**VI Semester**

## New Scheme of Examination as per AICTE Flexible Curricula
## Bachelor of Technology (B.Tech.) Computer Science and Engineering/ *(w.e.f. Jan, 2020)*
## Computer Engineering/Computer Science & Technology]

| S.No. | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total Marks | Contact Hours per week | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | Practical | | | | | | |
| | | | | End Sem. | Mid Sem. Exam. | Quiz/ Assignment | End Sem | Term work | | | L | T | P | |
| | | | | | | | | Lab Work & Sessional | | | | | |
| 1. | CS601 | DC | Machine Learning | 70 | 20 | 10 | 30 | 20 | 150 | 2 | 1 | 2 | 4 |
| 2. | CS602 | DC | Computer Networks | 70 | 20 | 10 | 30 | 20 | 150 | 2 | 1 | 2 | 4 |
| 3. | CS603 | DE | Departmental Elective | 70 | 20 | 10 | - | - | 100 | 4 | - | 0 | 4 |
| 4. | CS604 | OE | Open Elective | 70 | 20 | 10 | - | - | 100 | 4 | - | 0 | 4 |
| 5. | CS605 | D Lab | Data Analytics Lab | - | - | - | 30 | 20 | 50 | - | - | 6 | 3 |
| 6. | CS606 | O/E Lab | Skill Development Lab | - | - | - | 30 | 20 | 50 | - | - | 6 | 3 |
| 7. | CS607 | IN | Internship-III | To be completed anytime during Fifth/Sixth semester. Its evaluation/credit to be added in Seventh Semester. | | | | | | | | | |
| 8. | CS608 | P | Minor Project II | - | - | - | - | 50 | 50 | - | - | 4 | 2 |
| 9. | Additional Credits# | #Additional credits can be earned through successful completion of credit based MOOC's Courses available on SWAYAM platform (MHRD) at respective UG level. | | | | | | | | | | | |
| | | | Total | 280 | 80 | 40 | 120 | 130 | 650 | 12 | 2 | 20 | 24 |

| Departmental Electives | Open Electives |
|---|---|
| 603 (A) Advanced Computer Architecture | 604(A) Knowledge Management |
| 603 (B) Computer Graphics & Visualization | 604(B) Project Management |
| 603 (C) Compiler Design | 604 (C) Rural Technology & Community Development |

| 1 Hr Lecture | 1 Hr Tutorial | 2 Hr Practical |
|---|---|---|
| 1 Credit | 1 Credit | 1 Credit |

## Computer Science & Engineering, VI-Semester
## CS-601 Machine Learning

### COURSE OBJECTIVES

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To become familiar with regression methods, classification methods, clustering methods.
3. To become familiar with Dimensionality reduction Techniques.

### COURSE OUTCOMES

1. Apply knowledge of computing and mathematics to machine learning problems, models and algorithms.
2. Analyze a problem and identify the computing requirements appropriate for its solution
3. Design, implement, and evaluate an algorithm to meet desired needs.
4. Apply mathematical foundations, algorithmic principles, and computer science theory to the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.

### UNIT I

Introduction to machine learning, scope and limitations, regression, probability, statistics and Linear algebra for machine learning, convex optimization, data visualization, hypothesis function and testing, data distributions, data preprocessing, data augmentation, normalizing data sets, machine learning models, supervised and unsupervised learning.

### UNIT II

Linearity vs non linearity, activation functions like sigmoid, ReLU, etc., weights and bias, loss function, gradient descent, multilayer network, backpropagation, weight initialization, training, testing, unstable gradient problem, auto encoders, batch normalization, dropout, L1 and L2 regularization, momentum, tuning hyper parameters,

### UNIT III

Convolutional neural network, flattening, subsampling, padding, stride, convolution layer, pooling layer, loss layer, dance layer 1x1 convolution, inception network, input channels, transfer learning, one shot learning, dimension reductions, implementation of CNN like tensor flow, keras etc.

**UNIT IV**

Recurrent neural network, Long short-term memory, gated recurrent unit, translation, beam search and width, Bleu score, attention model, Reinforcement Learning, RL-framework, MDP, Dimensionality reduction techniques.

