FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Computer Science and Engineering

(With effect from the academic year 2019– 2020)

(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering
Osmania University, Hyderabad – 500 007
2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII - Semester
(COMPUTER SCIENCE AND ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Duration in Hrs	Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE		
Theory Courses										
1	**PC 701 CS**	Compiler Construction	3	1	-	4	30	70	3	3
2	**PC 702 CS**	Distributed Systems	3	1	-	4	30	70	3	3
3	**PC 703 CS**	Information Security	3	1	-	4	30	70	3	3
4	**PC 704 CS**	Data Mining	3	1	-	4	30	70	3	3
5		Open Elective – II	3	-	-	3	30	70	3	3
6		Open Elective – III	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	**PC 751 CS**	Compiler Construction Lab	-	-	2	2	25	50	-	1
8	**PC 752 CS**	Distributed Systems Lab	-	-	2	2	25	50	-	1
9	**PC 753 CS**	Data Mining Lab	-	-	2	2	25	50	-	1
10	**PW 761 CS**	Project Work – I	-	-	4	4	50	-	-	2
11	**SI 762 CS**	Summer Internship	-	-	-	-	50	-	-	2
			18	04	10	32	355	570		25

Open Elective – II			**Open Elective – III**		
S. No.	Course Code	Course Title	S. No.	Course Code	Course Title
1	**OE 771 CE**	Green Building Technologies	1	**OE 781 CE**	Road Safety Engineering
2	**OE 772 CS****	Data Science Using R Programming	2	**OE 782 IT****	Software Engineering
3	**OE 773 EC**	Fundamentals of IoT	3	**OE 783 EC**	Principles of Electronic Communications
4	**OE 774 EE**	Non-Conventional Energy Sources	4	**OE 784 EE**	Illumination and Electric Traction systems
5	**OE 775 ME**	Entrepreneurship	5	**OE 785 ME**	Mechatronics

PC: Professional Course   PE: Professional Elective
L: Lectures   T: Tutorials   P: Practical   D: Drawing
CIE: Continuous Internal Evaluation   **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Note-2: * The students have to undergo a Summer Internship of four weeks' duration after VI semester and credits will be awarded in VII semester after evaluation.
** Subject is not offered to the students of CSE and IT Departments.

Course Code	Course Title						Core / Elective
PC 701 CS	**Compiler Construction**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	3

Course Objectives
- ➢ To introduce the steps in language translation pipeline and runtime data structures used in translation
- ➢ To learn about Scanning (lexical analysis) process using regular expressions and use of LEX to generate scanner
- ➢ To introduce different Parsing strategies including top-down (e.g., recursive descent, Early parsing, or LL) and bottom-up (e.g., backtracking or LR) techniques
- ➢ Describe semantic analyses using an attribute grammar
- ➢ To learn how to build symbol tables and generate intermediate code.
- ➢ To introduce techniques of program analysis and code optimization

Course Outcomes
After completing this course, the student will be able to
1. Create lexical rules and grammars for a given language
2. Generate scanners and parsers from declarative specifications.
3. Describe an abstract syntax tree for a small language.
4. Use program analysis techniques for code optimization
5. Develop the compiler for a subset of a given language

UNIT – I
Introduction: Compilers, The translation process, Data structures and issues in compiler structure, Bootstrapping and Porting.
Scanning: The scanning process, Regular expressions, Finite Automata, Regular expressions to DFA's, use of LEX to generate scanner.

UNIT – II
Context Free Grammars & Parsing: The parsing process, Context free grammars, Parse tree &Abstract syntax trees, EBNF and syntax diagrams, and Properties of CFLs.
Top Down Parsing: Recursive descent parsing, LL (1) parsing, First and follow sets, Recursive descent parser, and Error recovery in top down parsers.

UNIT – III
Bottom-up Parsing: Overview, LR (0) items and LR (0) Parsing, SLR (1) Parsing, general LR (1) and LALR (1) parsing, YACC, and Error recovery in bottom-up parsers.

UNIT – IV
Semantic Analysis: Attributes and attribute grammars, Algorithms for attribute computation, Symbol table, Data types and Type checking.
Runtime Environments: Memory organization during program execution, fully static runtime environments, Stack-based runtime environments, Dynamic memory, and Parameter parsing mechanisms.

UNIT – V
Code Generation: Intermediate code and data structures for code generation, Basic code generation techniques, Code generation of data structure references, Code generation of control statements and logical expressions, Code generation of procedure and function calls, Code generation in commercial compilers, Code optimization techniques, and Data flow equation.

Suggested Readings:
1. Kenneth C. Louden, *Compiler Construction: Principles and Practice*, Thomson Learning Inc., 1997.
2. Ravi Sethi, Aho & Ullman JP, *Compilers: Principles, Techniques and Tools*, Addison Wesley publishing co., 1986.
3. J.P. Tremblay and P.S. Sorenson, *The Theory and Practice of Compiler Writing*, TMH-1985.

Course Code	Course Title						Core / Elective
PC 702 CS	**Distributed Systems**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	3

Course Objectives
- ➢ To acquire an understanding of the issues in distributed systems
- ➢ To study architectures and working of distributed file systems
- ➢ To expose the students to distributed transaction management, security issues and replication

Course Outcomes

By the end of this course, the students will be able to
1. Describe the problems and challenges associated with distributed systems.
2. Implement small scale distributed systems.
3. Understand design trade-offs in large-scale distributed systems

UNIT-I

Introduction: Goals and Types of Distributed Systems

Architectures: Architectural Styles, System Architectures, Architectures versus Middleware, and Self-Management in Distributed Systems.

Processes: Threads, Virtualization, Clients, Servers, and Code Migration.

Communication: Fundamentals, Remote Procedure Call, Message-Oriented Communication, Stream-Oriented Communication, and Multicast Communication.

UNIT-II

Naming: Names, Identifiers and Addresses, Flat Naming, Structured Naming, and Attribute-Based Naming.

Synchronization: Clock Synchronization, Logical Clocks, Mutual Exclusion, Global Positioning of Nodes, and Election Algorithms.

Consistency and Replication: Introduction, Data-Centric Consistency Models, Client-Centric Consistency Models, Replica Management, and Consistency Protocols.

UNIT-III

Fault Tolerance: Introduction to Fault Tolerance, Process Resilience, Reliable Client-Server Communication, Reliable Group Communication, Distributed Commit, and Recovery.

Distributed Object-Based Systems: Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

UNIT-IV

Distributed File Systems: Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

Distributed Web-Based Systems: Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

UNIT-V

Distributed Coordination-Based Systems: Introduction to Coordination Models, Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

Map-Reduce: Example, Scaling, programming model, Apache Hadoop, Amazon Elastic Map Reduce,Mapreduce.net, Pig and Hive.

Suggested Readings:
1. Andrew S. Tanenbaum and Maarten Van Steen, *Distributed Systems*, PHI 2nd Edition, 2009.
2. R. Hill, L. Hirsch, P. Lake, S. Moshiri, *Guide to Cloud Computing*, Principles and Practiceǁ, Springer, 2013.
3. R. Buyya, J. Borberg, A. Goscinski, *Cloud Computing-Principles and Paradigms*, Wiley, 2013.

Course Code	Course Title						Core / Elective
PC 703 CS	**Information Security**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	3

Course Objectives
- ➢ To learn legal and technical issues in building secure information systems
- ➢ To provide an understanding of network security
- ➢ To expose the students to security standards and practices

Course Outcomes

After completing this course, the student will be able to
1. Describe the steps in Security Systems development life cycle (SecSDLC)
2. Understand the common threats and attack to information systems
3. Understand the legal and ethical issues of information technology
4. Identify security needs using risk management and choose the appropriate risk control strategy based on business needs
5. Use the basic knowledge of security frameworks in preparing security blue print for the organization
6. Usage of reactive solutions, network perimeter solution tools such as firewalls, host solutions such as antivirus software and Intrusion Detection techniques and knowledge of ethical hacking tools
7. Use ethical hacking tools to study attack patterns and cryptography and secure communication protocols
8. Understand the technical and non-technical aspects of security project implementation and accreditation

UNIT-I
Introduction: History, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access,
The SDLC, The Security SDLC.
Need for Security: Business Needs, Threats, Attacks, and Secure Software Development

UNIT-II
Legal, Ethical and Professional Issues: Law and ethics in Information Security, Relevant U.S. Laws, International Laws and Legal Bodies, Ethics and Information Security.
Risk Management: Overview, Risk Identification, Risk Assessment, Risk Control Strategies, selecting a Risk Control Strategy, Quantitative versus Qualitative Risk Control Practices, Risk Management Discussion Points, Recommended Risk Control Practices.

