FACULTY OF ENGINEERING

Scheme of Instruction & Examination

And

Syllabi

B.E. VII and VIII Semester

Of

Four Year Degree Programme

In

Information Technology

(With effect from the academic year 2021-2022)

Issued by

Dean, Faculty of Engineering
Osmania University, Hyderabad
2021

IT Program Electives thread for V, VI , VII and VIII SEM

Thread	**5th SEM**	**6th SEM**		**7th SEM**		**8th SEM**
	Elective I	Elective II	III	IV	V	VI
AI&ML	Artificial Intelligence	Data Mining	Machine Learning	Natural Language Processing	Deep Learning	Computational Intelligence
Information &Network Security	Computational Number Theory	Information Security	Network Security	Cyber Security	Digital Forensics	Block Chain Technology
Software Engineering	Object oriented Analysis and Design	Compiler Construction	Software Testing	Software Reuse Techniques	Software Quality and Assurance	Agile Software Development
Multimedia and Internet of Things	Computer Graphics	Image Processing	Multimedia Technologies	Augmented and Virtual Reality	Internet of Things	Robotics
Computer Architecture and Cloud Computing	Advanced Computer Architecture	Distributed Systems	Cloud Computing	Advanced Cloud Computing	Scalable architectures for Large Applications	Architecting Applications for Cloud

SCHEME OF INSTRUCTION & EXAMINATION
B.E. - VII SEMESTER
(INFORMATION TECHNOLOGY)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC 701 EC**	VLSI Design	3	1	-	4	30	70	3	3
2	**PC 702 IT**	Big Data Analytics	3	1	-	4	30	70	3	3
3	**PE-V**	Professional Elective-V	3	-	-	3	30	70	3	3
4	**OE-II**	Open Elective II	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
5	**PC 751 EC**	VLSI Design Lab	-	-	2	2	25	50	3	1
6	**PC 752 IT**	Big Data Analytics Lab	-	-	2	2	25	50	3	1
7	**PW 761 IT**	Project Work – I	-	-	4	4	50	-	-	2
8	**SI 762 IT**	Summer Internship	`	-	-	-	25	50	-	2
			12	**02**	**8**	**22**	**245**	**430**	**18**	**18**

Profession Elective – V	
Course Code	**Course Title**
PE 711 IT	Wireless and Mobile Communication
PE 712 IT	Semantic Web
PE 713 IT	Cloud Computing
PE 714 IT	Human Computer Interaction

Open Elective II	
Course Code	**Course Title**
OE 701 CE	Green Building Technologies
OE 701 CS**	Data Science and Data Analytics
OE701EE	Non-Conventional Energy Sources
OE702EE	Transducers and Sensors
OE701EC	Fundamentals of IoT
OE701 IT**	Cyber Security
OE701ME	Start-Up Entrepreneurship
OE701AE	Automotive Maintenance

PC: Professional Course **PE**: Professional Elective,
HS: Humanities and social Science **MC**: Mandatory Course
L: Lecture T: Tutorial **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-1: ** Subject is not offered to the students of CSE and IT Department.

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

Course Objective:

- To provide a perspective on Digital Design in the Deep Sub-micron Technology.
- To focus on CMOS and Bi CMOS Short-channel Transistor Models.
- To Study CMOS Inverter elaborately.
- To explore static and dynamic implementations of combinational and sequential circuit designs and introduce Testability of VLSI circuits.

Course Outcomes:

Students will able to

- Explain VLSI Design hierarchy and analyse logic gates using CMOS & transmission gate structures.
- Identify the layers in the physical structure of ICs and draw the layouts of CMOS logic gates
- Summarize the fabrication process of CMOS ICs and analyse the DC, switching characteristics of CMOS inverter.
- Analyse dynamic CMOS & pseudo nMOS structures of logic gates, SRAM & DRAM cells
- Develop Verilog code for logic gates, examine the effects of interconnect elements in logic cascades and Explain the floor-planning , routing techniques of VLSI circuits

UNIT-I

Moore's law ,VLSI Design Hierarchy, MOSFET as switches, pass characteristics, Basic logic gates and complex logic gates using CMOS, Bubble pushing, XOR and XNOR gates, AOI and OAI logic gates, Transmission gates-TG based 2-to-1 MUX, XOR, XNOR circuits.

Electrical Characteristics of MOSFETs, Threshold voltage, nFET Current-Voltage equations, trans-conductance and drain characteristics of nFET, RC model of a FET, MOS capacitances, gate-source and gate- drain capacitances, Junction capacitances in a MOSFET, scaling concept of MOSFETs

UNIT-II

Integrated Circuit definition and layers, Top and side view of IC layers, CMOS Layers- MOSFET layers in an n-well process. Silicon patterning for series and parallel connected FETs. Layouts of NOT gate, transmission gate, non-inverting buffer, NAND2, NOR2, Complex logic gate, 4 input AOI gate. Stick diagram representation of NOT, NAND2 and NOR2 .

Fabrication of CMOS ICs, CMOS process flow, Design rules: minimum space width, minimum spacing, surround, extension.

UNIT-III

Layouts of Basic Structure: nwells, active area definition, design of n^+, p^+ regions, masks for the nFET, pFET,active contact cross section and mask set, metal1 line with active contact, poly contact: cross section and layout,. Latchup and its prevention, Cell based Design

DC characteristics of the CMOS inverter , Expression for midpoint voltage of CMOS inverter, Symmetrical inverter, Inverter switching characteristics- RC switch model equivalent for the CMOS inverter, rise time and fall time expressions,fan-out, input capacitance and loading due to fan-out, propagation delay of CMOS inverter.

UNIT-IV

Pseudo nMOS logic gates, tri-state inverter circuit, Clocked CMOS circuit, charge leakage in C^2MOS circuit, Dynamic CMOS logic circuits : pre-charge and evaluation modes of operation, Domino logic, Dual rail logic networks- Differential Cascade Voltage Switch Logic (DCVSL) AND/NAND, OR/NOR gates, Complementary Pass Transistor Logic (CPL) structures.

SRAM – General SRAM cell, 4T &6T SRAM cell design parameters, Writing to SRAM, resistor model, SRAM arrays. Dynamic RAMs: 1T DRAM cell, charge leakage and refresh in a DRAM cell

UNIT-V

VLSI Design flow, structural gate level modeling, gate primitives, gate delays, switch level modeling, behavioral and RTL operators, timing controls, blocking and non blocking assignments, conditional statements, Data flow modeling and RTL, Comparator and priority encoder , D latch and Master-Slave D flip-flop- verilog code. Arithmetic circuits: half adder, full adder, ripple carry adder, carry look ahead adder- verilog code.
Interconnect modeling; Interconnect resistance and capacitance ,sheet resistance R_s, time delay, single and multiple rung ladder circuits, simple RC inter connect model, modeling inter connect lines with a series pass FET, Crosstalk, Floor planning and routing.