**UNIT V**

Support Vector Machines, Decision Tree, application of machine learning in computer vision, speech processing, and natural language processing etc, Case Study: Image Net Competition

**Recommended Books:**

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer-Verlag New York Inc., $2^{nd}$ Edition, 2011.
2. Tom M. Mitchell, "Machine Learning", McGraw Hill Education, First edition, 2017.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016
4. Aurelien Geon, "Hands-On Machine Learning with Scikit-Learn and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems", Shroff/O'Reilly; First edition (2017).
5. Francois Chollet, "Deep Learning with Python", Manning Publications, 1 edition (10 January 2018).
6. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Shroff/O'Reilly; First edition (2016).
7. Russell, S. and Norvig, N. "Artificial Intelligence: A Modern Approach", Prentice Hall Series in Artificial Intelligence. 2003.

**List Of Experiments:**

Different problems to be framed to enable students to understand the concept learnt and get hands-on on various tools and software related to the subject. Such assignments are to be framed for ten to twelve lab sessions

**COURSE OBJECTIVE**

This course provides a foundation to understand computer networks using layered architectures. It also helps students to understand the various network models, addressing concept, routing protocols and design aspects of computer networks.

**COURSE OUTCOME**

1. Describe basics of computer network, network architecture, TCP/IP protocol suite, OSI reference models & fundamentals of physical layer.
2. Classify data link protocol like flow control, error control, bit oriented protocol.
3. Paraphrase multi-channel access protocol, IEEE 802 standards & use Ethernet standards.
4. Explain routing & congestion algorithm. State IP protocol, addressing & subnet.
5. Distinguish various transport & application layer protocols.

**UNIT I**

Introduction to computer networks: Network – Component and Categories – Topologies Reference Models: ISO/OSI Model and TCP/IP Protocol suite. Principals of physical layer: Transmission Media, Bandwidth, Multiplexing, Switching.

**UNIT II**

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP

**UNIT III**

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), Collision Free Protocols: Basic Bit Map,Binary Count Down,Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

**UNIT IV**

Network Layer: Need, Services Provided , Design issues, Routing algorithms: Least Cost Routing algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing, Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding, Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6.

**UNIT V**

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, Carrying Unicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of Data Transfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP Timer Management. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

**Recommended Books:**

1. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks" Pearson Education.
2. Douglas E Comer, "Internetworking WithTcp/Ip Principles, Protocols, And Architecture - Volume I" 6$^{th}$ Edition,Pearson Education
3. DimitriBertsekas, Robert Gallager, "Data Networks", PHI Publication, Second Edition.
4. KavehPahlavan, Prashant Krishnamurthy, "Networking Fundamentals", Wiley Publication.
5. Uyless Black, "Computer Networks", PHI Publication, Second Edition.
6. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill.

**List Of Experiments:**

1. Study of Different Type of LAN& Network Equipments.
2. Study and Verification of standard Network topologies i.e. Star, Bus, Ring etc.
3. LAN installations and Configurations.
4. Write a program to implement various types of error correcting techniques.
5. Write a program to Implement various types of framing methods.
6. Study of Tool Command Language (TCL).
7. Study and Installation of Standard Network Simulator: N.S-2, N.S3.OpNet,QualNetetc .
8. Study & Installation of ONE (Opportunistic Network Environment) Simulator for

High Mobility Networks .

9. Configure 802.11 WLAN.
10. Implement & Simulate various types of routing algorithm.
11. Study & Simulation of MAC Protocols like Aloha, CSMA, CSMA/CD and CSMA/CA using Standard Network Simulators.
12. Study of Application layer protocols-DNS, HTTP, HTTPS, FTP an  TelNet

## COURSE OBJECTIVES

1. To make students know about the Parallelism concepts in Programming
2. To give the students an elaborate idea about the different memory systems and buses.
3. To introduce the advanced processor architectures to the students.
4. To make the students know about the importance of multiprocessor and multicomputer.
5. To study about data flow computer architectures

## COURSE OUTCOMES

1. Discuss the classes of computers, and new trends and developments in computer architecture.

2. Study advanced performance enhancement techniques such as pipelines, dynamic scheduling branch predictions, caches.

3. Compare and contrast the modern computer architectures such as RISC, Scalar, and multi CPU systems.

4. Critically evaluate the performance of different CPU architecture.

5. Improve the performance of applications running on different CPU architectures.

6. Develop applications for high performance computing systems.

## UNIT I

Flynn's Classification, System Attributes to Performance, Parallel computer models - Multiprocessors and multicomputers, Multivector and SIMD Computers. Data and resource dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Control flow, data flow and Demand driven mechanisms. Static interconnection networks, Dynamic interconnection Networks: Bus Systems, Crossbar Switch, Multiport Memory, Multistage and Combining Networks

## UNIT II

Instruction set architecture, CISC Scalar Processors , RISC Scalar Processors, VLIW architecture, Memory Hierarchy, Inclusion, Coherence and Locality, Memory capacity planning. Interleaved memory organization-memory interleaving, pipelined memory access, Bandwidth and Fault Tolerance. Backplane Bus System :Backplane bus specification, Addressing  and timing protocols, Arbitration transaction and interrupt.