UNIT-III
Planning for Security: Security policy, Standards and Practices, Security Blue Print, Security Education, Continuity strategies.
Security Technology: Firewalls and VPNs: Physical Design, Firewalls, Protecting Remote connections.

UNIT-IV
Security Technology: Intrusion Detection, Access Control, and other Security Tools: Intrusion Detection and Prevention Systems-Scanning, and Analysis Tools- Access Control Devices.
Cryptography: Foundations of Cryptology, Cipher methods, Cryptographic Algorithms, Cryptographic Tools, Protocols for Secure Communications, Attacks on Cryptosystems

UNIT-V

Implementing Information Security: Information security project management, Technical topics of implementation, Non-Technical Aspects of implementation, Security Certification and Accreditation.

Security and Personnel: Positioning and staffing security function, Employment Policies and Practices, and Internal Control Strategies.

Information Security Maintenance: Security management models, Maintenance model, and Digital Forensics.

Suggested Readings:

1. Michael E Whitman and Herbert J Mattord, *Principles of Information Security*, Cengage Learning, 2011.
2. Thomas R Peltier, Justin Peltier, John Blackley, *Information Security Fundamentals*, Auerbach Publications, 2010.
3. Detmar W Straub, Seymour Goodman, Richard L Baskerville, Information *Security, Policy, Processes, and Practices,* PHI, 2008.
4. Mark Merkow and Jim Breithaupt*, Information Security Principle and Practices*, Pearson Education, 2007

Course Code	Course Title						Core / Elective
PC 704 CS	**Data Mining**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	3

Course Objectives
- ➤ To introduce the basic concepts of data Mining and its applications
- ➤ To understand different data mining like classification, clustering and Frequent Pattern mining
- ➤ To introduce current trends in data mining

Course Outcomes

After completing this course, the student will be able to
1. Organize and Prepare the data needed for data mining using prepreprocessing techniques
2. Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on a given data set
3. Define and apply metrics to measure the performance of various data mining algorithms

UNIT-I

Introduction: Why Data Mining? What is Data Mining? What kinds of data can be mined? What kinds of patterns can be mined? Which technologies are used? Which kinds of applications are Targeted? Major issues in Data Mining. Getting to know your data: Data objects and attributed types. Basic statistical descriptions of data. Data visualization, Measuring data similarity and dissimilarity.

UNIT-II

Mining frequent patterns, Associations and correlations: Basic concepts and methods, Frequent Item set Mining Methods, which patterns are interesting? Pattern evaluation methods.

UNIT-III

Classification: Basic concepts, Decision tree induction, Bayes classification methods, Advance methods, Bayesian Belief Network, Classification by back propagation, Support vector machine.

UNIT-IV

Cluster Analysis: Concepts and Methods: Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of clustering.

UNIT-V

Data Mining Trends and Research Frontiers: Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining trends.

Suggested Readings:
1. Jiawei Han, Micheline Kamber, Jin Pei, Data Mining: Concepts & Techniques, 3rd Edition., Morgon Koffman ,2011
2. Vikram Pudi, P. Radha Krishna, *Data Mining*, Oxford University Press, 1st Edition, 2009.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, *Introduction to Data Mining,* Pearson Education, 2008.

Course Code	Course Title						Core / Elective
OE 771 CE	**Green Building Technologies**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
  ➢ To impart knowledge of the principles behind the green building technologies.
  ➢ To know the importance of sustainable use of natural resources and energy.
  ➢ To understand the principles of effective energy and resources management in buildings.
  ➢ To bring awareness of the basic criteria in the green building rating systems.
  ➢ To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes
After completing this course, the student will be able to
  1. Define a green building, along with its features, benefits and rating systems.
  2. Describe the criteria used for site selection and water efficiency methods.
  3. Explain the energy efficiency terms and methods used in green building practices.
  4. Select materials for sustainable built environment & adopt waste management methods.
  5. Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials
Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. *Alternative building materials and technologies* by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. *Non-Conventional Energy Resources* by G. D. Rai, Khanna Publishers.
5. *Sustainable Building Design Manual*, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, *Green Building Fundamentals*, Pearson, USA, 2010.
7. Charles J. Kibert*, Sustainable Construction - Green Building Design and Delivery*, John Wiley & Sons, New York, 2008.
8. Regina Leffers*, Sustainable Construction and Design*, Pearson / Prentice Hall, USA, 2009.

Course Code	Course Title						Core / Elective
OE 772 CS	**Data Science Using R Programming**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

➢ To learn basics of R Programming environment: R language, R- studio and R packages
➢ To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting
➢ To learn Decision tree induction, association rule mining and text mining

Course Outcomes:

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

1. Use various data structures and packages in R for data visualization and summarization
2. Use linear, non-linear regression models, and classification techniques for data analysis
3. Use clustering methods including K-means and CURE algorithm

UNIT – I

Data Science: Introduction to data science, Linear Algebra for data science, Linear equations, Distance, Hyper planes, Half spaces, Eigen values, Eigenvectors.

UNIT II

Statistical Modelling, Random variables, Probability mass/density functions, sample statistics, hypothesis testing.

UNIT III

Predictive Modelling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression

UNIT IV

Introduction to R Programming, getting started with R: Installation of R software and using the interface, Variables and data types, R Objects, Vectors and lists, Operations: Arithmetic, Logical and Matrix operations, Data frames, functions, Control structures, Debugging and Simulation in R.

UNIT V

Classification: performance measures, Logistic regression implementation in R, K-Nearest neighbours (KNN), K-Nearest neighbours implementation in R, Clustering: K-Means Algorithm, K-Means implementation in R.

Suggested Readings:

1. Nina Zumel, Practical Data Science with R, Manning Publications, 2014.
2. Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly, 2017.
4. Roger D Peng, R Programming for Data science, Lean Publishing, 2016.
5. Rafael A Irizarry, Introduction to Data Science, Lean Publishing,2016.

Course Code	Course Title						Core / Elective
OE 773 EC	**Fundamentals of IoT**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
- ➢ Discuss fundamentals of IoT and its applications and requisite infrastructure Describe Internet principles and communication technologies relevant to IoT Discuss hardware and software aspects of designing an IoT system
- ➢ Describe concepts of cloud computing and Data Analytics
- ➢ Discuss business models and manufacturing strategies of IoT products

Course Outcomes

At the end of the course, the students will be able to
1. Understand the various applications of IoT and other enabling technologies. Comprehend various protocols and communication technologies used in IoT
2. Design simple IoT systems with requisite hardware and C programming software Understand the relevance of cloud computing and data analytics to IoT
3. Comprehend the business model of IoT from developing a prototype to launching a product

UNIT - I

Introduction to Internet of Things: IOT vision, Strategic research and innovation directions, IoT Applications, Related future technologies, Infrastructure, Networks and communications, Processes, Data Management, Security, Device level energy issues.

UNIT – II

Internet Principles and communication technology: Internet Communications: An Overview – IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open Source Vs Closed Source.

UNIT – III

Prototyping and programming for IoT: Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling.

Techniques for writing embedded C code: Integer data types in C, Manipulating bits - AND, OR, XOR, NOT, Reading and writing from I/ O ports. Simple Embedded C programs for LED Blinking, Control of motor using switch and temperature sensor for Arduino board.

UNIT – IV

Cloud computing and Data analytics: Introduction to Cloud storage models -SAAS, PAAS, IAAS. Communication APIs, Amazon web services for IoT, Skynet IoT Messaging Platform.

Introduction to Data Analytics for IoT - Apache Hadoop- Map reduce job execution workflow.

UNIT – V

IoT Product Manufacturing - From prototype to reality: Business model for IoT product manufacturing, Business models canvas, Funding an IoT Start-up, Mass manufacturing - designing kits, designing PCB,3D printing, certification, Scaling up software, Ethical issues in IoT- Privacy, Control, Environment, solutions to ethical issues.

Suggested Readings:

1. *Internet of Things* - Converging Technologies for smart environments and Integrated ecosystems, River Publishers.
2. Designing the Internet of Things, Adrian McEwen (Author), Hakim Cassimally. Wiley India Publishers.
3. Fundamentals of embedded software: where C meets assembly by Daneil W lewies, Pearson.
4. *Internet of things* -A hands on Approach, Arshdeep Bahga, Universities press.