Suggested Reading

1. John P. Uyemura, "Introduction to VLSI circuits and Systems", John Wiley & Sons, 2002
2. John P. Uyemura, "Chip design for submicron VLSI: CMOS layout and simulation" IE, Cengage learning, 2006.
3. Douglas A. Pucknell, Kamran Eshraghian, "Basic VLSI Design" 3rd Edition, PHI, 2000.
4. Jan M. Rabey and others "Digital Integrated Circuits A design perspective", Pearson Education 2016

Course Code	Course Title						Core / Elective
PC 702 IT	**Big Data Analytics**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**1**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand big data for business intelligence.
- Identify business case studies for big data analytics.
- Defend big data Without SQL.
- Discuss the process of data analytics using Hadoop and related tools.

Course Outcomes

By the end of this course, the students will be able to

1. Demonstrate big data and use cases from selected business domains.
2. Apply the knowledge of NoSQL big data management and experiment with Install, configure, and run Hadoop and HDFS.
3. Analyse map-reduce analytics using Hadoop.
4. Adapt Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data Analytics.

UNIT-I

Understanding Big Data: Characteristics of Data, Introduction to Big Data and its importance, Challenges posed by Big Data, Big data analytics and its classification, Big data applications: big data and healthcare – big data in banking – advertising and big data, big data technologies.

UNIT-II

Hadoop Distributed File System: Hadoop Ecosystem, Hadoop Architecture, HDFS Concepts, Blocks, Namenodes and Datanodes, Hadoop FileSystems, The Java Interface, Reading Data from a Hadoop URL, Writing Data, Querying the FileSystem, Deleting Data, Anatomy of File Read and Write

UNIT-III

NOSQL Data Management: Introduction to NOSQL – aggregate data models, aggregates key value and document data models, relationships – graph databases, schema less databases, Sharding - map reduce – partitioning and combining – composing map-reduce calculations.

UNIT-IV

Map Reduce and Yarn: Hadoop Map Reduce paradigm, Map and Reduce tasks, Job and Task trackers, Mapper, Reducer, Map Reduce workflows, classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – Map Reduce types – input formats – output formats

UNIT-V

Pig: Installing and Running Pig, an Example, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators. Hive: The Hive Shell, An Example, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User- Defined Functions, writing a User Defined Functions.

Suggested Reading:

1.Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilly, 2012, ISBN -13: 978-1449311520, ISBN-10: 1449311520

2. Pramod Sadalage, Martin Fowler, "NoSQL Distilled - A brief guide to the emerging world of polyglot", Addison Wesley 2013

3. Eric Sammer, "Hadoop Operations", O'Reilly, 2012, ISBN -13 978-1449327057, ISBN-10: 1449327052

4. VigneshPrajapati, Big data analytics with R and Hadoop, 2013, ISBN -13: 978- 1782163282

5.. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilly, 2012, ISBN -13: 978-1449319335

Course Code	Course Title						Core/Elective
PE 711 IT	**WIRELESS AND MOBILE COMMUNICATION**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives

Students shall be able to

- To introduce the transition from 2D to 3D structural problems (linear and non-linear).
- Analyse all kinds of loads and their respective effects.
- To introduce a high-end computer oriented numerical analysis tool.

Course Outcomes

Student will be able to:

- Understand the fundamental concepts of wireless and cellular Networks.
- Understand Spread spectrum modulation techniques and compare various Medium Access Control mechanisms
- Describe WLAN and GSM
- Analyze different variations of TCP for mobile communication systems.
- Discuss protocols for MANETs and WAP

Unit-I

Introduction to Wireless Communication Systems: Evolution of Mobile Radio Communications, Examples of Wireless Communication Systems. Modern Wireless Communication Systems : Second Generation (2G) Cellular Networks, Third Generation (3G) Wireless Networks, Wireless local Loop, Wireless **Local Area Networks.The Cellular Concept**: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and Systems Capacity, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems.

Unit-II

Spread spectrum modulation techniques: Pseudo-noise sequence, direct sequence spread spectrum (DS-SS), frequency hopped spread spectrum(FHSS), performance of DS-SS, performance of FH-SS

Medium Access Control: Motivation for a specialized MAC: Hidden and Exposed terminals. Near and Far terminals; SDMA, FDMA, TDMA, and CDMA

Unit-III

Wireless LAN: IEEE 802-11 Protocol, System Architecture, Protocol Architecture, Physical Layer & MAC Layer, Newer developments, Hiper LAN

GSM: Mobile services, System architecture, Localization, Call Handling, Handover, Security, New data services.

Unit-IV

Mobile Network Layer: Mobile IP: Goals, assumptions and requirements, Entities and Terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunneling and Encapsulation, Optimizations, Reverse tunneling, Ipv6; Dynamic host configuration protocol.

Mobile Transport Layer: Traditional TCP: Congestion control, Slow start, Fast retransmit/fast recovery, Implications on mobility; Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/timeout freezing, Selective retransmission, Transaction oriented TCP

Unit-V

Mobile Ad hoc Networks (MANETs): Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc. , Mobile Agents, Service Discovery.

PROTOCOLS AND TOOLS: Wireless Application Protocol-WAP. (Introduction, protocol architecture, and treatment of protocols of all layers), Bluetooth (User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME.

Suggested Reading:

1) Theodore S. Rappaport, "Wireless Communications Principles and Practice", 2nd Edition,

Pearson Education, 2003.

2) Jochen Schiller, “Mobile Communication”, 2nd Edition, Pearson Education 2003

Course Code	Course Title						Core/Elective
PE 712 IT	**SEMANTIC WEB**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To introduce the concept of Semantic Web.
- To provides a comprehensive understanding of the layered architecture of Semantic Web.
- To learn about the various Semantic Web technologies i.e. RDF,RDFS and OWL2.
- To understand the role of ontology in Semantic Web.
- To represent logic in Semantic Web and perform inference.
- To understand the concepts in ontology construction.
- To analyze the applications based on Semantic Web Technology.

Course Outcomes:

Students will be able to:

- To understand the vision of Semantic Web.
- To evaluate the role played by each layer in bringing up the Semantic Web.
- To analyze the ontology construction steps in detail with a possibility to reuse existing ontologies.
- To design queries in Semantic Web using SPARQL.
- To perform reasoning on ontologies using user defined rules.
- To gain an understanding of the use of Semantic Web technologies in various applications.

UNIT-I

The Semantic Web Vision: Introduction, Semantic Web Technologies, A Layered Approach.

