Name of the course	**INTERNET OF THINGS**
Course Code: **PC-ECS 701**	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 2 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand the terminology, technology and its applications
2.	To understand the concept of M2M (machine to machine) with necessary protocols
3.	To learn the Python Scripting Language which is used in many IoT devices.
4.	To understand the Raspberry PI platform, that is widely used in IoT applications
5.	To understand the implementation of web based services on IoT devices.

Pre-Requisite:	
1.	Programming for problem solving (ES-CS201)

Unit	Content	Hrs	Marks
1	**Introduction to Internet of Things:** Definition and characteristics of IoT, Physical design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs, IoT enabled technologies – Wireless sensor networks, Cloud computing, Big data analytics, Communication protocols, Embedded systems, IoT levels and templates, Domain specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.	**8**	
2	**IoT and M2M:** Software defined networks, network function virtualization, difference between SDN and NFV for IoT. Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER	**6**	
3	**Introduction to Python:** Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling. Python packages - JSON, XML, HTTP Lib, URL Lib, SMTP Lib.	**8**	
4	**IoT Physical Devices and Endpoints:** Introduction to Raspberry PI - Interfaces (serial, SPI, I2C). Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controllingoutput, reading input from pins.	**8**	
5	**IoT Physical Servers and Cloud Offerings:** Introduction to CloudStorage models and communication APIs. Webserver – Web server for IoT, Cloud for IoT, Python web application framework.Designing a RESTful web API	**8**	

Text books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, UniversitiesPress, 2015.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2016.
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things**,** David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,Pearson Education, 2017.
4. Internet of Things, K.G. Srinivasa , G.M. Siddesh, R.R. Hanumantha, CENGAGE Leaning India,2018

Reference books:

1. Internet of Things (A Hands-on-Approach), Arshdeep Bahga and Vijay Madisetti, VPT, 2014.
2. Internet of Things: Architecture and Design Principles, Raj Kamal , McGraw Hill Education,2017.

Course Outcome:

After completion of this course, the learners will be able to

1. describe different type of networks, sources and signals with examples.
2. explain different network theorems, coupled circuit and tools for solution of networks.
3. apply network theorems and different tools to solve network problems.
4. select suitable techniques of network analysis for efficient solution.
5. estimate parameters of two-port networks.
6. design filter circuits.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Signals & Systems**
Course Code: **PC-ECS 702**	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand sampling and reconstruction of signal
2.	To understand the method of Z-transform and inverse Z- transform of signal and its property
3.	To understand Discrete Fourier Transform
4.	To understand applications of Digital signal processing
5.	To understand methods of design of Digital filters
6	To solve numerical problems on the topics studied
Pre-Requisite:	
1.	Electric circuit theory (PC-EE-301)
2	Control system (PC-EE-503)

Unit	Content	Hrs	Marks
1	**Introduction to Signals and Systems:** Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.	**3**	
2	**Behavior of continuous and discrete-time LTI systems (8 hours)** Impulse response and step response, convolution, input-output behavior with periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi- output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.	**8**	
3	**Fourier, Laplace and z- Transforms** Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and	**10**	

	systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.		
4	The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero- order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.	**9**	

Text books:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
6. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
7. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.
8. R. Anand, "Signals and Systems, Khanna Publishing House, 2018

Reference books:

1. Digital Signal Processing using MATLAB, Ingle, Vikas.
2. Digital Signal Processing, Ifachor, Pearson Education.
3. Digital Signal Processing, A.V. Oppenhein & R.W. Shaffer, PHI
4. Theory and application of Digital Signal Processing, L.R. Rabiner & B. Gold, PHI
5. Digital Signal Processing, Ashok Ambarder, Cengage Learning.
6. Digital Signal Processing, S. Salivahanan, A. Vallavaris & C. Gnanpruja, TMH.

Course Outcome:

After completion of this course, the learners will be able to .

1. Understand the concepts of continuous time and discrete time systems.
2. Analyse systems in complex frequency domain.
3. Understand sampling theorem and its implications.
4. Understand the concepts of continuous time and discrete time systems.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**INDUSTRIAL AUTOMATION AND CONTROL**
Course Code: **PE-ECS 701A**	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	To understand Industrial automation and control.
2.	To understand the different control modes.
3.	To understand advance industrial control strategies.
4.	To understand the Programmable Logic Controller and distributed control system.
5.	