Course Code	Course Title						Core / Elective
OE 774 EE	**Non-Conventional Energy Sources**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

To impart the knowledge of basics of different non-conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature

Course Outcomes

On completion of course the student will be able to:

1. Understand the different nonconventional sources and the power generation techniques to generate electrical power.
2. Understand the Solar energy power development and different applications.
3. Understand different wind energy power generation techniques and applications.
4. Design a prescribed engineering sub-system
5. Recognize the need and ability to engage in lifelong learning for further developments in this field.

UNIT-I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2 °2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells-Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations -Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT- IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-Thermal Energy - Types of Geo-Thermal Energy Systems - Applications of Geo-Thermal Energy.

UNIT-V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifiers.

Suggested Readings:

1. Rai G.D, *Non-Conventional Sources of Energy,* Khandala Publishers, New Delhi, 1999.
2. M.M. El-Wakil, Power *Plant Technology.* McGraw Hill, 1984.

Course Code	Course Title						Core / Elective
OE 775 ME	**Entrepreneurship**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
- To motivate students to take up entrepreneurship in future
- To learn nuances of starting an enterprise & project management
- To understand the design principles of solar energy systems, their utilization and performance evaluation
- To understand the behavioural aspects of entrepreneurs and time management

Course Outcomes
At the end of the course, the students will be able to
1. Understand Indian Industrial Environment, Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
5. Understand the Behavioural aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

UNIT-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

UNIT-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Readings:

1. Vasant Desai, *"Dynamics of Entrepreneurial Development and Management",* Himalaya Publishing House, 1997
2. Prasanna Chandra, *"Project-Planning, Analysis, Selection, Implementation and Review",* Tata McGraw-Hill Publishing Company Ltd. 1995.
3. Stephen R. Covey and A. Roger Merrill, *"First Things First",* Simon and Schuster Publication, 1994.
4. G.S. Sudha, *"Organizational Behaviour",* 1996.
5. Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship",* Tata Me Graw Hill Publishing Company Ltd., 5ᵗʰ Ed., 2005.

Course Code	Course Title						Core / Elective
OE 781 CE	**Road Safety Engineering**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	30	70	3

Course Objectives
- ➢ Introduction to various factors considered for road safety and management
- ➢ Explain the road safety appurtenances and design elements
- ➢ Discuss the various traffic management techniques

Course Outcomes

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

1. Prepare accident investigation reports and database
2. Apply design principles for roadway geometrics improvement with various types of traffic safety appurtenances/tools
3. Manage traffic including incident management

UNIT – I

Road Accidents: Causes, scientific investigations and data collection, Analysis of individual accidents to arrive at real causes, statistical methods of analysis of accident data, Basic concepts of Road accident statistics, Safety performance function: The empirical Bayes method Identification of Hazards road location. Application of computer analysis of accident data.

UNIT – II

Safety in Road Design: Operating the road network for safety, highway operation and counter measures, road safety audit, principles-procedures and practice, code of good practice and checklists, vehicle design factors & Driver characteristics influencing road safety.

UNIT – III

Road Signs and Traffic Signals: Classification, Location of Signs, measures of sign effectiveness, Types of visual perception, sign regulations, sign visibility, sign variables, Text versus symbols. Road Marking: Role of Road markings, Classification, visibility. Traffic Signals: Need, Signal face. Illumination and location of Signals, Factors affecting signal design, pedestrians' safety, fixed and vehicle actuated signals. Design of signa1s, Area Traffic control. Delineators, Traffic Impact Attenuators, Road side rest areas, Safety Barriers, Traffic Aid Posts.

UNIT – IV

Traffic Management Techniques: Integrated safety improvement and Traffic Calming Schemes, Speed and load limit, Traffic lights, Safety cameras, Tests on driver and vehicles, pedestrian safety issues, Parking, Parking enforcement and its influence on Accidents. Travel Demand Management; Methods of Traffic management measures: Restriction of Turning Movements, One-way streets, Tidal Flow Operation Methods, Exclusive Bus Lanes and Closing Side-streets; Latest tools and techniques used for Road safety and traffic management. Road safety issues and various measures for road safety; Legislation, Enforcement, Education and Propaganda, Air quality, Noise and Energy Impacts; Cost of Road Accidents.

UNIT – V

Incident Management: Introduction, Characteristics of Traffic Incidents, Types of Incidents, Impacts, Incident management process, Incident traffic management; Applications of ITS: Motorist information, Equipment used; Planning effective Incident management program, Best practice in Incident management

programs. National importance of survival of Transportation systems during and after all natural disasters especially cyclones, earthquakes, floods etc. and manmade disasters like sabotage, terrorism etc.

Suggested Readings:
1. Guidelines on Design and Installation of Road Traffic Signals, IRC:93.
2. Specification for Road Traffic Signals, IS: 7537-1974.
3. Principles and Practice of Highway Engineering by L.R. Kadiyali and N.B. Lal.
4. Hand Book of T.E. Myer Kutz, Editor McGraw Hill, 2004.

Course Code	Course Title						Core / Elective
OE 782 CS	**Software Engineering**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
- ➢ To introduce the basic concepts of software development- processes from defining a product to shipping and maintaining that product
- ➢ To impart knowledge on various phases, methodologies and practices of software development
- ➢ To understand importance of software modelling using UML
- ➢ To understand the importance of testing in software development and study various testing strategies and software quality metrics.

Course Outcomes
At the end of the course students will be able to:
1. Acquire knowledge about different software development processes and their usability in different problem domains.
2. Understand the process of requirements collection, analysing, and modelling requirements for effective understanding and communication with stakeholders.
3. Design and develop the architecture of real world problems towards developing a blueprint for implementation.
4. Use the UML language to design various models during software development life cycle.
5. Understand the concepts of software quality, testing and maintenance.

UNIT-I
The software Problem: Cost, Schedule and Quality, Scale and change, Software Processes: - Process and project, Component Software Processes, Software Development Process Models, Project management Process.

UNIT-II
Software Requirements Analysis and Specification: Value of a good SRS, Requirements Process, Requirements Specification, Functional Specification with Use Cases, Other approaches for analysis. Software Architecture: Role of Software Architecture Views, Component and connector view, Architectural styles for C & C view, Documenting Architecture Design, Evaluating Architectures.

UNIT-III
Planning a Software Project: Effort Estimation, Project Schedule and staffing, Quality Planning, Risk Management Planning, Project Monitoring Plan, Detailed Scheduling. Design: Design concepts, Function oriented Design, Object Oriented Design, Detailed Design, Verification, Metrics.

UNIT-IV
Coding and Unit Testing: Programming Principles and Guidelines, incrementally developing code, managing evolving code, unit testing, code inspection, Metrics. Testing: Testing Concepts, Testing Process, Black Box testing, White box testing, Metrics.

UNIT-V
Maintenance and Re-engineering: Software Maintenance, supportability, Reengineering, Business process Reengineering, Software reengineering, Reverse engineering; Restructuring, Forward engineering, Economics of Reengineering. Software Process Improvement: Introduction, SPI process, CMMI, PCMM, Other SPI Frameworks, SPI return on investment, SPI Trends.
Suggested Readings:

1. Pankaj Jalote, "Software Engineering- A Precise Approach", Wiley India, 2010.
2. Roger. S. Pressman, "Software Engineering - A Practitioner's Approach", 7th Edition, McGraw Hill Higher Education, 2010.
3. Deepak Jain, "Software Engineering", Oxford University Press, 2008.
4. Rajib Mall, "Fundamentals of Software Engineering", 4th Edition, PHI Learning, 2014.
5. Ian Sommerville, "Software Engineering", 10th Edition, Addison Wesley, 2015.

Course Code	Course Title						Core / Elective
OE 783 EC	**Principles of Electronic Communications**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
- ➢ Provide an introduction to fundamental concepts in the understanding of communications systems.
- ➢ Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
- ➢ Provide an introduction to the evolution of wireless systems and current wireless technologies.

Course Outcomes
1. Understand the working of analog and digital communication systems
2. Understand the OSI network model and the working of data transmission
3. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.

UNIT – I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.
Signal Transmission Concepts: Baseband transmission and Broadband transmission,
Communication Parameters: Transmitted power, Channel bandwidth and Noise, Need for modulation
Signal Radiation and Propagation: Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT – II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT – III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

UNIT – IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony.
Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT – V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:
1. *Principles of Electronic Communication Systems*, Louis E. Frenzel, 3e, McGraw Hill, 2008.
2. *Data Communications and Networking,* Behrouz A. Forouzan, 5e TMH, 2012.
3. Kennady, Davis, *Electronic Communications systems*, 4e, McGraw Hill, 1999.