UNIT –II

Describing Web Resources RDF: Introduction , RDF: Data Model, RDF Syntaxes, RDFS: Adding Semantics, RDF Schema: The Language, RDF and RDF Schema in RDF Schema, An Axiomatic Semantics for RDF and RDF Schema , A Direct Inference System for RDF and RDFS.

UNIT-III

Web Ontology Language OWL2: Introduction, Requirements for Ontology Languages, Compatibility of OWL2 with RDF/RDFS, The OWL Language, OWL2 Profiles.

Querying the Semantic Web: SPARQL Infrastructure, Basics: Matching Patterns, Filters, Constructs for Dealing with an Open World, Organizing Result Sets, Other Forms of SPARQL Queries, Querying Schemas, Adding Information with SPARQL Update.

UNIT-IV

Logic and Inference Rule: Introduction, Example of Monotonic Rules: Family Relationships, Monotonic Rules: Syntax, Monotonic Rules: Semantics, OWL2 RL: Description Logic Meets Rules, Rule Interchange Format: RIF, Semantic Web Rules Language (SWRL), Rules in SPARQL: SPIN, Nonmonotonic Rules: Motivation and Syntax, Example of Nonmonotonic Rules: Brokered Trade, Rule Markup Language (RuleML).

UNIT-V

Ontology Engineering: Introduction, Constructing Ontologies Manually, Reusing Existing Ontologies, Semiautomatic Ontology Acquisition, Ontology Mapping, Exposing Relational Databases, Semantic Web Application Architecture.

Applications: GoodRelations, BBC Artists, BBC World Cup 2010 Website, Government Data, New York Times, Sig.ma and Sindice, OpenCalais, Schema.org.

Suggested Reading:

1. Groth, Paul, Frank van Harmelen, Rinke Hoekstra, and Grigoris Antoniou. A Semantic Web Primer, MIT Press, Third edition 2012.
2. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, CRC Press, 2009.
3. Dean Allemang, James Hendler, Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL, Morgan Kauffmann, ISBN-10: 0-12-373556-4 2008.
4. Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008.

Course Code	Course Title						Core/Elective
PE 713 IT	**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:**

Student will be able to :

- Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS
- Create virtual machine images and deploy them on cloud
- 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 ParallelProcessing to the Internet of Things*‖,Elsevier, 2012.

Course Code	Course Title						Core/Elective
PE 714 IT	**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:**

Student will be able to :

- Ability to specify, design and implement a prototype that involves significant human computer interaction.
- Describe typical human–computer interaction (HCI) models and styles, as well asvarious historic HCI paradigms.
- Understand that the interfaces' design emerges iteratively, through repeated design–evaluation–redesign cycles involving users.
- Outline how to characterize the user experience in terms of usability, user experience goals, and design principles.
- Analyze and identify user models, user support, socio-organizational issues, andstakeholder requirements of HCI systems.

UNIT- I

Interaction Paradigms: Computing Environments, Analyzing 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-Centered 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, Learn ability, Effectiveness/Usefulness, Efficiency/Usability, Grouping, Stimulus Intensity, Proportion, Screen Complexity, Resolution/Closure, and Usability Goals
Interaction Design Models: Model Human Processor , Keyboard Level Model, GOMS, Modeling Structure, Modeling 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
Color: The Human Perceptual System, Using Color in Interaction Design, Color Concerns for Interaction Design, Technical Issues Concerning Color

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 Hap-tics in Interaction Design, Technical Issues Concerning Hap-tics

Suggested reading:

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 Ed., 2007
3) Ben Shneiderman, Catherine Plaisant, Designing the User Interface: Strategies for Effective Human-Computer Interaction, 5th edition,, Addison-Wesley, 2009

Course Code	Course Title						Core / Elective
OE701CE	GREEN BUILDING TECHNOLOGIES						OE-II
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- Learn the principles of green building technologies and rating systems
- Understand the principles of effective energy and resources management in buildings
- Understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes:

1. After completing this course, the student will be able to
2. Classify the various features, benefits, and rating systems for a green building
3. Outline the criteria used for site selection and water efficiency methods
4. Select the energy efficiency techniques in designing a green building
5. Select materials for sustainable built environment & adopt waste management methods
6. Identify an appropriate method for maintaining indoor environmental quality in a green building

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.

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 (c) use of materials with recycled content such as blended cements 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 Well being: Day lighting, 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

Course Code	Course Title						Core / Elective
OE 701 CS	**Data Science and Data Analytics**						**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 Data Science: Linear Algebra, Linear Equations, Matrices, Eigen Values and Eigen Vectors.
- 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:

1. At the end of the course, the students will be able to
2. Use various Mathematical models, and Probability and Statics
3. Uselinear,non-linearregressionmodels,andclassificationtechniquesfordataanalysis
4. 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

Decision Tree: Introduction, What Is A Decision Tree? 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.

Classification: K-Nearest neighbors (KNN), Performance Measures,

UNIT V

Clustering: K-Means Algorithm,

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.

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, LeanPublishing,2016.
6. Vishwa Vishwanathan and Shanthi Vishwanathan, R Data Analysis cookbook 2015

Course Code	Course Title						Core / Elective
OE701EC	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:

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

UNIT – I

Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics (Ref 1)

IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and smart Health (Ref1)

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. 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 (Ref 2)

UNIT – III

API Development and Embedded programming: Getting started with API, writing a new API, Real time Reactions, Other Protocols, Techniques for writing embedded code: Memory management, Performance and Battery Life, Libraries, Debugging. (Ref 2)

Developing Internet of Things: IoT design Methodology, Case study on IoT System for weather monitoring (Ref 1)

UNIT – IV

IoT Systems - Logical Design using Python: Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations., Classes, Python packages for IoT (Ref 1 and Ref 3)

IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT – V

Cloud computing and Data analytics and IoT Product Manufacturing: Introduction to Cloud storage models and Communication APIs, Amazon web services for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT (Ref 1). Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation. (Ref 1) Business model for IoT product manufacturing, IoT Start-ups, Mass manufacturing, Ethical issues in IoT. (Ref 2)

Suggested Readings:

1. Internet of Things (A Hands-On-Approach), Vijay Madisetti, ArshdeepBahga, VPT Publisher, 1st Edition, 2014.

2. Designing the Internet of Things, Adrian McEwen (Author), Hakim Cassimally. Wiley India Publishers.

3. Fundamentals of Python, Kenneth A Lambert and B.L. Juneja, Cengage Learning

4. Internet of Things - Converging Technologies for smart environments and Integrated ecosystems, River Publishers.

5. Internet of things -A hands on Approach, Arshdeep Bahga, Universities press.

Course Code	Course Title						Core/Elective
OE 701 IT	**CYBER SECURITY**						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	**30**	**70**	**3**

Course Objectives:

Students should be able to understand

- The difference between threat and attacks, how threats materialize into attacks.
- Security in Operating Systems & Networks.
- Security Countermeasures
- Privacy in Cyberspace.
- Security Planning, Risk Analysis, Cyber Warfare, Cyberspace and Law

Course Outcomes:

Student will be able to

1. Acquire adequate knowledge about threat and attacks
2. Enhance their skills to implement security in design of Operating Systems
3. Use various techniques of Security Countermeasures
4. Acquire understanding in Privacy Principles and Policies in Cyberspace
5. Enhance their understanding in Security Planning, Risk Analysis, Cyber Warfare, Cyberspace and Law

UNIT I

Introduction To Cyber Security

Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls - Authentication - Access Control and Cryptography - Web—User Side - Browser Attacks - Web Attacks Targeting Users - Obtaining User or Website Data - Email Attacks

UNIT II

Security In Operating System & Networks

Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service.