Pre-Requisite:

1.	Control System (PC-EEE-503)

Unit	Content	Hrs	Marks
1	**Introduction to Industrial Automation and Control**: Architecture of Industrial Automation Systems. General review of process, Process control & automation, Servo and regulatory control, Characteristic parameter of a process: Process quality, Process potential, Process resistance, Process capacitance, Process lag, Self regulation.	**8**	
2	**Different control modes and Implementation:** On-off control, Multistep, Time proportional, Proportional, Proportional-integral, Proportional -derivative, Proportional- integral-derivative, integral windup, bump less transfer, Inverse derivative control, controller tuning techniques and selection guideline. Implementation of PID Controllers.	**8**	
3	**Advance Industrial control strategies (Brief analysis):** Feedforward control, Cascade control, Ratio control, Selective Control, Split Range Control, Adaptive control.	**6**	
4	**Actuators and final control elements:** Classification of Actuators: pneumatic, hydraulic, electro-pneumatic, and stepper motor operated actuators. Pumps and motors, proportional and servo valves.	**6**	
5	**Programmable Logic Controller:** Block diagram, Classification, Basic Architecture and Functions; Input-	**6**	

	Output Modules, power supply. PLC Programming: Relay logic and ladder logic, PLC ladder diagram realization, PLC Timer, PLC Counter, advance instructions.PLC programming examples for Industrial maintenance and control.		
6	**Distributed Control System (DCS):** Basic concept and overview of DCS, DCS System Architecture, configuration, operation and features. HMI and SCADA, OSI Communication Standard and Fieldbus.	**6**	

Text Books

1. Industrial Instrumentation and Control, S. K. Singh, Tata-McGraw , 2010
2. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K.Deb, Jaico Publishing House, 2012.
3. Process Control, K. Krishnaswamy, New Age International Publishers, 2009
4. Programmable Logic Controllers with Control Logix, Jon Stenerson, Delmar Cengagelearning, 2009

Reference books:

1. Automatic Process Control, D.P. Eckman, John Wiley and sons, 1958
2. Process control instrumentation technology, C.D. Johnson, PHI, 2005
3. Instrument Engineers Handbook, B.G. Liptak, CRC Press, 2003

Course Outcome:

After completion of this course, the learners will be able to.

1. explain the basic structure of industrial automation and control
2. classify different types of control actions of controllers.
3. analyze control strategies of different processes of industry.
4. illustrate the construction and use of different types of actuators and control valves.
5. use PLC, DCS and SCADA in advanced industrial control.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**SMART ELECTRIC GRID AND ENERGY MANAGEMENT**
Course Code: **PE-ECS 701B**	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	To understand the terminology, technology and its applications
2.	To understand the concept of Smart Grid with necessary protocols
3.	To understand the concept of EMS (Energy Management System) with necessary protocols
4.	To understand the PLC and its applications.
5.	To understand the concept of Smart Metering.

Pre-Requisite:

1.	Power System

Unit	Content	Hrs	Marks
1	**Introduction to Smart Grid:** Basics of power systems, definition of smart grid, need for smart grid, functions of smart grid, opportunities & barriers of smart grid, difference between conventional & smart grid, regulatory challenges, present development & International policies in smart grid.	**8**	
2	**Architecture of Smart Grid:** Functional elements of Smart grid designs, transmission automation, distribution automation, renewable integration. Distribution energy sources, microgrids, storage technologies, electric vehicles and plug-in hybrids, environmental impact and economic issues. Smart grid architecture, standards-policies, network architectures, IP-based systems, power line communications, SCADA system	**8**	
3	**Energy Management in Smart Grid:** General principles, Planning and program, concept and scope of demand side management (DSM). DSM Strategy, Planning, Implementation and its application, Energy Management System (EMS) , smart substations , substation automation, feeder Automation, smart switchgear, remote terminal unit, Intelligent electronic devices , protocols, phasor measurement unit , wide area monitoring, protection and control, smart integration of energy resources.	**6**	
4	. **Tools and Techniques for Smart Grid:** static and dynamic optimization techniques for power applications such as economic load dispatch, Conventional and evolutionary algorithms in power system	**6**	