Faculty of Engineering, O.U **CBCS Curriculum with effect from Academic Year 2019 - 2020**

Course Code	Course Title						Core / Elective
OE 784 EE	**Illumination and Electric Traction Systems**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
- ➢ To introduce the students and understand Utilization of electrical energy for various applications like industrial heating, welding etc.,
- ➢ To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- ➢ To understand the concept of electrification of traction system

Course Outcomes
On successful completion of course, students will be able to:
1. Design the resistive and inductive heating and calculate the requirements of heating power for an industrial need
2. Analyse the type of motor control required and select the type and rating of motor.
3. Understand and Design illumination for different application
4. Understand the traction and use of DC machines
5. Analyse the traction mechanics to arrive at a rating of drive.

UNIT-I
Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens — Design of elements. Core type, Coreless type furnaces, High frequency eddy current heating, Dielectric heating. Arc furnace. Electric welding, Resistance welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

UNIT-II
Schematic Utilization and Connection Diagrams for Motor Control: Two supply sources for 3 phase Induction motors. Direct reversing, remote control operation, and jogging operating of Induction motor. Contactor control circuit. Push button control stations. Over load relays, limit switches, float switches. Interlocking methods for reversing control.

UNIT-III
Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, lighting calculations — Determination of M.S.C.P, Rousseau's construction, Discharge lamps, Sodium vapour lamps, Mercury vapour lamps — Fluorescent lamp, Starting and power factor corrections, Stroboscopic effects — Neon signs, Application to factory lighting, Street lighting and Flood lighting.

UNIT-IV
Electric Traction: System of Electric Traction — Transmission of drive — Systems of track electrification — Traction mechanics — Speed time curves — Tractive effort — Power of Traction motor — Specific energy consumption — Mechanics of train movement— Coefficient of adhesion.
Traction Motors: Desirable characteristics, DC series motors, AC series motors 3-phase induction motors, DC motor series & parallel control, Energy saving.

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UNIT-V

Train Lighting: Systems of train lighting — Special requirements of train lighting — Methods of obtaining unidirectional polarity — Methods of obtaining constant output — Single battery system — Double battery parallel block system — Principal equipment of double battery system — Coach wiring — Dynamo.

Batteries: Lead acid batteries, SMF batteries, Construction and maintenance, Charging and rating of batteries.

Suggested Readings:

1. Partab H, Art and Science of Utilization of Electric Power, Dhanpat Rai & Sons, 1997.
2. K.B. Raina & S.K. Bhattacharya, Electrical Design, Estimating and Costing, Wiley Eastern Ltd., 1991.
3. Partab H, Modern Electric Traction, Dhanpat Rai & Sons, 2000.
4. B.L. Theraja, A Text Book of Electrical Technology, S. Chand & Company Ltd, Vol —I.

Course Code	Course Title						Core / Elective
OE 785 ME	**Mechatronics**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

Student has to understand the

➤ How to identify, formulate, and solve engineering problems
➤ The design a system, component, or process to meet desired needs within realistic constraints
➤ The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
➤ The use of drive mechanisms and fluid power systems
➤ The use of industrial electronic devices
➤ The demonstrate the design of modern CNC machines, and Mechatronics elements

Course Outcomes

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

1. Model and analyse electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design of Mechatronics systems
3. Do the complete design, building, interfacing and actuation of a Mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various Mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and Mechatronics elements

UNIT-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

UNIT-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

UNIT-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydro pneumatic circuits

UNIT-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to microprocessor & micro controller, Temperature measurement interface and LVDT interface, Systems response

UNIT-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Suggested Readings:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education
2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998
3. Michaels Histand & David G, Alciatore, Introduction to Mechatronics and Measurement Systems, Tata McGraw-Hill International Edition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, New Delhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann

Course Code	Course Title						Core / Elective
PC 751 CS	**Compiler Construction Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives
  ➢ To learn usage of tools LEX, YAAC
  ➢ To develop a code generator
  ➢ To implement different code optimization schemes

Course Outcomes
After completing this course, the student will be able to
  1. To Generate scanner and parser from formal specification
  2. To design a compiler for a subset of any High level language

List of Experiments to be performed:

  1. Construction of DFA from NFA
  2. Scanner program using LEX
  3. Construction of a Predictive Parsing Table
  4. SLR Parser table generation
  5. Implement unification Algorithm
  6. LR Parser table generation
  7. Parser Generation using YACC
  8. Write a program on code generation
  9. Write a program on code optimization

Course Code	Course Title						Core / Elective
PC 752 CS	**Distributed Systems Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives

> ➢ To implement client and server programs using sockets
> ➢ To learn about working of NFS
> ➢ To use Map, reduce model for distributed processing
> ➢ To develop mobile applications

Course Outcomes

After completing this course, the student will be able to

1. Write programs that communicate data between two hosts
2. Configure NFS
3. Use distributed data processing frameworks and mobile application tool kits

List of Experiments to be performed:

1. Implementation FTP Client
2. Implementation of Name Server
3. Implementation of Chat Server
4. Understanding of working of NFS (Includes exercises on Configuration of NFS)
5. Implementation of Bulletin Board.
6. Implement a word count application which counts the number of occurrences of each word a large collection of documents Using Map Reduce model.
7. Develop an application (small game-like scrabble, Tic-tac-Toe) using Android SDK.

Course Code	Course Title						Core / Elective
PC 753 CS	**Data Mining Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives
- ➢ To introduce the basic concepts of data Mining and its applications
- ➢ To understand different data mining like classification, clustering and Frequent Pattern mining
- ➢ To introduce current trends in data mining

Course Outcomes

After completing this course, the student will be able to
1. Organize and Prepare the data needed for data mining using prepreprocessing techniques
2. Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on a given data set
3. Define and apply metrics to measure the performance of various data mining algorithms

List of Experiments to be performed

1. Implement the following Multidimensional Data Models
   a. Star Schema
   b. Snowflake Schema
   c. Fact Constellation
2. Implement Apriori algorithm to generate frequent item sets.
3. Implement the following clustering algorithms
   a. K-means
   b. K-medians
4. Implement the following classification algorithms
   a. Decision Tree Induction
   b. KNN
5. Perform data preprocessing using WEKA
6. Perform discretization using WEKA
7. Classification of algorithms using WEKA
8. Apriori algorithm using WEKA
9. Perform data transformations using an ETL Tool
10. A small case study involving all stages of KDD (Datasets are available online like UCI Repository etc.)

Course Code	Course Title						Core / Elective
PW 761 CS	**Project Work – I**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	50	-	2

Course Objectives
- ➢ To enhance practical and professional skills.
- ➢ To familiarize tools and techniques of systematic literature survey and documentation
- ➢ To expose the students to industry practices and team work.
- ➢ To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes
1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

The department will appoint a project coordinator who will coordinate the following:
- ➢ Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
- ➢ Grouping of students (max 3 in a group)
- ➢ Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:
1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes' presentation followed by 10 minutes' discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:
- ➢ Problem definition and specification
- ➢ Literature survey
- ➢ Broad knowledge of available techniques to solve a particular problem.
- ➢ Planning of the work, preparation of bar (activity) charts
- ➢ Presentation- oral and written.

Course Code	Course Title						Core / Elective
SI 762 CS	**Summer Internship**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	-	**50**	-	**2**

Course Objectives
- ➢ To train and provide hands-on experience in analysis, design, and programming of information systems by means of case studies and projects.
- ➢ To expose the students to industry practices and team work.
- ➢ To provide training in soft skills and also train them in presenting seminars and technical report writing.