**UNIT III**

Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, pipeline hazards, Dynamic instruction scheduling - score boarding and Tomosulo's algorithm, Branch handling techniques, Arithmetic Pipeline Design, Static arithmetic pipeline, Multifunctional arithmetic pipelines. Superscalar pipeline design, Super pipeline processor design.

**UNIT IV**

Cache coherence, Snoopy protocols, Directory based protocols. Message routing schemes in multicomputer network, deadlock and virtual channel. Vector Processing Principles, Vector instruction types, Vector-access memory schemes. Vector supercomputer architecture, SIMD organization: distributed memory model and shared memory model. Principles of Multithreading: Multithreading Issues and Solutions, Multiple-Context Processors.

**UNIT V**

Parallel Programming Models, Shared-Variable Model, Message-Passing Model, Data-Parallel Model, Object-Oriented Model, Functional and Logic Models, Parallel Languages and Compilers, Language Features for Parallelism, Parallel Programming Environment, Software Tools and Environments.

**Recommended Books:**

1. Kai Hwang, "Advanced computer architecture", TMH.
2. J.P.Hayes, "computer Architecture and organization"; MGH.
3. V.Rajaranam & C.S.R.Murthy, "Parallel computer"; PHI Learning.
4. Kain,"Advance Computer Architecture: -A System Design Approach", PHI Learning
5. M.J Flynn, "Computer Architecture, Pipelined and Parallel Processor Design"; Narosa Publishing.
6. Hwang and Briggs, "Computer Architecture and Parallel Processing"; MGH.
7. David E. Callav & Jaswinder Pal Singh Marge Kaufmann"Advance Computer Architecture",EIS India.
8. Sajjan G. Shiva, Taylar & Francis, "Advance Computer Architecture

## Computer Science & Engineering, VI-Semester
## Departmental Elective - CS603 (B) Computer Graphics & Visualization

### COURSE OBJECTIVES

1. To equip students with the fundamental knowledge and basic technical competence in the field of computer graphics.
2. To emphasize on implementation aspect of Computer Graphics Algorithms.
3. To prepare the student for advance areas like Image Processing or Computer Vision or Virtual Reality and professional avenues in the field of Computer Graphics.

### COURSE OUTCOMES

1. Understand the basic concepts of Computer Graphics.
2. Demonstrate various algorithms for scan conversion and filling of basic objects and their comparative analysis.
3. Apply geometric transformations, viewing and clipping on graphical objects.
4. Explore solid model representation techniques and projections.
5. Understand visible surface detection techniques and illumination models

**UNIT I** Introduction to Raster Scan displays, Pixels, Frame buffer, Vector & Character generation, Random Scan systems, Display devices, Scan Conversion techniques, Line Drawing algorithms: simple DDA, Bresenham's Algorithm, Circle Drawing Algorithms: Midpoint Circle drawing and Bresenham's Algorithm, Polygon fill algorithm: Boundary-fill and Flood-fill algorithms.

**UNIT II** 2-D Transformation: Translation, Rotation, Scaling, Shearing, Reflection. Inverse Transformation, Homogeneous coordinate system, Matrice Transformation, Composite Transformation. Windowing & Clipping: World Coordinate System, Screen Coordinate System, Viewing Transformation, Line Clipping & Polygon Clipping Algorithms

**UNIT III** 3-D Transformations: Translation, Rotation and Scaling. Parallel & Perspective Projection: Types of Parallel & Perspective Projection, Hidden Surface elimination: Depth comparison, Back face detection algorithm, Painter's Algorithm, Z-Buffer Algorithm. Curve generation, Bezier and B-spline methods. Basic Illumination Model: Diffuse reflection, Specular reflection, Phong Shading, Gouraud shading, Ray Tracing, Color models like RGB, YIQ, CMY, HSV.