5	. **Communication Technologies in Smart Grid:** Introduction to communication technology, architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) – House Area Network (HAN) – Wide Area Network (WAN) – Broadband over Power line (BPL) – IP based Protocols – Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.	**6**	
6	**Advanced Metering:** Introduction to Smart meters, Advanced metering infrastructure and phasor measurement unit (PMU)	**6**	

Text Books

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, Integration of Green and Renewable
2. Energy in Electric Power Systems, Wiley, (2009) Clark W. Gellings, The Smart Grid: Enabling Energy Efficiency and Demand Response,
3. CRC Press, (2009) Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianz hong Wu, Akihiko
4. Yokoyama, Smart Grid: Technology and Applications, Wiley, (2012) G. Masters, Renewable and Efficient Electric Power System, Wiley–IEEE Press, 2nd
5. Edition, (2013). Stuart Borlase, Smart Grids (Power Engineering), CRC Press, (2012)

Reference books:

1. Andres Carvallo, John Cooper, The Advanced Smart Grid: Edge Power Driving
2. Sustainability, Artech House Publishers , (2011). James Northcote, Green, Robert G. Wilson Control and Automation of Electric Power
3. Distribution Systems (Power Engineering), CRC Press.(2017) James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley, (2012)

Course Outcome:

After completion of this course, the learners will be able to.

1. Understand and explain the concept of Smart Grid
2. Analyze the architecture and key components of Smart Grids
3. Apply energy management techniques in Smart Grids
4. Evaluate the tools and techniques used in Smart Grid optimization
5. Understand and implement communication technologies in Smart Grids.
6. Integrate advanced metering systems into Smart Grids.
7. Assess the environmental and economic impact of Smart Grid

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**RENEWABLE & NON-CONVENTIONAL ENERGY**
Course Code: **PE-ECS 701C**	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand the difference between Renewable and non-renewable energy sources
2.	To understand methods of conversion of solar energy and wind energy to other form of energy.
3.	To understand methods harnessing energy from Biomass, Geothermal and ocean
4.	To understand the principle of operation of Magneto Hydrodynamic power generation:
5.	To understand the principle and operation of fuel cell.
6	To solve numerical problems of Renewable and non-renewable energy sources
Pre-Requisite:	
1.	Electric Circuit Theory (PC-EE-301)
2	Electric Machine-I (PC-EE-401)
3	Electromagnetic field theory (PC-EE-303)
4	Electrical and Electronics measurement (PC-EE-403)

Unit	Content	Hrs	Marks
1	**Introduction to Energy sources:** Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol.	**3**	
2	**Solar Energy:** Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaic - solar cells, different types of PV Cells, Mono-poly Crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems	**8**	

3	**Wind Energy:** Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations	**5**	
4	**Energy from Biomass:** Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas	**5**	
5	**Geothermal Energy:** Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India	**5**	
6	**Energy from Ocean:** Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.	**5**	
7	**Magneto Hydrodynamic power generation:** Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects.	**3**	
8	**Hydrogen Energy:** Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.	**3**	
9	**Fuel cell:** Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells	**3**	

Text books:

1. Renewable energy sources and conversion technology, Bansal Keemann, Meliss, Tata Mc Graw Hill.

2. Energy Technology, O.P. Gupta, Khanna Publishing House.
3. Renewable energy resources and emerging technologies, D.P. Kothari, PHI.
4. Non-conventional Energy sources, G.D. Rai, Khanna Publishers.
5. Non Conventional Energy Resources, Chandra, Khanna Publishing House.