Course Outcomes

After completing this course, the student will be able to
1. Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
2. Gain working practices within Industrial/R&D Environments.
3. Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organisations/Computer Industry/Software Companies/R&D Organization for a period of 4-6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship
- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:
1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Award of sessionals are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Note: Students have to undergo summer internship of 4-6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

SCHEME OF INSTRUCTION& EXAMINATION
B.E. VIII - SEMESTER
(COMPUTER SCIENCE AND ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	Credits
Theory Courses										
1		Professional Elective – III	3	-	-	3	30	70	3	3
2		Professional Elective – IV	3	-	-	3	30	70	3	3
3		Professional Elective – V	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
4	**PW 961 CS**	Project Work – II	-	-	16	16	50	100	-	8
			09	-	16	25	140	310		17

Professional Elective – III			Professional Elective – IV		
S. No.	Course Code	Course Title	S. No.	Course Code	Course Title
1	**PE 821 CS**	Mobile Computing	1	**PE 831 CS**	Embedded Systems
2	**PE 822 CS**	Image Processing	2	**PE 832 CS**	Information Retrieval Systems
3	**PE 823 CS**	Software Quality and Testing	3	**PE 833 CS**	Machine Learning
4	**PE 824 CS**	Web Services and Architecture	4	**PE 834 CS**	Natural Language Processing
5	**PE 825 CS**	Computational Intelligence	5	**PE 835 CS**	Data Science using R Programming

Professional Elective – V		
1	**PE 841 CS**	Multicore and GPU Programming
2	**PE 842 CS**	Cloud Computing
3	**PE 843 CS**	Human Computer Interaction

PC: Professional Course   PE: Professional Elective
L: Lectures   T: Tutorials   P: Practical   D: Drawing
CIE: Continuous Internal Evaluation   **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

Course Code	Course Title						Core / Elective
PE 821 CS	**Mobile Computing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

> To introduce basics of wireless voice and data communication technologies
> To build working knowledge on various telephone and satellite networks
> To study the working principles of wireless LANs and standards
> To study principles of adhoc networks and routing
> To gain knowledge on integration of mobile networks into Internet
> To build skills in working with wireless application protocols to develop mobile applications.

Course Outcomes

After completing this course, the student will be able to

1. Understand and apply various techniques involved in planning and construction stages.
2. Implement Adhoc Network Routing protocols.
3. Mini based project based on tracking, localization and routing in wireless networks.
4. Implement file transfer, access and authentication based applications for mobile computing.

UNIT-I

Introduction – Wireless transmission – Frequencies for radio transmission – Signals – Antennas – Signal Propagation – Multiplexing – Modulations – Spread spectrum – MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless Networks.

UNIT-II

Telecommunication systems – GSM – GPRS – DECT – UMTS – IMT-2000 – Satellite Networks - Basics – Parameters and Configurations – Capacity Allocation – FAMA and DAMA – Broadcast Systems – DAB - DVB.

UNIT-III

Wireless LAN – IEEE 802.11 - Architecture – services – MAC – Physical layer – IEEE 802.11a - 802.11b standards – HIPERLAN – Blue Tooth.

UNIT-IV

Mobile IP, Dynamic Host Configuration Protocol, Routing in MANETs: DSDV, DSR, AODV and ZRP. MANETS vs VANETs

UNIT-V

Traditional TCP – classical TCP improvements – WAP, and WAP 2.0.
Mobile Transaction models, File Systems and Mobility Management

Suggested Readings:

1. Jochen H. Schiller, *Mobile Communications*, Addison Wesley, Second Edition, 2003.
2. William Stallings, *Wireless Communications and Networks*, PHI/Pearson Education, 2002.
3. Kaveh Pahlavan, Prasanth Krishnamurthy, *Principles of Wireless Networks*, Prentice Hall, 2003.
4. Uwe Hansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, *Principles of Mobile Computing*, Springer, 2003.
5. Krzysztof Wesolowski, *Mobile Communication Systems*, John Wiley and Sons Ltd, 2002.

Course Code	Course Title						Core / Elective
PE 822 CS	**Image Processing**						**Elective**
Prerequisites	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
- ➢ To introduce basics of visual perception, sampling, quantization and representation of digital images
- ➢ To introduce spatial domain and frequency domain filtering techniques necessary for image processing operations.
- ➢ To learn advanced image analysis techniques such as image compression, image segmentation, and object recognition
- ➢ To learn techniques of colour image processing, multi resolution methods, wavelets and morphological processing

Course Outcomes

After completing this course, the student will be able to
1. Analyse images in the frequency domain using various transforms
2. Design and implement algorithms that perform image processing operations such as histogram equalization, enhancement, restoration, filtering and denoising
3. Explain colour spaces, restoration and enhancement of colour images
4. Develop simple object recognition systems

UNIT-I

Image Processing: Introduction, Examples, Fundamental steps, Components, Elements of visual perception, Light and Electromagnetic Spectrum, Image sensing and Acquisition, Image Sampling and Quantization, Basic relationships between pixels.

Intensity Transformations and Spatial Filtering: Background, some basic intensity transformation functions, Histogram processing, Fundamentals of Spatial filtering, smoothing spatial filters, sharpening spatial filters, Combining Spatial Enhancement Methods.

UNIT-II

Filtering in the Frequency Domain: Background, Preliminary concepts, Sampling and Fourier Transform of Sampled Functions, Discrete Fourier Transform (DFT) of one variable, Extension to functions of two variables, Some Properties of the 2-D Discrete Fourier Transform, Basics of Filtering in the Frequency Domain, Image Smoothing, Image Sharpening, Homomorphic Filtering.

Image Restoration: Noise Models, Restoration in the presence of noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering.

Linear Degradation, Position-invariant Degradation, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error Filtering, Constrained Least Squares Filtering, Geometric Mean Filter.

UNIT-III

Colour Image Processing: Colour fundamentals, Colour models, Pseudocolour Image Processing, Basics of Full-colour Image Processing, Colour Transformations, Smoothing and Sharpening, Colour-based Image Segmentation, Noise in Colour Images, Colour Image Compression.

Wavelets and Multi resolution Processing: Background, Multiresolution Expansions, Wavelet Transforms in One Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions, Wavelet Packets.

UNIT-IV

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory, Error-free Compression, Lossy Compression, Image Compression Standards, Some Basic Compression Methods.

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms, Some Basic Gray-Scale Morphological Algorithms.

UNIT-V

Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-based Segmentation, Segmentation using Morphological Watersheds, The use of Motion in Segmentation.

Object Recognition: Patterns and Pattern Classes, Recognition based on Decision-theoretic Methods, Structural Methods.

Suggested Readings:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing,* PHI Learning Pvt. Limited, 3rd Edition, 2008.
2. William K. Pratt, *Digital Image Processing*, John Wiley & Sons, Inc., 3rd Edition, 2001.

Course Code	Course Title					Core / Elective
PE 823 CS	**Software Quality and Testing**					**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

➢ To understand the challenges of Software Quality and the need for integration of quality activities in project life cycle
➢ To introduce supporting software quality devices
➢ To introduce software quality metrics and Quality Assurance models
➢ To understand the steps in software testing process and taxonomy of testing tools

Course Outcomes

After completing this course, the student will be able to

1. Describe the role of quality assurance activities in the software process
2. Compare several process improvement models such as CMM, CMMI, PCMM, and ISO9000
3. Describe several process metrics for assessing and controlling a project
4. Describe how available static and dynamic test tools can be integrated into the software development environment

UNIT - I

The Software Quality Challenge, Introduction Software Quality Factors, The Components of the Software Quality Assurance System – Overview, Development and Quality Plans.

UNIT - II

Integrating Quality Activities in the Project Life Cycle, Assuring the Quality of Software Maintenance Components, CASE Tools and their effect on Software Quality, Procedure and Work Instructions, Supporting Quality Devices, Configuration Management, Documentation Control, Project Progress Control.

UNIT - III

Software Quality Metrics, Costs of Software Quality, Quality Management Standards - ISO 9000 and Companion ISO Standards, CMM, CMMI, PCMM, Malcom Balridge, 3 Sigma, 6 Sigma, SQA Project Process Standards – IEEE Software Engineering Standards.

UNIT - IV

Building a Software Testing Strategy, establishing a Software Testing Methodology, Determining Your Software Testing Techniques, eleven – Step Software Testing Process Overview, Assess Project Management Development Estimate and Status, Develop Test Plan, Requirements Phase Testing, Design Phase Testing, Program Phase Testing, Execute Test and Record Results, Acceptance Test, Report Test Results, Test Software Changes, Evaluate Test Effectiveness.

UNIT - V

Testing Client / Server Systems, Testing the Adequacy of System Documentation, Testing Web-based Systems, Testing Off – the – Shelf Software, testing in a Multiplatform Environment, Testing Security, testing a Data Warehouse, Creating Test Documentation, Software Testing Tools, Taxonomy of Testing Tools, Methodology to Evaluate Automated Testing Tools, Load Runner, Win Runner and Rational Testing Tools, Java Testing Tools, JMetra, JUNIT and Cactus.