**UNIT IV** Visualization: Visualization of 2D/3D scalar fields: color mapping, ISO surfaces. Direct volume data rendering: ray-casting, transfer functions, segmentation. Visualization of Vector fields and flow data, Time-varying data, High-dimensional data: dimension reduction, parallel coordinates, Non-spatial data: multi-variate, tree/graph structured, text Perceptual and cognitive foundations, Evaluation of visualization methods, Applications of visualization, Basic Animation Techniques like traditional, key framing

**UNIT V** Multimedia :Basic of multimedia, application of Multimedia, Text-Types, Unicode Standard ,text Compression, Text file formats, Audio Components, Digital Audio, Digital Audio processing, Sound cards, Audio file formats ,Audio Processing software ,Video-Video color spaces, Digital Video, Digital Video processing, Video file formats. Animation: Uses of Animation, Principles of Animation, Computer based animation, 3D Animation, Animation file formats, Animation software,Special Effects in animation, Storyboarding for Animation, Compression: Lossless/Lossy Compression techniques, Image, Audio & Video Compression, MPEG Standards ,Multimedia Architecture, Multimedia databases.

**Recommended Books:**

1. Donald Hearn and M.P. Becker "Computer Graphics" Pearson Pub.

2. Foley, Van Dam, Feiner, Hughes, "Computer Graphics: Principles and Practice" Addison- Wesley

3. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill

4. Parekh "Principles of Multimedia" Tata McGraw Hill

5. Maurya, "Computer Graphics with Virtual Reality System " , Wiley India

6. Pakhira,"Computer Graphics ,Multimedia & Animation",PHI learning

7. Andleigh, Thakral , "Multimedia System Design " PHI Learning

8. Khalid Sayood , "Introduction to Data Compression", Morgan Kaufmann

# Departmental Elective - CS603 (C) Compiler Design

## COURSE OBJECTIVES

1. To implement Lexical Analyzer using Lex tool & Syntax Analyzer or parser using YACC Tool
2. To implement NFA and DFA from a given regular expression
3. To implement front end of the compiler by means of generating Intermediate codes.
4. To implement code optimization techniques.

## COURSE OUTCOMES

1. Understand the overview of phase of compiler and Lexical analysis.
2. Design and implement various parsing techniques of compiler.
3. Apply type checking for semantic analysis and analyze Run time environment.
4. Design and implement different intermediate code generation techniques.
5. Analyze various code optimization techniques

## UNIT I  Introduction to compiling & Lexical Analysis

Introduction of Compiler, Major data Structure in compiler, types of Compiler, Front-end and Back-end of compiler, Compiler structure: analysis-synthesis model of compilation, various phases of a compiler,Single & Multipass Compiler, Lexical analysis: Input buffering, Specification & Recognition of Tokens,Design of a Lexical Analyzer Generator,  LEX.

## UNIT II Syntax Analysis &Syntax Directed Translation

Syntax analysis: CFGs, Top down parsing, Brute force approach, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence parsing, LR parsers  (SLR,LALR, LR),Parser generation. Syntax directed definitions: Construction of Syntax trees, Bottom up evaluation of S-attributed definition, L attribute definition, Top down translation, Bottom Up evaluation of inherited attributes Recursive Evaluation, Analysis of Syntax directed definition.

## UNIT III Type Checking & Run Time Environment

Type checking: type system, specification of simple type checker, equivalence of expression, types, type conversion, overloading of functions and operations, polymorphic functions. Run time Environment: storage organization, Storage allocation strategies, parameter passing, dynamic storage allocation , Symbol table, Error Detection & Recovery.

**UNIT IV Code Generation**

Intermediate code generation: Declarations, Assignment statements, Boolean expressions, Case statements, Back patching, Procedure calls Code Generation: Issues in the design of code generator, Basic block and flow graphs, Register allocation and assignment, DAG representation of basic blocks, peephole optimization, generating code from DAG.

**UNIT V Code Optimization**

Introduction to Code optimization: sources of optimization of basic blocks, loops in flow graphs, dead code elimination, loop optimization, Introduction to global data flow analysis, Code Improving transformations ,Data flow analysis of structure flow graph Symbolic debugging of optimized code.

**Recommended Books:**

1. A. V. Aho, R. Sethi, and J. D. Ullman. Compilers: Principles, Techniques and Tools , Pearson Education
2. Raghavan, Compiler Design, TMH Pub.
3. Louden. Compiler Construction: Principles and Practice, Cengage Learning
4. A. C. Holub. Compiler Design in C , Prentice-Hall Inc., 1993.
5. Mak, writing compiler & Interpreters, Willey Pub.

# Open Elective - CS604 (A) Knowledge Management

## COURSE OBJECTIVES

1. Learn the Evolution of Knowledge management.
2. Be familiar with tools.
3. Be exposed to Applications.
4. Be familiar with some case studies.