Reference books

1. Non-conventional Energy, Ashok V. Desai, New Age International Publishers Ltd.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the principle of conversion of solar energy, wind energy , biomass, Geothermal energy, Ocean energy and Hydrogen energy to other form of energy.
2. explain the principle of operation of magneto hydrodynamic power generation:
3. use Solar energy, Wind energy , Biomass, Geothermal energy, Ocean energy, Hydrogen energy and fuel cell for different applications.
4. suggest location to set up wind mill and biogas generation plant
5. estimate conversion efficiency of fuel cell.
6. solve numerical problems relating to conversion of Solar energy, Wind energy , Biomass, Ocean energy and Hydrogen energy to heat and electric energy.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Project Management & Entrepreneurship**
Course Code: OE-ECS 701A	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	To impart among students, the concept of project, its characteristics, and its management subject to given constraints to successfully deliver the agreed outcomes of the project.
2.	To imbibe students with the knowledge of effective project planning, project evaluating, and project scheduling with optimal resource allocation.
3.	To impart among students, the legal aspect and quality aspect of project management.
4.	To familiarize the students with the concept of entrepreneurship, its theoretical and practical approach.

Pre-Requisite:

1.	Fundamentals of Management
2	Elementary Mathematics

Unit	Content	Hrs	Marks
1	**Project Management Concepts:** Concept and Characteristics of a Project, Types of Projects, Project Management (Need, Knowledge Areas, Project Manager, Project Management Triangle, Project Scope and Scope Creep, Importance of Project Management). **Project Management Life Cycle:** Project Management Life Cycle Phases, Project Management Process (Project Process, Process Group, Process Interactions, Customization, Process Group and Knowledge Area Matrix) **Project Planning:** Planning Need, Importance of Planning, Planning Process, Work Breakdown Structure and Organization Breakdown Structure, Roles, Responsibility and Team Work, Feasibility Studies	**10**	
2	**Project Evaluation:** Investment Analysis of Projects (Time Value of Money, Interest Rates, Compounding/Discounting, Payback Period, Average Rate of Return, Net Present Value, Profitability Index, Internal Rate of Return), Sources of Finance. **Project Scheduling:** Importance of Project Scheduling, Scheduling Techniques (Gantt Chart and Line of Balance, Network Analysis – CPM/PERT, Slack and Float).	**10**	

	Project Cost Control: Direct and Indirect Cost, Normal Cost and Crash Cost, Time– Cost Trade-off Analysis - Optimum Project Duration, Resource Allocation and Leveling.		
3	**Legal and Quality Aspects of Project Management:** Project Contract (Types of Contract, Sub-Contracting, Tenders, Payment to Contractors), Project Audit. **IT in Projects:** Overview of types of Software for Projects, Major Features of Project Management Software like MS Project, Criterion for Software Selection.	**5**	
4	**Entrepreneurship:** Meaning & Concept of Entrepreneurship, Conditions needed for Entrepreneurship (Social Factors, Economic Factors, Psychological Factors, Legal Factors, Education & Technical Knowhow, Financial Assistance), Qualities of a Prospective Entrepreneur. **Entrepreneurial Motivation:** McClelland's N-Ach Theory (Need for Affiliation, Need for Power, Need for Achievement), Self–Analysis, Personal Efficacy, Culture & Values, Risktaking Behaviour, Technology Backup. **Entrepreneurial Skills:** Creativity, Problem Solving, Decision Making, Communication, Leadership Quality	**6**	

Textbooks:

1. P. Gopalkrishnan and R. M. Moorthy; Text Book of Project Management, Macmillan
2. K. Nagarajan; Project Management, New Age International Publishers; 5th Edn.
3. P. Chandra; Projects; Tata McGraw Hill; 6th Edn.
4. J. M. Nicholas; Project Management for Business and Technology – Principles and Practice; Prentice Hall India; 2nd Edn.
5. H. Maylor; Project Management; Pearson; 3rd Edn.
6. D. F. Kuratko and R. M. Hodgetts; Entrepreneurship; Thomson Learning; 7th Edn.
7. R. Roy; Entrepreneurship; Oxford University Press.