Suggested Readings:

1. Daniel Galin, *Software Quality Assurance–From Theory to Implementation*, Pearson Education.2004
2. Mordechai Ben Menachem / Garry S. Marliss, *Software Quality–Producing Practical, Consistent Software*, BS Publications, 2014
3. William E. Perry, *Effective Methods for Software Testing*, 2nd Edition, Wiley.
4. Srinivasan Desikan, Gopalaswamy Ramesh, *Software Testing, Principles and Practices*, 2006. Pearson Education.
5. K.V.K.K. Prasad, *Software Testing Tool*, Wiley Publishers

Web Resources:

1. http://www.sei.cmu.edu/cmmi/
2. www.ibm.com/software/awdtools/tester/functional/index.html
3. www.ibm.com/software/awdtools/test/manager/
4. *java-source.net/open-source/testing-tools*
5. www.junit.org
6. *java-source.net/open-source/web-testing-tools*

Course Code	Course Title					Core / Elective
PE 824 CS	**Web Services and Architecture**					**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			

Prerequisite	L	T	D	P	CIE	SEE	Credits
-	3	-	-	-	30	70	3

Course Objectives

To make the student familiar with the concepts of
➢ To study the evolution of SOA and Web Services
➢ To understand the principles of service orientation, Service layers
➢ To learn about WS* Specifications, messaging with SOAP and Service composition
➢ To learn about service oriented analysis and service oriented design
➢ Gained knowledge on various open standards available for developing SOA compliant web services

Course Outcomes

After completing this course, the student will be able to
1. Understand web service framework with respect to SOA
2. Develop SOA compliant web services using open standards and various technologies
3. Model and implement businesses processes using service oriented approach

UNIT- I

SOA and Web Services Fundamentals: Introducing So, The Evolution of SOA, Web services and primitive SOA.

UNIT-II

SOA and WS-*Extensions: Web Services and Contemporary SOA (I: Activity Management and Composition), Web Services and Contemporary SOA (II: Advanced Messaging, Metadata, and Security).

UNIT-III

SOA and Service-Orientation: Principles of Service-Orientation, Service Layers.

UNIT-IV

Building SOA (Planning and Analysis): SOA Delivery Strategies, Services-Oriented Analysis (I: Introduction), Service-Oriented Analysis (II: Service Modelling).

UNIT-V

Building SOA (Technology and Design): Service-Oriented Design (I: Introduction), Service-Oriented Design (II: SOA Composition Guidelines), Service-Oriented Design (III: Service-Design), Service- oriented Design (IV: Business Process Design), Fundamentals WS-*Extensions, SOA Platforms.

Suggested Readings:
1. Thomas Eri*," Service-Oriented Architecture(SOA): Concepts, Technology, and Design*, Prentice Hall PTR, 2005
2. James McGovern and Sameer Tyagi, *Java Web Services Architecture*, Morgan Kaufmann-May 2003.

Course Code	Course Title						Core / Elective
PE 825 CS	**Computational Intelligence**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

> ➢ To introduce the concepts of Biological and Artificial neural networks
> ➢ To understand different neural architectures with supervised learning and their learning mechanisms
> ➢ To study different neural architectures with unsupervised learning such as PCA Networks Kohenen's Self-Organizing Maps
> ➢ To introduce Markov decision processes, Q-Learning and TD-Learning
> ➢ To study different models of evolution and learning, neuro-fuzzy techniques, rough set theory and their applications

Course Outcomes

After completing this course, the student will be able to

1. Design single and multi-layer feed-forward neural networks
2. Implement various unsupervised learning networks
3. Design new evolutionary operators, representations and fitness functions for specific practical problems
4. Apply fuzzy logic and rough sets to handle uncertainty and vagueness in practical problems

UNIT-I

Introduction to Computational Intelligence / Soft computing: Soft versus Hard Computing, Various paradigms of computing

Foundations of Biological Neural Networks: Introduction to Neural Networks, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN (Learning, Generalization, Memory, Abstraction, Applications), McCulloch-Pitts Model, Historical Developments

Essentials of Artificial Neural Networks: Introduction, Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity (Feed forward, feedback, Single and Multi-layer), Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules (Error Correction, Hebbian, Competitive, Stochastic), Types of Application (Pattern Classification, Pattern Clustering, Pattern Association / Memory, Function Approximation, Prediction, Optimization)

UNIT-II

Neural Architectures with Supervised Learning: Single Layer Feed Forward Neural Networks(Perception), Multilayer Feed Forward Neural Networks (Back propagation learning), Radial Basis Function Networks, Support Vector Machines, Simulated Annealing, Boltzmann Machine, Feedback (Recurrent) Networks and Dynamical Systems

Associative Memories: Matrix memories, Bidirectional Associative Memory, Hopfield Neural Network,

UNIT-III

Neural Architectures with Unsupervised Learning: Competitive learning, Principal Component Analysis Networks (PCA), Kohonen's Self-Organizing Maps, Linear Vector Quantization, Adaptive Resonance Theory (ART) Networks, Independent Component Analysis Networks (ICA)

UNIT-IV

Reinforcement Learning: Markov Decision Processes, Value Functions, Bellman Optimality Criterion, Policy and Value Iterations, Q-Learning, TD Learning

UNIT-V

Fuzzy Logic: Basic concepts, fuzzy set theory, basic operations, fuzzification, defuzzification, neurofuzzy approach, applications

Evolutionary and Genetic Algorithms: Basic concepts of evolutionary computing, genetic operators, fitness function and selection, genetic programming, other models of evolution and learning, ant colony systems, swarm intelligence, applications

Rough Set Theory: Basic concepts, indiscernability relation, lower and upper approximation, decision systems based on rough approximation, applications

Suggested Readings:
1. Jacek M. Zurada. Introduction to Artificial Neural Systems, Jaico Publishers, 1992.
2. S. Haykin. Neural Networks: A Comprehensive Foundation, Prentice Hall, 1999.
3. P. S. Churchland and T. J. Sejnowski. The Computational Brain. MIT Press, 1992.
4. A. M. Ibrahim. Introduction to Applied Fuzzy Electronics. PHI, 2004
5. Z. Pawlak. Rough Sets, Kluwer Academic Publishers, 1991.

Course Code	Course Title						Core / Elective
PE 831 CS	**Embedded Systems**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
➢ To provide basics of embedded systems design and development flow.
➢ To study the processor architectures that supports embedded systems.
➢ To gain knowledge developing platforms for embedded systems.
➢ To provide basics of real time operating systems that supports embedded systems.
➢ To study the concepts on testing and development tools.

Course Outcomes
After completing this course, the student will be able to
1. Understand the basics of embedded systems design and development flow.
2. Apply knowledge to develop the embedded systems.
3. Analyse the real time operating that supports embedded systems.

UNIT-I
Design of Embedded System: Sensors and Actuators, Embedded Processors, Memory Architectures, Input and Output.

UNIT-II
Embedded Systems Development Environment: IDE, Cross compilation, Disassembler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan.
Embedded Computing Platform: Programming for Embedded systems using C, Device drivers, program modelling concepts, Process of Embedded system development: embedded software development on microcontroller platform, network-based embedded applications and embedded control applications.

UNIT-III
Embedded C Programming: Review of data types - Scalar Types-Primitive Types-Enumerated Types-Subranges, Structure types-character strings -arrays- Functions. Interfacing C with Assembly. Embedded programming issues - Re-entrancy, Portability, Optimizing, and testing embedded C programs.

UNIT-IV
Concept of Embedded Operating Systems: Differences between Traditional OS and RTOS. Real-time System Concepts, RTOS Kernel & Issues in Multitasking – Task Assignment, Task Priorities, Scheduling, Intertask Communication & Synchronization – Definition of Context Switching, Foreground ISRs and Background Tasks. Critical Section – Reentrant Functions, Interprocess Communication (IPC) – IPC through Semaphores, Mutex, Mailboxes, Message Queues or Pipes and Event Flags.

UNIT-V
VxWorks – POSIX Real Time Extensions, timeout features, Task Creation, Semaphores (Binary, Counting), Mutex, Mailbox, Message Queues, Memory Management – Virtual to Physical Address Mapping.

Suggested Readings:
1. Edward Ashford Lee and Sanjit Arunkumar Seshia, *Introduction to Embedded Systems- A Cyber-Physical Systems Approach*, Second Edition, MIT Press, 2017.
2. Jones, M Tim, *GNU/Linux Application Programming*, 2nd Edition, Course Technology PTR, 2008.
3. Raj Kamal, *Embedded systems Architecture, programming & Design*, Tata McGraw Hill, 2010.