## COURSE OUTCOMES

Use a framework and a clear language for knowledge management concepts.

1. Describe how valuable individual, group and organizational knowledge is managed throughout the knowledge management cycle.
2. Define the different knowledge types and explain how they are addressed by knowledge management.
3. Describe the major roles and responsibilities in knowledge management implementations;
4. Identify some of the key tools and techniques used in knowledge management applications.
5. Identify and evaluate major KM issues such as ethics, knowledge ownership vs. authorship, copyright, intellectual property and knowledge sharing incentives.

## UNIT I INTRODUCTION

Introduction: An Introduction to Knowledge Management – The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management – Key Challenges Facing the Evolution of Knowledge Management – Ethics for Knowledge Management.

## UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING

Organization and Knowledge Management – Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

**UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS**

Telecommunications and Networks in Knowledge Management – Internet Search Engines and Knowledge Management – Information Technology in Support of Knowledge Management – Knowledge Management and Vocabulary Control – Information Mapping in Information Retrieval – Information Coding in the Internet Environment – Repackaging Information.

**UNIT IV KNOWLEDGE MANAGEMENT-APPLICATION**

Components of a Knowledge Strategy – Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

**UNIT V FUTURE TRENDS AND CASE STUDIES**

Advanced topics and  case studies in knowledge management – Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan – A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

**Recommended Books:**

1. Srikantaiah, T.K., Koenig, M., "Knowledge Management for the Information Professional" Information Today, Inc., 2000.

2. Nonaka, I., Takeuchi, H., "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", Oxford University Press, 1995.

## Open Elective - CS604 (B) Project Management

### COURSE OBJECTIVES

Understand the different activities in software project development i.e., planning, design and management.

### COURSE OUTCOMES

1. Understanding the evolution and improvement of software economics according to the basic parameters and transition to the modern software management.

2. Learning the objectives, activities and evaluation criteria of the various phases of the life cycle of software management process.

3. Gaining knowledge about the various artifacts, workflows and checkpoints of the software management process and exploring the design concept using model based architecture from technical and management perspective.

4. Develop an understanding of project planning, organization, responsibilities, automation and control of the processes to achieve the desirable results.

### UNIT I Conventional Software Management
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Evolution of software economics. Improving software economics: reducing product size, software processes, team effectiveness, automation through software environments. Principles of modern software management.

### UNIT II Software Management Process

Framework: Life cycle phases- inception, elaboration, construction and training phase. Artifacts of the process- the artifact sets management artifacts, engineering artifacts, and pragmatics artifacts. Model based software architectures. Workflows of the process. Checkpoints of the process.

### UNIT III Software Management Disciplines

Iterative process planning. Project organizations and responsibilities. Process automation. Project control and process instrumentation- core metrics, management indicators, life cycle expectations. Process discriminants. Project Schedule, Scheduling Objectives, Building the Project Schedule, Scheduling Terminology and Techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts.

**Recommended Books:**

1. Software Project management, Walker Royce, Addison Wesley, 1998.

2. Project management 2/e, Maylor.

3. Managing the Software Process, Humphrey.

4. Managing global software Projects, Ramesh, TMH, 2001

## Open Elective - CS604 (C) Rural Technology & Community Development

### COURSE OBJECTIVES

1. Understand theories and practices in the rural development model.
2. Learn and analyse rural life and rural economy.
3. Understand different measures in rural development.
4. Learn different technologies used in upliftment of rural life.
5. To participate in visits and case studies for better understanding for rural development and its impact on overall economy.

### COURSE OUTCOMES

1. Understand rural development model.
2. Learn different measures in rural development and its impact on overall economy.
3. Understand and learn importance of technologies in rural and community development.
4. Understand challenges and opportunities in rural development.

### UNIT I Rural Management

Principles and Practices Introduction to Management and Theory of Management B. Planning, Organization Structure and Design C. Motivation and Leadership D. Management Control and Managerial Decision Making

### UNIT II Human Resource Management for rural India

Nature, Scope of Human Resource Management. F. Human Resource Planning, Recruitment and Selection, Training and Development, Performance Appraisal G. Welfare programme and Fringe benefits, Wage and Salary Administration H. Morale and Productivity, Industrial Relations and Industrial Disputes

### UNIT III Management of Rural Financing

Rural Credit System, Role of Rural Credit in Rural Development. Evolution and Growth of Rural Credit System in India. B: Agricultural Credit, Agricultural Credit Review Committee, Report of different Committees and Commissions, Problems and Prospects. C: Rural Credit to Non-farm Sector, Credit for small and marginal entrepreneurs. D: Role of Government Institutions towards facilitating Rural Credit. Role of Non- Government/ Semi Government / Quasi- Government Institutions. Growth and Present trend of Rural Financing towards Small scale and Cottage Industries.