UNIT III

Defences: Security Countermeasures

Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data.

UNIT IV

Privacy In Cyberspace

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining -Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies - Where the Field Is Headed.

UNIT V

Management And Incidents

Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law - International Laws - Cyber crime - Cyber Warfare and Home Land Security.

Suggested for Readings

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition , Pearson Education , 2015
2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013.

Course Code	Course Title						Core/Elective
OE 701 ME	**START- UP ENTREPRENEURSHIP**						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	**30**	**70**	**3**

Course Objectives:

Students should be able to understand

- 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:

Student 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. Understand the concept of Intellectual Property Rights and Patents
5. Comprehend the aspects of Start-Ups.

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

Intellectual Property Rights: Meaning, Nature, Classification and protection of Intellectual Property, the main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

Unit-V

Aspects of Start-Up: What is Start-Up, Start-up Policy, start-up strategy, Progress of startups in India, Principles of future organizations, start-up sectors, action plan for start-ups by Govt. of India.

Suggested Reading:

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., 5^{lh} Ed.,2005.
6. G.B. Reddy, Intellectual Property Rights and the Law 5th Ed. 2005 Gogia Law Agency
7. Ajit Parulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications, Macmillan India Ltd, 2006.

Course Code	Course Title						Core/Elective
OE 701 AE	**AUTOMOTIVE MAINTENANCE**						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	**30**	**70**	**3**

Course Objectives:

Students should be able to understand

- To study basic types of vehicle maintenance along with its importance
- To understand the trouble diagnosis procedure for electrical and electronic systems in
- automobiles
- To acquaint with various Trouble shooting, fault tracing practices available in
- automobile industry
- To understand the maintenance procedure for air-conditioning in automobiles.

Course Outcomes:

Student will be able to

1. Demonstrate the maintenance procedure for automotive Engine.
2. Illustrate the trouble diagnosis procedure for electrical systems like Battery, Starting
3. Systems
4. Identify the trouble diagnosis procedure for steering and suspension system
5. Illustrate trouble diagnosis procedure for lubrication and fuel delivery system etc.
6. Explain trouble diagnosis procedure for heating system of automobile.

UNIT – I

Maintenance, Workshop Practices, Safety and Tools: Maintenance – Need, importance,primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis.

vehicles, fire safety - First aid. Basic tools –Scheduled maintenance services – service intervals -Towing and recovering.

UNIT – II

Engine and Engine Subsystem Maintenance: introduction engine IC Engine General Engine service-cooling and lubricating system, fuel system, Intake and Exhaust system, electricalsystem - Electronic fuel injection and engine management. **S**ervice - fault diagnosis- servicing

emission controls.

UNIT – III

Transmission and Driveline Maintenance: Clutch- general checks, adjustment and service- roadtesting, Rear axle service points- removing axle shaft and bearings- servicing differential

assemblies- fault diagnosis.

UNIT – IV

Steering, Brake, Suspension and Wheel Maintenance: *Inspection*, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Wheel

alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage.

UNIT – V

***Auto Electrical and Air Conditioning Maintenance*:** Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Vehicle body repairlike panel beating, tinkering, soldering, polishing, painting.

Suggested Readings:

1. Ed May, "*Automotive Mechanics Volume* , McGraw Hill Publications, 2003.
2. Ed May, "*Automotive Mechanics Volume Two*‖, McGraw Hill Publications, 2003
3. *Vehicle Service Manuals of reputed manufacturers*
4. *Bosch Automotive Handbook*, Sixth Edition, 2004

Course Code	Course Title						Core/Elective
OE701EE	**Non-Conventional Energy Sources (Open Elective –II)**						**Open Elective**
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
OE702EE	**Transducers and Sensors**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To expose the students to various sensors and transducers for measuring mechanical quantities.
- To understand the specifications of sensors and transducers.
- To learn the basic conditioning circuits for various sensors and transducers.

Course Outcomes: At the end of the course students will be

1. Familiar with the basics of measurement system and its input, output configuration of measurement system.
2. Familiar with both static and dynamic characteristics of measurement system.
3. Familiar with the principle and working of various sensors and transducers.

UNIT -I Introduction to measurement system (MS) static characteristics of MS: linearity, Hysteresis, Threshold, Repeatability, Reliability and maintainability, Span, Calibration. **Sensor Fundamentals**: Basic sensor technology and sensor system Sensor characteristics, system characteristics, instrument selection, data acquisition and readout, and installation.

UNIT-II Resistive Transducer: Classification of transducers, Basic requirements of transducers, Variable resistance transducers; Potentiometers, Strain gauge (SG), types of Strain Guage.

UNIT-III Variable capacitive transducers: Capacitance, Principles, Capacitance displacement transducers, Capacitive hygrometer, and capacitive proximity transducers. **Variable inductive transducers**: Linear variable differential transformer, Rotary variable differential transformer.

UNIT-IV Measurement of temperature: Standards for calibration of temp. Temperature measuring devices, types of filled in system thermometers — liquid in glass, vapour pressure, bimetallic on solid rod thermometer Resistance temperature detectors, thermostat thermocouple.

UNIT-V Advance Sensors: Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Digital displacement sensors, Fibre optic sensor, Semiconductor sensor and Smart sensors.

Suggested Reading:

1. C.S.Rangan, G R Sarma & V S N Mani, *Instrumentation Devices and Systems*-TMH, 2nd Edition 2004
2. B.Nakra & Chowdhari, *Instrumentation Measurement and Analysis*, TMH, 2nd Edition 2003
3. D.V.S.Murthy, *Transducers and Instrumentation*, PHI, 1995 4. John P. Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education, 2000.
4. Doebelin E.O, *Measurement Systems - Application and Design*, 4th Edition, McGraw-Hill, New
5. Patranabis D, *Principles of Industrial Instrumentation*, 2nd Edition, Tata McGraw Hill, New Delhi, 1997.
6. Jon Wilson *Sensor Technology Handbook* , Newness Publication Elsevier.