4. Real Time Systems, C.M. Krishna and G. Shin, McGraw-Hill Companies Inc., McGraw Hill International Edition, 1997.
5. Programming Embedded Systems with C and GNU Development Tools, Second Edition, 1977.

Course Code	Course Title						Core / Elective
PE 832 CS	**Information Retrieval Systems**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
- ➢ To understand indexing and querying in information retrieval systems
- ➢ To learn the different models for information retrieval
- ➢ To expose the students to text classification and clustering
- ➢ To learn about web searching

Course Outcomes

After completing this course, the student will be able to
1. Understand the algorithms and techniques for information retrieval (document indexing and retrieval, query processing)
2. Quantitatively evaluate information retrieval systems
3. Classify and cluster documents
4. Understand the practical aspects of information retrieval such as those in web search engines.

UNIT-I

Boolean Retrieval: An example information, Building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval.

The term vocabulary and postings lists: Document delineation and character sequence decoding, determining the vocabulary of terms, Faster postings list intersection via skip pointers, Positional postings, and Phrase queries.

Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, Spelling correction.

Index construction: Hardware basics, blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes.

UNIT-II

Index compression: Statistical properties of terms in information retrieval, Dictionary compression, Postings file compression.

Scoring, term weighting and the vector space model: Parametric and zone indexes, Term frequency and weighting, the vector space model for scoring, and Variant tf-idf functions.

Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system, Vector space scoring and query operator interaction.

Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance.

UNIT-III

Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, Global methods for query reformulation.

XML retrieval: Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Probabilistic information retrieval: Basic probability theory, The Probability Ranking Principle, The Binary Independence Model.

Language models for information retrieval: Language models, The query likelihood model.

UNIT-IV

Text classification and Naive Bayes: The text classification problem, Naive Bayes text classification, The Bernoulli model, Properties of Naive Bayes, and Feature selection.

Vector space classification: Document representations and measures of relatedness in vector spaces, Rocchio classification, k- nearest neighbour, Linear versus nonlinear classifiers.

Flat clustering: Clustering in information retrieval, Problem statement, Evaluation of clustering, k-means.

Hierarchical clustering: Hierarchical agglomerative clustering, Single-link and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Divisive clustering.

UNIT-V

Matrix decompositions and Latent semantic indexing: Linear algebra review, Term-document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing.

Web search basics: Background and history, Web characteristics, Advertising as the economic model, The search user experience, Index size and estimation, Near-duplicates and shingling.

Web crawling and Indexes: Overview, Crawling, Distributing indexes, Connectivity servers.

Link analysis: The Web as a graph, Page Rank, Hubs and Authorities.

Suggested Readings:
1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, *An Introduction to Information Retrieval*, Cambridge University Press, Cambridge, England, 2008
2. David A. Grossman, Ophir Frieder, *Information Retrieval–Algorithms and Heuristics*, Springer, 2nd Edition (Distributed by Universities Press), 2004.
3. Gerald J Kowalski, Mark T Maybury. *Information Storage and Retrieval Systems*, Springer, 2000
4. Soumen Chakrabarti, *Mining the Web: Discovering Knowledge from Hypertext Data*, Morgan-Kaufmann Publishers, 2002.

Course Code	Course Title						Core / Elective
PE 833 CS	**Machine Learning**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

To make the student familiar with the concepts of
- ➢ To introduce the basic concepts of machine learning and range of problems that can be handled by machine learning.
- ➢ To introduce the concepts of instance based learning and decision tree induction
- ➢ To introduce the concepts of linear separability, Perceptron and SVM
- ➢ To learn the concepts of probabilistic inference, graphical models and evolutionary learning
- ➢ To learn the concepts of ensemble learning, dimensionality reduction and clustering

Course Outcomes

After completing this course, the student will be able to
1. Explain the strengths and weaknesses of many popular machine learning approaches
2. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques
3. Design and implement various machine learning algorithms in a range of real-world applications

UNIT-I
Introduction: Learning, Types of Machine Learning.
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.
Learning with Trees: Constructing Decision Trees, CART, Classification Example

UNIT-II
Linear Discriminants: The Perceptron, Linear Separability, Linear Regression
Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back
Propagation SUPPORT Vector Machines: Optimal Separation, Kernels

UNIT-III
Some Basic Statistics: Averages, Variance and Covariance, The Gaussian, The Bias-Variance Trade-off
Bayesian learning: Introduction, Bayes theorem. Bayes Optimal Classifier, Naive Bayes Classifier.
Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm.

UNIT-IV
Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming
Ensemble L**earning:** Boosting, Bagging
Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis

UNIT-V
Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison

Suggested Readings:
1. Tom M. Mitchell, *Machine Learning*, Mc Graw Hill, 1997
2. Stephen Marsland, *Machine Learning - An Algorithmic Perspective*, CRC Press, 2009
3. Margaret H Dunham, *Data Mining*, Pearson Edition., 2003.

4. Galit Shmueli, Nitin R Patel, Peter C Bruce, *Data Mining for Business Intelligence*, Wiley India Edition, 2007

5. Rajjan Shinghal, *Pattern Recognition*, Oxford University Press, 2006.

Course Code	Course Title						Core / Elective
PE 834 CS	**Natural Language Processing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
➢ To learn about corpus-based work collections
➢ To understand the models and methods of Statistical NLP
➢ To introduce IR and ML based techniques for NLP tasks

Course Outcomes
1. Impalement probabilistic models and estimate parameters for such models
2. Gain understanding of linguistic phenomenon and will explore linguistic features relevant to each NLP task
3. Apply the methods to new NLP problems and also to problems outside NLP

UNIT- I
Natural Language Processing: Introduction to Natural Language Processing, the study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural Language Understanding Systems, Linguistic Background: An outline of English syntax Spoken Language input and output Technologies. Written language Input – Mathematical Methods – statistical Modelling and classification Finite State Methods.
Grammar for Natural Language Processing – Parsing – Semantic and Logic Form –

UNIT- II
Introduction to Semantics and Knowledge Representation: some applications like Machine translation, database interface Semantic Interpretation, word senses and ambiguity, Basic logical form language, Encoding ambiguity in logical from, Thematic roles, Linking syntax and semantics, Recent trends in NLP.

UNIT- III
Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top- Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

UNIT- IV
Semantic Interpretation: word senses and ambiguity, Basic logical form language, Encoding ambiguity in logical from, Thematic roles, Linking syntax and semantics, Recent trends in NLP.

UNIT-V
Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context- Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

Suggested Readings:
1. Christopher D. Manning, Hinrich Schutze, *Foundations of Statistical Natural Language Processing,* MIT Press, 1999.
2. James Allan, *Natural Language Understanding*, Pearson Education, 1994.
3. Tanveer Siddiqui, US Tiwary, *Natural Language Processing and Information Retrieval,* Oxford University Press, 2008.

4.   Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, "NLP: A Paninian Perspective", Prentice Hall, New Delhi

5.   D. Jurafsky, J. H. Martin, "Speech and Language Processing", Pearson

Course Code	Course Title						Core / Elective
PE 835 CS	**Data Science using R Programming**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

➢ To learn basics of R Programming environment: R language, R- studio and R packages
➢ To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting
➢ To learn Decision tree induction, association rule mining and text mining

Course Outcomes

After completing this course, the student will be able to

1. Use various data structures and packages in R for data visualization and summarization
2. Use linear, non-linear regression models, and classification techniques for data analysis
3. Use clustering methods including K-means and CURE algorithm

UNIT-I

Introduction to R: Introduction, Downloading and Installing R, IDE and Text Editors, Handling Packages in R.

Getting Started with R: Introduction, Working with Directory, Data Types in R, Few Commands for Data Exploration.

Loading and Handling Data in R: Introduction, Challenges of Analytical Data Processing, Expression, Variables, Functions, Missing Values Treatment in R, using as 'Operator to Change the Structure of the Data, Victors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregation and Group Processing of a Variable, Simple Analysis Using R, Methods for Reading Data, Comparison of R GUI's for Data Input, Using R with Databases and Business Intelligence Systems.

UNIT-II

Exploring Data in R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data, Data Summary, Finding the Missing Values, Invalid Values and Outliers, Descriptive Statistics, Spotting Problems in Data with Visualization.

UNIT-III

Linear Regression Using R: Introduction, Model Fitting, Linear Regression, Assumptions of Linear Regression, Validating Linear Assumption.

