution: Preamble Salient Features	2
Unit 3: Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights	2

Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	
Unit 4: Organs of Governance: Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	2
Unit 5: Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	2
Unit 6: Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	2

COURSE OUTCOMES

Students will be able to

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

Reference

1. The Constitution of India, 1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B.R.Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M.P.Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D.Basu, Introduction to the Constitution of India, LexisNexis, 2015.

Course Code	Audit Course I(F)
Course Name	PEDAGOGY STUDIES
Credits	0
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 12

• Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
• Identify critical evidence gaps to guide the development.

LECTURE WITHB REAKUP	**NO.OF LECTURES**
Unit 1: Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology. Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.	2
Unit 2: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	2
Unit 3: Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices.	3

Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	
Unit 4: Professional development: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes	3
Unit 5: Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	2

COURSE OUTCOMES

Students will be able to:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Reference

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

CourseCode	Audit Course I(G)
CourseName	STRESS MANAGEMENT BY YOGA
Credits	0
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 12

• To achieve overall health of body and mind
• To overcome stress

LECTURE WITHB REAKUP	**NO.OF LECTURES**
Unit 1: Definitions of Eight parts of yog. (Ashtanga)	4
Unit 2: Yam and Niyam. Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	4
Unit 3: Asan and Pranayam Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayam	4

COURSEOUTCOMES

Students will be able to

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Reference

1. ‘Yogic A sanas for Group Tarining-Part-I”:Janardan Swami Yogabhyasi Mandal, Nagpur.
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department),Kolkata

Course Code	Audit Course I (H)
Course Name	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
Credits	0
Pre-Requisites	

COURSE OBJECTIVES Total Number of Lectures: 12

● To learn to achieve the highest goal happily
● To become a person with stable mind, pleasing personality and determination
● To awaken wisdom in students

LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit 1: Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52,53,59 (dont's) Verses- 71,73,75,78 (do's)	4
Unit 2: Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	4
Unit 3: Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,	4

Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	

COURSEOUTCOMES

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

Reference

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.