Reference Books:

1. S. A. Kelkar; Software Project Management: A concise Study; Prentice Hall India; 2nd Edn.
2. F. K. Levy, J. D. Wiest; A Management Guide to PERT/CPM with GERT/PDM/DCPM and other networks; Prentice Hall India, 2nd Edn.
3. J. Mantel, J. R. Meredith, S. M. Shafer, M. M. Sutton, M. R. Gopalan; Project Management: Core Text Book, Wiley India, 1st Indian Edn.
4. L. C. Jhamb; Industrial Management-II; Everest Publishing House; 10th Edn.
5. S. N. Chary; Production and Operation Management; Tata McGraw Hill
6. Clements, Gido; Effective Project Management; Thomson Learning
7. C. F. Gray, E. W. Larson; Project Management; Tata McGraw Hill; 3rd Edn.
8. S.C. Sharma & T.R.Banga, Industrial Engineering & Management, Khanna Book Publishing Co. (P) Ltd.

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. Learn general concept of a project and project management, the importance of project life cycle and essential elements of project planning.
2. Analysis of project evaluation, project scheduling as well as project cost control through application of financial and mathematical tools.
3. Learn details of legal and quality aspects of project management to face various issues.
4. Study and demonstrate the features of different project management softwares with special emphasis on "MS Project" and can able to select the best PMS subject to desired requirements.
5. Develop skills of entrepreneurship both theoretical and practical approach and can take initiative of starting a new business.
6. Align the successful approach of entrepreneurship in undertaking large investment projects for the necessity and benefit of the society.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Data Analytics**

Course Code: OE-ECS 701B	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	**Understand the fundamental concepts of Data Analytics**, including its applications, types of data, and the entire analytics process, from collection to analysis.
2.	**Develop skills in data preprocessing and statistical analysis**, including handling missing data, normalizing data, and applying descriptive and inferential statistics for data interpretation.
3.	**Learn data visualization techniques**, utilizing tools like Matplotlib, Seaborn, Tableau, and Power BI to create informative and interactive visual representations of data.
4.	**Explore machine learning techniques** for data analytics, including supervised and unsupervised learning models, performance evaluation metrics, and real-world applications of these methods.
5	**Get introduced to Big Data technologies** like Hadoop, Apache Spark, and NoSQL databases to process and analyze large-scale data sets efficiently.
6	**Apply data analytics concepts** to real-world problems, particularly in business intelligence, sentiment analysis, and social media analytics.
Pre-Requisite:	
1.	**Basic knowledge of Statistics and Probability** (Descriptive Statistics, Probability Distributions).
2	**Familiarity with Programming** (Preferably in Python or R, as they are commonly used for data analytics tasks).

Unit	Content	Hrs	Marks
1	Introduction to Data Analytics • Overview of Data Analytics and its Applications in Industry • Types of Data: Structured, Unstructured, Semi-structured • Data Analytics Process: Data Collection, Cleaning, Processing, and Analysis • Data Lifecycle and Role of Data Analysts	**6**	
2	Data Preprocessing and Statistical Analysis • Handling Missing Data, Outliers, and Data Normalization • Descriptive and Inferential Statistics: Mean, Median, Mode, Variance, Standard Deviation	**6**	

	• Probability Distributions and Hypothesis Testing • Correlation and Regression Analysis		
3	Data Visualization Techniques • Introduction to Data Visualization and Importance • Tools and Libraries: Matplotlib, Seaborn, Tableau, Power BI • Creating Line Charts, Bar Charts, Histograms, and Scatter Plots • Interactive Dashboards and Storytelling with Data	**8**	
4	Machine Learning for Data Analytics • Introduction to Supervised and Unsupervised Learning • Regression Models (Linear, Logistic), Decision Trees, and Random Forests • Clustering (K-Means, Hierarchical Clustering) • Performance Evaluation Metrics (Precision, Recall, F1-Score)	**6**	
5	Big Data Analytics and Technologies • Introduction to Big Data: Characteristics and Challenges • Hadoop Ecosystem: HDFS, MapReduce, YARN • Apache Spark: Architecture, RDDs, and DataFrames • NoSQL Databases for Data Analytics (MongoDB, Cassandra)	**8**	
6	Real-World Applications and Case Studies • Business Intelligence and Decision Making • Sentiment Analysis and Social Media Analytics	**4**	

Textbooks:

1. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking," Foster Provost, Tom Fawcett, O'Reilly Media
2. Python for Data Analysis," Wes McKinney, O'Reilly Media"
3. Data Analytics: Models and Algorithms for Intelligent Data Analysis," Thomas A. Runkler, Springer"

Reference Books

1. Introduction to Data Science: A Python Approach to Concepts, Techniques, and Applications," Rafael A. Irizarry, CRC Press.
2. Data Mining: Concepts and Techniques," Jiawei Han, Micheline Kamber, Jian Pei, Elsevier.