Logistic Regression: Introduction, What Is Regression? Introduction to Generalized Linear Model, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression, Multinomial Logistic Regression Model.

UNIT-IV

Decision Tree: Introduction, What Is a Decision Tree? Decision Tree Representation in R, Appropriate Problems for Decision Tree Learning, Basic Decision Tree Learning Algorithm, Measuring Features, Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning, Why Prefer Short Hypotheses, Issues in Decision Tree Learning.

Time Series in R: Introduction, What Is Time Series Data, Reading Time Series Data, Decomposing Time Series Data, Forecasts Using Exponential Smoothing, ARIMA Models.

UNIT-V

Clustering: Introduction, What Is Clustering, Basic Concepts in Clustering, Hierarchical Clustering, K-Means Algorithm, CURE Algorithm, clustering in Non-Euclidean Space, Clustering for Streams and Parallelism.

Association Rules: Introduction, Frequent Itemset, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association.

Text Mining: Introduction, Definition of Text Mining, A Few Challenges in Text Mining, Text Mining Verses Data Mining, Text Mining in R, General Architectures of Text Mining Systems, Pre-Processing of Documents in R, Core Text Mining Operations, Using Background Knowledge for Text Mining, Text Mining Query Languages.

Mining Frequent Patterns, Associations and Correlations: Basic Concepts and Methods. Frequent Itemset, Closed Itemset and Association Rules. Frequent Itemset: Mining Methods, Pattern Evaluation Methods, Sentiment Analysis

Suggested Readings:

1. Nina Zumel, Practical Data Science with R, Manning Publications, 2014.
2. Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly, 2017.
4. Roger D Peng, R Programming for Data science, Lean Publishing, 2016.
5. Rafael A Irizarry, Introduction to Data Science, Lean Publishing,2016.
6. Seema Acharya, Data Analytics using R, McGraw Hill, 2018.
7. Crawley, Michael J., The R book, John Wiley & Sons, 2017.

Course Code	Course Title						Core / Elective
PE 841 CS	**Multi-core and GPU Programming**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	L			
-	3	-	-	-	30	70	3

Course Objectives
- To learn the paradigms of parallel computing, PRAM and BSP model.
- To study the heterogeneous processor architectures
- To understand the multicore programming using OpenCL
- To provide basics of OpenCL computing models

Course Outcomes

After completing this course, the student will be able to
1. Apply the knowledge of parallel computing models to solve real time applications.
2. Gain the knowledge of heterogeneous processor architectures
3. Apply the multi core programming knowledge to solve the sequential tasks.

UNIT-I

Introduction to Parallel Computing: Scope of Parallel Computing, Sieve of Eratosthenes, Control and Data Approach, PRAM model of parallel computation, Design paradigms of Parallel Computing, examples, Bulk Synchronous Parallel (BSP) model, algorithms on PRAM and BSP model.

UNIT-II

Introduction to Heterogeneous Multi-Core Processors, Many cores Programming, Cell Processor Multi-Node Computing.
Introduction to Graphics Processors, Graphics Processing Units, GPGPUs and GPU Hardware. Programming using CUDA/ OpenCL, Direct Compute CPU alternatives, Directives and libraries, Understanding Parallelism with GPUs.

UNIT-III

Heterogeneous Multi-Core Programming with OpenCL: OpenCL Programming Model, OpenCL Device Architectures, Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

UNIT-IV

Introduction to OpenCL: Understanding OpenCL's Concurrency and Execution Model, Dissecting a CPU/GPU, OpenCL Implementation. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU
Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

UNIT-V

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning, Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

Suggested Readings:
1. David Kaeli, Perhaad Mistry, Dana Schaa and Dong Ping Zhang, *Heterogeneous Computing with OpenCL 2.0*, 1st Edition, Mourgan Kaufmann, 2015.

2. Vipin Kumar, George Karypis, Anshul Gupta, Ananth Grama, Introduction to Parallel Computing, Addison Wesley, 2nd Edition, 2003.

3. Gregory V. Wilson, *Practical Parallel Programming*, PHI, 1998.

Course Code	Course Title						Core / Elective
PE 842 CS	**Cloud Computing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
- ➢ To introduce basic concepts cloud computing and enabling technologies
- ➢ To learn about Auto-Scaling, capacity planning and load balancing in cloud
- ➢ To introduce security, privacy and compliance issues in clouds
- ➢ To introduce cloud management standards and programming models

Course Outcomes

After completing this course, the student will be able to
1. Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS
2. Create virtual machine images and deploy them on cloud
3. Identify security and compliance issues in clouds.

UNIT- I

Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning

UNIT -II

Scaling in the Cloud, Capacity Planning, Load Balancing, File System and Storage,

UNIT-III

Multi-tenant Software, Data in Cloud, Database Technology, Content Delivery Network, Security Reference Model, Security Issues, Privacy and Compliance Issues

UNIT-IV

Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

UNIT-V

Enterprise architecture and SOA, Enterprise Software, Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Suggested Readings:
1. Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.
2. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016.
3. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, *Distributed and Cloud Computing from Parallel Processing to the Internet of Things*, Elsevier, 2012.

Course Code	Course Title						Core / Elective
PE 843 CS	**Human Computer Interaction**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives
  ➢ To introduce interaction frameworks and styles
  ➢ To learn about interaction design process, design standards and principles
  ➢ To introduce the concept of usability and usability testing
  ➢ To familiarize interface components and technical issues of concern

Course Outcomes
Students who successfully complete this course will be able to:
  1. Describe different types of interactive environments and interaction styles
  2. Understand the user interface design process and the need for user-centred design
  3. Describe techniques for developing prototypes of user interfaces and evaluation of user interfaces
  4. Create an appropriate usability test plan
  5. Understand the human and technical issues involved in the usage of text, icons and colours in user interfaces.

UNIT- I
Interaction Paradigms: Computing Environments, Analysing Interaction Paradigms, Interaction Paradigms
Interaction Frameworks and Styles: Frameworks for Understanding Interaction, Coping with Complexity, Interaction Styles.

UNIT- II
Interaction Design Process: Iterative Design, User-centred Design, Interaction Design Models, Overview of Interaction Design Models
Discovery: Discovery Phase Framework, Collection, Interpretation, Documentation
Design: Conceptual Design, Physical Design, Evaluation, Interface Design Standards, Designing the Facets of the Interface.

UNIT-III
Design Principles: Principles of Interaction Design, Comprehensibility, Learnability, Effectiveness/Usefulness, Efficiency/Usability, Grouping, Stimulus Intensity, Proportion, Screen Complexity, Resolution/Closure, Usability Goals
Interaction Design Models: Model Human Processor, Keyboard Level Model, GOMS, Modelling Structure, Modelling Dynamics, Physical Models
Usability Testing: Usability, Usability Test, Design the Test, prepare for the Test, Perform the Test, Process the Data

UNIT- IV
Interface Components: The WIMP Interface, Other Components
Icons: Human Issues Concerning Icons, Using Icons in Interaction Design, Technical Issues Concerning Icons
Colour: The Human Perceptual System, Using Colour in Interaction Design, Colour Concerns for Interaction Design, Technical Issues Concerning Colour

UNIT- V
Text: Human Issues Concerning Text, Using Text in Interaction Design, Technical Issues Concerning Text

Speech and Hearing: The Human Perceptual System, Using Sound in Interaction Design, Technical Issues Concerning Sound

Touch and Movement: The Human Perceptual System, Using Haptics in Interaction Design, Technical Issues Concerning Haptics.

Suggested Readings:
1. Steven Heim, *The Resonant Interface: HCI Foundations for Interaction Design*, Addison-Wesley, 2007
2. J. Preece, Y. Rogers, and H. Sharp, *Interaction Design: Beyond Human-Computer Interaction*, Wiley & Sons, 2nd Edition, 2007
3. Ben Shneiderman, Catherine Plaisant, *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, Addison-Wesley, 5thEdition, 2009.

Course Code	Course Title						Core / Elective
PW 961 CS	**Project Work - II**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	16	50	100	8

Course Objectives
- ➢ To enhance practical and professional skills.
- ➢ To familiarize tools and techniques of systematic literature survey and documentation
- ➢ To expose the students to industry practices and team work.
- ➢ To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes
1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of Project work –II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:
1. Re-grouping of students - deletion of internship candidates from groups made as part of project Work-I
2. Re-Allotment of internship students to project guides
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.