Course Code	Course Title						Core/Elective
PC 751IT	**VLSI DESIGN LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To introduce the students to understand basics in Hardware design using CAD tools
- Understand and Experience Verilog Design Flow
- Learn Transistor-Level CMOS Logic Design using both Verilog and VHDL
- Understand VLSI Fabrication and experience CMOS Physical Design using backend tools

Course Outcomes

After completing this course, the student will be able to

- Demonstrate Xilinx ISE suite to write Verilog code for logic gates, combinational circuits and sequential circuits.
- Write Verilog code for basic logic gates, complex logic gates, combinational circuits, and sequential circuits using switch level, gate level, data flow and behavioural modelling.
- Develop test bench code using Verilog and verify the simulation results.
- Demonstrate the FPGA implementation of digital circuits and generate the synthesis report.
- Draw the layouts of basic logic gates using Microwind

List of Experiments to be performed

1. Switch level modelling using Verilog a) Logic gates b) AOl and OAI gates c) Transmission gate d) Complex logic gates using CMOS
2. Gate-level Modelling—Digital circuits using gate primitives—using Verilog.

a) Half adder and full adders b) AOl gate with and without delay c) OAl gate with and without delay d) 2:1 MUX using tri-state buffers e) S-R latch

3. RTL Modelling of general VLSI system components.

a) 4:1 MUX b) 2 to 4 Decoder c) 8:3 Priority encoder d) Flip-flops

4. Mixed gate-level and Switch-level modelling using Verilog a) Constructing a 4-input AND gate using CMOS 2-input NAND and NOR gates. b) Constructing a 2 to 4 decoder using CMOS 2-input AND gates and NOT gates etc.
5. Synthesis of Digital Circuits a) Ripple carry adder and carry look-ahead adder
6. Verilog code for finite state machine
7. Simple layouts of Inverter, NAND2 and NOR2 gates
8. Stick diagram representations of Inverter, NAND2 and NOR2 gates

Course Code	Course Title						Core / Elective
PC 752 IT	**Big Data Analytics Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To provide the knowledge to setup a Hadoop Cluster
- To impart knowledge to develop programs using MapReduce Technique
- To learn file handling in HDFS
- To introduce Pig, PigLatin and HiveQL to process big data
- To learn machine learning operations using Mahout Hadoop
- To introduce NoSQL databases

Course Outcomes

After completing this course, the student will be able to

1. Understand Hadoop working environment
2. Work with big data applications in multi node clusters
3. Write scripts using Pig to solve real world problems
4. Write queries using Hive to analyse the datasets
5. Apply big data and echo system techniques for real world

List of Experiments to be performed

1. Understanding and using basic HDFS commands
2. Word count application using Mapper Reducer on single node cluster
3. Working with files in Hadoop file system: Reading, Writing and Copying
4. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig
5. Retrieving user login credentials from /etc/passwd using Pig Latin
6. Working with HiveQL.
7. Writing User Defined Functions in Hive

Suggested reading:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, April 2015.
2. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.

Course Code	Course Title						Core/Elective
PW 761 IT	**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

After completing this course, the student will be able to

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- 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 IT	**SUMMER INTERNSHIP**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	-	**25**	**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

- Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
- Gain working practices within Industrial/R&D Environments.
- 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 coordinate (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
(INFORMATION TECHNOLOGY)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PE-VI	Professional Elective – VI	3	-	-	3	30	70	3	3
2	OE-III	Open Elective – III	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
3	PW861 IT	Project Work – II	-	-	16	16	50	100	-	8
			06	**-**	**16**	**22**	**110**	**240**	**06**	**14**

Profession Elective – VI	
Course Code	**Course Title**
PE 811 IT	Quantum Computing
PE 812 IT	Deep Learning
PE 813 IT	Cryptography and Network Security
PE 814 IT	Scalable Architecture

Open Elective III	
Course Code	**Course Title**
OE 801 CE	Road Safety Engineering
OE 801CS**	Fundamentals of AL & ML
OE801EE	Smart Building Systems
OE802EE	Programmable Logic Controllers
OE801EC	Principles of Electronic Communications
OE801 IT**	Software Engineering
OE801ME	3D Printing Technologies
OE801AE	ELEMENTS OF ELECTRIC AND HYBRID VEHICLE TECHNOLOGY

Note-1: ** Subject is not offered to the students of CSE and IT Department.

PC: Professional Course **MC**: Mandatory Course **HS**: Humanities and Sciences
L: Lectures **T**: Tutorials **P**: Practical D: Drawing
CIE: Continuous Internal Evaluation
SEE: Semester End Examination (Univ. Exam)

Note-2: 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.

Course Code	Course Title						Core/Elective
PE 811 IT	**QUANTUM COMPUTING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

The objective of this course is to impart necessary knowledge to the learner so that he/she can develop and implement algorithm and write programs using these algorithms.

Course Outcomes:

After completing this course, students will be able to:

- Explain the working of a Quantum Computing program, its architecture and program model
- Develop quantum logic gate circuits
- Develop quantum algorithm
- Program quantum algorithm on major toolkits

UNIT-I

Introduction to Quantum Computing: Motivation for studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.) Origin of Quantum Computing, Overview of major concepts in Quantum Computing Qubits and multi-qubits states, Bra-ket notation: Bloch Sphere representation, Quantum Superposition, Quantum Entanglement

UNIT-II

Math Foundation for Quantum Computing: Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

UNIT-III

Building Blocks for Quantum Program: Architecture of a Quantum Computing platform, Details of q-bit system of information representation: Block Sphere, Multi-qubits States, Quantum superposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perceptive e.g. Bell State, Operation on qubits: Measuring and transforming using gates. Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates.

UNIT-IV

Programming model for a Quantum Computing Program: Steps performed on classical computer, Steps performed on Quantum Computer, Moving data between bits and qubits.

UNIT-V

Quantum Algorithms: Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks

Suggested Readings:

1. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University Press. October 2000.
2. David McMahon, “Quantum Computing Explained”, Wiley 2007
3. IBM Experience: https://quantumexperience,ng,bluemix.net
4. Microsoft Quantum Development Kit https://www.microsoft.com/en-us/quantum/development-kit
   Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/

Course Code	Course Title						Core/Elective
PE 812 IT	**DEEP LEARNING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- Understand the concept of neural networks, convolutional neural networks, and recurrent neural networks.
- Implement deep learning algorithms, and learn how to train deep networks.
- Gain in-depth knowledge of TensorFlow along with its functions, operations, and the execution pipeline.
- Understanding the major Architectures of Neural Networks and getting into the Convolutional neural Networks.
- Understand the applications of implementing deep learning such as image processing, natural language processing, speech recognition, deep face - facial recognition system, etc.