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. Understand the fundamental concepts of data analytics, types of data, and its significance in modern industries
2. Apply statistical methods and data preprocessing techniques to clean and analyze raw data.
3. Develop skills in data visualization using libraries such as Matplotlib and Seaborn for effective data representation
4. Implement machine learning algorithms for predictive analytics and data-driven decision-making
5. Evaluate big data technologies, frameworks (Hadoop, Spark), and their application in large-scale data processing.
6. Design and implement real-world data analytics projects for business intelligence and scientific research.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Product Life Cycle Management**

Course Code: OE-ECS 701C	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	Understand the fundamental concepts and evolution of Product Lifecycle Management (PLM) and its benefits for modern industries.
2.	Examine the phases of the product lifecycle, including concept development, manufacturing, service, and end-of-life disposal, along with the role of PLM tools and techniques in managing these phases effectively.
3.	Explore the architecture and core functionalities of PLM systems, focusing on the integration with ERP and MES systems, and understand implementation strategies and associated challenges.
4.	Assess PLM strategies and engineering tools, such as PDM, version control, change management, and the integration of IoT, AI, and ML in the product development lifecycle.
5	Analyze the role of digital technologies**,** such as digital twins, simulation, additive manufacturing, and AR/VR, in transforming product design and development processes in the context of PLM.
6	Evaluate PLM software solutions available in the industry, including the criteria for selecting PLM software, and understand the future trends in PLM, such as AI, Blockchain, and Cloud platforms.
Pre-Requisite:	
1.	Basic knowledge of Product Development and Manufacturing Processes
2	Familiarity with ERP Systems and their role in business operations

Unit	**Content**	**Hrs**	**Marks**
1	**Introduction to Product Lifecycle Management (PLM)** – Definition, Need & Benefits of PLM, Evolution of PLM, Key Challenges in PLM Implementation, PLM vs. PDM (Product Data Management), PLM Trends in Various Industries (Automotive, Aerospace, Electronics, Healthcare, Consumer Goods).	**6**	
2	**Phases of Product Lifecycle** – Concept Development, Detailed Design, Manufacturing, Production, Service, End-of-Life Disposal; Impact of Lifecycle Management on Cost and Time-to-Market; Industry Case Studies on Product Lifecycle Phases; Role of Digital Twins and Digital Thread in PLM.	**7**	

3	**PLM Architecture and Components** – Introduction to PLM Framework, Core Functionalities, Business Process Mapping, Key Components (BOM Management, Change Management, Workflow Automation), Enterprise Integration of PLM with ERP and MES, PLM System Implementation Strategies and Challenges.	**7**	
4	**PLM Strategies and Engineering Tools** – Product Data Management (PDM), Version Control & Configuration Management, Change Management, Engineering Workflow Automation, Document & CAD Data Management, Role of IoT, AI, and ML in PLM, Introduction to Model-Based Systems Engineering (MBSE).	**8**	
5	**Digital Manufacturing and PLM** – Role of Digital Twins and Simulation in PLM, Virtual Prototyping, Additive Manufacturing (3D Printing) in PLM, Smart Factories & Industry 4.0, Collaborative Engineering in PLM, Augmented Reality (AR) & Virtual Reality (VR) in Product Design and Development	**7**	
6	**PLM Software and Solutions** – Overview of PLM Software (Siemens Teamcenter, PTC Windchill, Dassault Systèmes Enovia, SAP PLM), Selection Criteria for PLM Software, Comparison of PLM Solutions, Cloud-Based PLM Platforms, Open-Source PLM Systems, Future of PLM Software Integration with AI & Blockchain.	**8**	
7	**Sustainability and Future Trends in PLM** – Sustainable Product Design, Eco-Friendly Manufacturing, Lifecycle Assessment (LCA), Circular Economy & PLM, Digital Transformation in PLM, Globalization Challenges, Trends Shaping the Future of PLM (AI-Driven Automation, Blockchain in PLM, Big Data in PLM).	**7**	