**UNIT IV Research Methodology**

Concept of Social Research, Traditional Research, Action Research and Participatory Research B: Qualitative Data Construction and Methods of Data Collection C: Techniques of Interview D: Qualitative methods: Sociometry, Case Studies, observation, coding and content analysis.

**UNIT V Research Methodology**

Collection, Tabulation and Presentation of data B: Measures of Central Tendency, Dispersion, Moments, Skewness and Kurtosis, Correlation and Regression: Sampling Theory and Test of Significance.

**Recommended Books:**

1. Rural Development in India Concepts, Philosophy & Approaches Author: - Vikram Singh ISBN: - 9789382823957 Published In: 2018 Publisher: Satyam Law International.

2. Directory of Rural Technologies, Part 1 Mathew C. Kunnumkal, Bharat R. Sant National Institute of Rural Development, 2001 - Appropriate technology - 432 pages.

3. Rural Technology Development and Delivery RuTAG and Its Synergy with Other Initiatives Editors: Saha, Subir Kumar, Ravi, M. R. (Eds.)

4. Rural Development: Principles, Policies and Management - Katar Singh , Sage Publications.

5. Introduction to Community Development - Theory, Practice and Service Learning, Edited by J W Robinson, Sage Publications.

6.  G. N. Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa, 2002.

7. Fundamentals of Entrepreneurship", H. Nandan, Third Edition, PHL Learning Pvt. Ltd.

8. Monetary Economics-Institutions, Theory and Policy , First Edition, S B Gupta, S Chand Publications, ISBN – 9788121904346.

**CS605 Data Analytics Lab**

## COURSE OBJECTIVES

1. To learn the probability distributions and density estimations to perform analysis of various kinds of data.
2. To explore the statistical analysis techniques using Python and R programming languages.
3. To expand the knowledge in R and Python to use it for further research.

## COURSE OUTCOMES

1. Understand the basic of data analytics using concepts of statistics and probability.
2. Understand the needs of data processing techniques.
3. Implement the data analytics techniques using R, MATLAB and Python.
4. Apply the data analytics techniques in real life applications.

## UNIT I

Basics of data analytic framework, data per-processing, Statistics, probability, Probability Distribution, Bayes' Theorem, Central Limit theorem, Data Exploration & preparation, Concepts of Correlation, Regression, Covariance, Outliers, Data visualization. Statistical hypothesis testing.

## UNIT II

Basic Analysis Techniques: Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Practice and analysis with R or Python.

## UNIT III

Data analysis techniques: Regression analysis, Classification Techniques, Clustering, association rules analysis.

## UNIT IV

Practice and analysis with R or Python.

**UNIT V**

Case studies.

**Recommended Books:**

- The Data Science Handbook: Advice and Insights from 25 Amazing Data Scientists" by Carl Shan, William Chen, Henry Wang, and Max Song

- Doing Data Science: Straight Talk from the Frontline" by Cathy O'Neil and Rachel Schutt

- Numsense! Data Science for the Layman: No Math Added" by Annalyn Ng and Kenneth Soo

- The Art of Data Science" by Roger D. Peng and Elizabeth Matsui

- Data Science For Dummies" by Lillian Pierson

## Computer Science and Engineering, VI-Semester

## CS606 Skill  Development Lab

**COURSE OBJECTIVES**

The primary objective of skill development lab is to impart the set of skills into students, so that they are industry ready.

**COURSE OUTCOMES**

1. Understand the basics of software as a product.
2. Understand the current requirements of industries.
3. Implement the software as a product using different design patterns.
4. Apply the software development techniques in real life applications.

**UNIT I**

Software product life cycle.

**UNIT II**

Software product development standards.

**UNIT III**

Design Pattern-I &II.

**UNIT IV**

Software development Techniques Specification & Details.

**UNIT V**

Testing, Test case & Deployment.

**Recommended Books:**

1. Software Project management, Walker Royce, Addison Wesley, 1998.
2. Project management 2/e ,Maylor.
3. Managing the Software Process, Humphrey.
4. Managing global software Projects, Ramesh, TMH,2001