Course Outcomes:

After completing this course, students will be able to:

- To understand the fundamentals of deep learning.
- To be able to understand deep learning algorithms and design neural network.
- To be able to train and implement a neural network.
- To be able to have knowledge about convolutional neural networks.
- To be able to apply neural networks in various fields.

UNIT – I

What is deep learning? Artificial intelligence, Machine learning, and Deep learning -Artificial intelligence -Machine learning - Learningrepresentations from data - The "deep" in deep learning -Understanding how deep learning works, in three figures -What deep learning has achieved so far- The promise of AI

UNIT – II

Getting started with neural networks - Anatomy of a neural network - Layers: the building blocks of deep learning - Models:networks of layers - Loss functions and optimizers: keysto configuring the learning process

The Neural Network-Building Intelligent Machines, The Limits of Traditional Computer Programs, The Mechanics of Machine Learning, The Neuron, Expressing Linear Perceptrons as Neurons, Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Sigmoid, Tanh

UNIT – III

Training Feed-Forward Neural Networks - The Fast-Food Problem - Gradient Descent - The Delta Rule and Learning Rates - Gradient Descent with Sigmoidal Neurons - The Backpropagation Algorithm - Stochastic and Minibatch Gradient Descent - Test Sets, Validation Sets, and Overfitting - Preventing Overfitting in Deep Neural Networks

Implementing Neural Networks in TensorFlow - What is TensorFlow? - How Does TensorFlow Compare to Alternatives?- Installing TensorFlow - Creating and Manipulating TensorFlow Variables - TensorFlow Operations - Placeholder Tensors - Sessions in TensorFlow - Navigating Variable Scopes and Sharing Variables - Managing Models over the CPU and GPU - Specifying the Logistic Regression Model in TensorFlow - Logging and Training the Logistic Regression Model - Leveraging TensorBoard to Visualize Computation Graphs and Learning -Building a Multilayer Model for MNIST in TensorFlow

UNIT – IV

Introduction to Major Architectures of Deep Networks–Unsupervised Pretrained Networks (UPNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks, Recursive Neural Networks

Convolutional Neural Networks -Neurons in Human Vision - The Shortcomings of Feature Selection - Vanilla Deep Neural Networks Don't Scale - Filters and Feature Maps - Full Description of the Convolutional Layer - Max Pooling - Full Architectural Description of Convolution Networks - Closing the Loop on MNIST with Convolutional Networks - Accelerating Training with Batch Normalization.

UNIT –V

Deep Learning Applications - Large Scale Deep Learning - Computer Vision - Speech Recognition - Natural Language Processing - Other Applications

Suggested Reading:

1. Nikhil Buduma and Nicholas Locascio - Fundamentals of Deep Learning : Designing Next-Generation Machine Intelligence Algorithms – First Edition - O'Reilly , 2017
2. Francois Chollet-Deep Learning with Python-Second Edition,Manning Publications, 2017.
3. Josh Patterson and Adam Gibson- Deep Learning: A Practitioner's Approach - First Edition - O'Reilly , 2017
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville - Deep Learning – Second Edition- MIT Press , 2016

Course Code	Course Title						Core/Elective
PE 813 IT	**CRYPTOGRAPHY AND NETWORK SECURITY**						Elective
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:

Student will be able to

- Understand the various applications of IoT and other enabling technologies.
- Comprehend various protocols and communication technologies used in IoT
- Design simple IoT systems with requisite hardware and C programming software
- Understand the relevance of cloud computing and data analytics to IoT
- Comprehend the business model of IoT from developing a prototype to launching a product.

UNIT – I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT – II

Symmetric key Ciphers:Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange.

UNIT – III

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service.

UNIT – IV

Transport-level Security:Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH) Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

UNIT – V

E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations.

Suggested reading:

- Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition
- Cryptography and Network Security: AtulKahate, Mc Graw Hill, 3rd Edition

Course Code	Course Title						Core/Elective
PE 814 IT	**SCALABLE ARCHITECTURE**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- Students will be able to learn application and building Scalable Machine Learning, Hadoop, SMACK Stack and also Message Services.
- Students will be able to select the appropriate architecture for enterprise architectures based on the size, scale and applications used in the enterprise

Course Outcomes:

Student will be able to

- Understand the basic concepts of Scalable Machine Learning
- To become a data scientist work in some development environment tailored for statistics and Machine Learning.
- Obtain expertise to turn actionable insights and Fast Data Applications into innovative methods to solve real-world problems.
- To impart knowledge on Kubernetes and batch processing.

UNIT –I

Introduction to Scalable Machine Learning, Some Machine Learning Background
Algorithms for Large scale Learning, Overview of Hadoop and Current Big Data Systems

UNIT II

How Programming for Data Flow Differs, Basic Spark, Working with Vectors and Matrices in Spark, Brief tour of Spark ML, beyond parallelization, Practical Big Data

UNIT III

Anatomy of Fast Data Applications, SMACK Stack – Functional Decomposition,
Message Backbone- Understanding messaging requirements, Data ingestion, Fast data& low latency, Message Delivery Semantics, Distributing Messages

UNIT IV

Compute Engines- Micro Batch Processing, One-at-a time Processing, Choice of processing engine,
Storage as the Fast Data Borders, The message backbone as Transition Point

UNIT V

Sharing stateful streaming state, Data Driven Micro-services, State and Micro-services.
Deployment environments for Fast Data Applications, Application containerization, resource scheduling, Apache Mesos, Kubernetes, Cloud Deployments.

Suggested Reading:

1. Designing Fast Data Application Architectures by Gerard Maas, Stavros Kontopoulos, Sean Glover , Publisher: O'Reilly Media, Inc., June 2018
2. Spark- The definitive Guide by Bill Chambers & Matei Zaharia, O'Reilly Media, Inc., June 2019

Course Code	Course Title						Core / Elective
OE801CE	**ROAD SAFETY ENGINEERING**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**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:

After completing this course, the student will be able to

1. Understand the fundamentals of traffic safety analysis
2. Analyze Accident data
3. Remember the concepts of road safety in urban transport
4. Apply crash reduction techniques
5. Design of urban Infrastructure considering safety aspects.

UNIT – I

Introduction: Road Safety scenario in India and World, Road Accident Characteristics.

Traffic Safety Analysis: Fundamentals of Traffic Engineering **-** Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared
Distribution, Statistical Comparisons.

UNIT – II

Accident Analysis: Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness
of Safety Design Features, Accident Reconstruction. Application of computer analysis of accident data.

UNIT – III

Road Safety in planning and Geometric Design: Vehicle And Human Characteristics, Road Design and RoadEquipment‘s, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads,
Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.

UNIT – IV

Traffic Signals & Road signs**:** Traffic Signals, Factors affecting signal design, street lighting, Provisions for NMTVehicles in India, Safety Provisions for Pedestrians & Cyclists, Road Signs and Pavement Markings.

Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT – V

Traffic Management safety audit: Traffic Management Systems for Safety, Road Safety Audits and Tools forSafety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

Suggested Readings:

1. Kadiyali L.R,. *Traffic Engineering and Transport planning*, 9th Edition, Khanna Tech Publishers, 2013.
2. C.E.G. Justo, A. Veeraragavan and S. K. Khanna, *Highway Engineering*, 10th Edition, Nem Chand Publishers, 2017.
3. Donald Drew, *Traffic Flow Theory Chapter 14 in Differential Equation Models*, Springer, 1983
4. C. Jotinkhisty and B. Kent Lall, *Transportation Engineering – An Introduction, 3rd Edition, Pearson publications, 2017*
5. Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson, *Handbook of Road Safety measures, second Edition, Emerald Publishing, 2009.*
6. Highway Research Programme (NCHRP) Synthesis 336.*A synthesis of Highway Research Board, Washington D.C, 2016*.

Course Code	Course Title						Core / Elective
OE801CS	**FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Cover various paradigms that come under the broad umbrella of AI.
- To understand various key paradigms for machine learning approaches
- To familiarize with the mathematical and statistical techniques used in machine learning.
- To understand and differentiate among various machine learning techniques

Course Outcomes:

After completing this course, the student will be able to

1. Develop an understanding of modern concepts in AI and where they can be used
2. Design, implement and apply novel AI techniques based on emerging real-world requirements
3. To formulate a machine learning problem
4. Select an appropriate pattern analysis tool for analyzing data in a given feature space.
5. Apply pattern recognition and machine learning techniques such as classification and feature selection to practical applications and detect patterns in the data.
6. Design and program efficient algorithms related to recent machine learning techniques, train models, conduct experiments, and develop real-world ML-based applications and products

UNIT-I:

INTRODUCTION: Definitions of Artificial Intelligence, Artificial Intelligence Problems, Topics of Artificial Intelligence, Timelines of Artificial Intelligence, Production Systems, State Space Representation, Branches of Artificial Intelligence, Applications of Artificial Intelligence,

UNIT-II:

HEURISTIC SEARCH TECHNIQUES: Generate-and-Test , Hill Climbing, Search Techniques, Problem Reduction, Constraints Satisfaction, Means-ends Analysis

KNOWLEDGE REPRESENTATION: Knowledge Management, Types of Knowledge, Knowledge Representation, Approaches to Knowledge Representation, Issues in Knowledge Representation, Knowledge Base

UNIT-III:

LEARNING: Types of Learning, Machine Learning, Intelligent Agents

CLUSTERING: k-Means Clustering, Fuzzy Clustering, Hierarchical Clustering, Cluster Similarity, Case Studies,

UNIT-IV:

STATISTICAL LEARNING: Hidden Markov Models, Linear Classifiers, Quadratic Classifiers, Decision Trees, Bayesian Networks, Case Studies,

ARTIFICIAL NEURAL NETS: ANN Basics, ANN—Learning Process, Types of Networks, Perceptron, RBF Networks, ANN Summary, Case Studies

UNIT-V:

SUPERVISED LEARNING: Support Vector Machines, Inductive Logic Programming, Case-based Reasoning, Ensemble Classifiers, Nearest Neighbourhood, Fuzzy Network, Case Studies,

UNSUPERVISED LEARNING: Expectation Maximization, Self organizing maps, Adaptive resonance theory, Case studies

Suggested Readings:

1. Vinod Chandra S.S and AnandHareendran S , “Artificila Intelligence and Machine Learning ”, PHI , 2014
2. PrashantKikani, “Demystifying Artificial intelligence: Simplified AI and Machine Learning concepts for Everyone”, January 2021, BPB publication
3. Dr. Nilakshi Jain , “Artificial Intelligence, As per AICTE: Making a System Intelligent” January 2019, WILEY India
4. LavikaGoel , “Artificial Intelligence: Concepts and Applications” January 2021, WILEY India

Course Code	Course Title						Core / Elective
OE801EE	**Smart Building Systems**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the basic blocks of Building Management System.
- To design various sub systems (or modular system) of building automation
- To integrate all the sub systems

Course Outcomes

At the end of the course students will be able to

1. Describe the basic blocks and systems for building automation
2. Use different subsystems for building automation and integrate them.
3. Understand basic blocks and systems for building automation
4. Design different systems for building automation and integrate those systems

UNIT-I

Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT-II

Fire Alarm (FA) System: concept of fire, Fire modes, History, Components, and Principles of Operation. Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. Types of FAS Architectures, Examples. Classification of FAS loops, Examples. FAS Design procedure in brief, NFPA 72A, BS 5839, IS, Concept of IP enabled fire & alarm system, design aspects and components of PA system.

UNIT-III

Access Control System: Access Components, Access control system Design.

CCTV: Camera Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical typesof cables, controlling system. CCTV Applications.

UNIT-IV

Security Systems Fundamentals: Introduction to Security Systems, Concepts.

Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security system design for verticals. concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control –DAC, MAC, RBAC.

EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components, integration of all the above systems to design BMS.

UNIT-V

Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.

Building Management System: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS, Advantages & Applications of BMS, IBMS Architecture, Normal & Emergency operation, Advantages of BMS.

Suggested Reading:

1. Jim Sinopoli, *Smart Buildings,* Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Reinhold A. Carlson, Robert A. Di Giandomenico, *Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs),* R.S. Means Company Publishing, 1991.
3. Albert Ting-Pat So, WaiLok Chan, Kluwer , *Intelligent Building Systems*, Academic publisher, 3rd ed.,2012.
4. Robert Gagnon, *Design of Special Hazards and Fire Alarm Systems*, Thomson Delmar Learning; 2nd edition, 2007.
5. Levenhagen, John I.Spethmann, Donald H, *HVAC Controls and Systems*, McGraw-Hill Pub.
6. Hordeski, Michael F, *HVAC Control in the New Millennium*, Fairmont press, 2001.
7. Bela G. Liptak, *Process Control-Instrument Engineers Handbook*, Chilton book co.

Course Code	Course Title						Core / Elective
OE 802 EE	**PROGRAMMABLE LOGIC CONTROLLERS**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To be able to understand basics of Programmable logic controllers, basic programming of PLC.
- To make the students to understand the Functions and applications of PLC

Course Outcomes

At the end of the course students will be able to

1. Develop PLC programs for industrial applications.
2. Acquire the knowledge of PLC counter functions and PLC Arithmetic functions and data handlingfunctions.

UNIT-I

PLC Basics: Definition and History of PLC - PLC advantages and disadvantages - Over all PLC Systems - CPUs and Programmer Monitors - PLC input and output models - Printing PLC Information- Programming Procedures - Programming Equipment - Programming Formats- Proper Construction of PLC Diagrams - Devices to which PLCinput and output modules are connected - Input on/off switching devices - Input analog devices - Output analog on/off devices and output analog devices.

UNIT-II

Basic PLC Programming: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs - Operational procedures - Contact and coil input/output programming examples - Relation of digital gate logic contact / coil logic - PLC programming and conversion examples - Creating ladder diagrams from process control descriptions - Sequence listings - Large process ladder diagram constructions.

UNIT-III

Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Input registers - output registers - PLC timer functions - examples of timer functions. Industrial applications - PLC counter functions.

UNIT-IV

Intermediate Functions: PLC Arithmetic functions - PLC additions and subtractions - The PLC repetitive clock -PLC Multiplications, Division and Square Root - PLC trigonometric and log functions - Other PLC arithmetic functions - PLC number comparison functions. PLC basic

comparison functions and applications - Numbering systems and number conversion functions - PLC conversion between decimal and BCD-Hexadecimals numbering systems.

UNIT-V

Data Handling Functions: The PLC skip and master control relay functions - Jump functions - Jump with non return - Jump with return. PLC data move Systems - The PLC functions and applications. PLC functions working with bits - PLC digital bit functions and applications - PLC sequence functions - PLC matrix functions.

Suggested Reading:

1. John W. Weff, Ronald A. Reis, Programmable Logic Controllers, Prentice Hall of India Private Limited, Fifth edition, 2003.
2. Frank D. Petruzella, *Programmable Logic Controllers*, 5th Edition, Mc-Graw Hill, 2019.

Course Code	Course Title						Core / Elective
OE 801 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.

Course Code	Course Title						Core / Elective
OE 801 IT	**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.
- To impart knowledge on various phases, methodologies and practices of software development.
- To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metrics.

Course Outcomes:

After completing this course, the student will be able to

1. Acquired working knowledge of alternative approaches and techniques for each phase ofsoftware development
2. Judge an appropriate process model(s) assessing software project attributes and analyze necessary requirements for project development eventually composing SRS.
3. Creation of visual models to describe (non-) algorithmic solutions for projects using various design principles.
4. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting knowledge on patterns.

UNIT – I

Introduction to Software Engineering:

A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models

UNIT – II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT – III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT – IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design. ***Modeling Component-Level Design:*** Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components. ***Performing User Interface Design:*** The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT – V

Testing: Strategies: A Strategic Approach to Conventional Software Testing, Test Strategies for O-O Software.

Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods.

Debugging: Debugging Techniques, The Art of Debugging.

Product Metrics: A Framework for Product Metrics, Metrics for each phase of software development.

Software Quality: Definition, ***Quality Assurance:*** Basic Elements, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO9000 Quality Standards, SQA Plan.

Suggested Readings:

1. Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, 7th Edition,McGraw Hill, 2009
2. Ali Behforooz and Frederick J. Hudson, *Software Engineering Fundamentals*, Oxford University Press, 1996
3. Pankaj Jalote, *An Integrated Approach to Software Engineering*, 3rd Edition, Narosa Publishing House, 2008

Course Code	Course Title						Core / Elective
OE 801 ME	**3D PRINTING TECHNOLOGIES**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To understand the fundamental concepts of 3D Printing, its advantages and limitations.
- To know the working principle, advantages, disadvantages and applications of liquid,solid and Powder based 3D Printing Technologies.
- To know diversified applications of 3D Printing Technologies.

Course Outcomes:

After completing this course, the student will be able to

1. Interpret the features of 3D Printing and compare it with conventional methods.
2. Illustrate the working principle of liquid, solid and powder-based 3D Printing Technologies.
3. Apply the knowledge of various 3D Printing technologies for developing Innovativeapplications.

Unit-I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of 3D Printing, Advantages and Limitations of 3D Printing, commonly used Terms, 3D Printing Process Chain, 3D Modeling, Data conversion and Transmission, Checking and Preparing, Building, Post-processing, RP Data formats, Classification of 3D printing processes, Fundamental Automated Processes, Distinction between 3D Printing and Conventional Machining Processes.

Unit-II

Liquid-based Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit-III

Solid-based System: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, Working principle, Applications, Advantages and Disadvantages, Case studies.

Unit-IV

Powder Based Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three- dimensional Printing

(3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture, Pattern for investment and vacuum casting, Medical Models and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, and Web Based Rapid Prototyping Systems.

Suggested Reading:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principlesand Applications" Fifth Edition, World scientific
2. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" Springer, Second Edition,2010.
3. Frank W.Liou, "Rapid Prototyping & Engineering Applications"- CRC Press, Taylor &Francis Group, 2011.
4. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", JohnWiley & Sons, 2006.

Course Code	Course Title						Core / Elective
OE 801 AE	**ELEMENTS OF ELECTRIC AND HYBRID VEHICLE TECHNOLOGY**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To understand the hybrid vehicle technology
- To know the energy storage requirements and analyze the hybridization of different storage devices.
- To understand the configuration of various electric propulsion units.
- To know the different hybrid drives and the concept of electric drive trains.

Course Outcomes:

After completing this course, the student will be able to

1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
2. Discuss different energy storage technologies used for hybrid electric vehicles and their control.
3. Analyze various electric drives suitable for hybrid electric vehicles.
4. Explain plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
5. Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

Unit - I

Introduction: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies Electric vehicles; configuration of EVs, performance, traction motor characteristics, tractive effort and transmission requirements.

Unit- II

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

Unit - III

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives

Unit - IV

Hybrid Drives: Introduction, features, functional classification, start/stop system, mild hybrid, full hybrid, plug-in-hybrid, batteries for hybrid vehicles, and optimization of hybrid configurations. Changing modes for conductive charging.

Unit - V

Hybrid Electric Vehicles (HEVs) And Drive Structures: Concept of electric drive train, architecture of hybrid electric drive train, series hybrid drive, parallel hybrid electrical drive train.

Electric and Hybrid Vehicles - Case Studies: Honda Insight, Chevrolet Volt, GM EV1, Toyota RAV 4 EV and Ford; Think City

Suggested Reading

1. Iqbal Husain, "Electic and Hybrid vehicles Design Fundamentals" , CRC Press, second edition 2013
2. James Larminie, John Lowry, "Electric vehicle techonology Explained" 2nd Ed.,Wiley 2012
3. Vehicular Electrical Power Systems – Emadi, Ehasni, Mercel (Marcel Dekker)
4. Electric and Hybrid vehicles – Pistoia (Elsevier)
5. Fuel cells principles and applications - B.Vishwanath, M. AuliceScibion (University Press)
6. Electrical vehicle machine and drives – K.T.Chau (Wiley).

Course Code	Course Title						Core/Elective
PW 961 IT	**PROJECT WORK – II**						Elective
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

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

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- 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.