Textbooks:

1. Product Lifecycle Management: 21st Century Paradigm for Product Realisation," John Stark, Springer"
2. Product Lifecycle Management: Driving the Next Generation of Lean Thinking," Michael Grieves, McGraw-Hill Education"

Reference Books

1. Introduction to Product Lifecycle Management," Mahesh R. Soni, Wiley India"
2. Product Lifecycle Management: A Guide to New Product Development," Rainer Stark, Thomas O. B. Lehtinen, Springer"
3. Product Lifecycle Management (PLM): A Case Study Approach," M. A. S. Kamrani, Elsayed A. Elsayed, Springer"
4. PLM in Practice: 21st Century Paradigm for Product Realisation," David A. Meeker, Wiley"

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. Explain the fundamental concepts, need, and benefits of Product Lifecycle Management (PLM) in modern industries.
2. Describe and analyze the phases of the product lifecycle and their impact on engineering and business processes.
3. Apply PLM strategies, tools, and software solutions to optimize product development, manufacturing, and lifecycle management
4. Evaluate different PLM architectures, frameworks, and software tools used in enterprise-wide implementations.
5. Develop PLM strategies integrating sustainability, digital transformation, and global market trends to enhance competitive advantage.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**E-Commerce**

Course Code: OE-ECS 702A	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	**Introduce the fundamentals of E-Commerce**, including its models, strategies, technologies, and security concerns.
2.	**Familiarize students with the legal and regulatory environment** of E-Commerce, including cyber laws and digital payment regulations.
3.	**Explore the technologies that enable E-Commerce**, such as networking, EDI, mobile commerce, and web security frameworks.
4.	**Understand the structure and functioning of ERP systems**, their modules, implementation challenges, and real-world applications.
5	**Enable students to integrate E-Commerce and ERP concepts** with modern business practices such as supply chain management, e-marketing, and business process reengineering.
6	**Prepare students for digital transformation and enterprise system integration**, equipping them with knowledge of the ERP market and future trends.
Pre-Requisite:	
1.	Basic understanding of Information Technology and Computer Fundamentals
2	Familiarity with **Database Management Systems (DBMS)** and **Business Processes**
3	Interest in business operations, management systems, and digital platforms
4	Introductory knowledge of Networking and Internet Technologies

Unit	Content	Hrs	Marks
1	Overview, Definitions, Advantages & Disadvantages of E – Commerce, Threats of E – Commerce, Managerial Prospective, Rules & Regulations for Controlling E – Commerce, Cyber Laws	**3**	
2	Technologies: Relationship Between E – Commerce & Networking, Different Types of Networking Commerce, Internet, Intranet & Extranet, EDI Systems Wireless Application Protocol: Definition, Hand Held Devices, Mobility & Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement for E – Commerce	**5**	
3	Business Models of e –commerce: Model Based on Transaction Type, Model Based on Transaction Party - B2B, B2C, C2B, C2C, E – Governance	**2**	

4	E – strategy: Overview, Strategic Methods for developing E – commerce	**2**	
5	Four C's: (Convergence, Collaborative Computing, Content Management & Call Center). Convergence: Technological Advances in Convergence – Types, Convergence and its implications, Convergence & Electronic Commerce. Collaborative Computing: Collaborative product development, contract as per CAD, Simultaneous Collaboration, Security. Content Management: Definition of content, Authoring Tools & Content Management, Content – partnership, repositories, convergence, providers, Web Traffic & Traffic Management; Content Marketing. Call Center: Definition, Need, Tasks Handled, Mode of Operation, Equipment, Strength & Weaknesses of Call Center, Customer Premises Equipment (CPE).	**6**	
6	Supply Chain Management: E – logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, Internet's effect on Supply Chain Power.	**3**	
7	E – Payment Mechanism: Payment through card system, E – Cheque, E – Cash, E – Payment Threats & Protections	**1**	
8	E – Marketing:. Home –shopping, E-Marketing, Tele-marketing	**1**	
9	Electronic Data Interchange (EDI): Meaning, Benefits, Concepts, Application, EDI Model, Protocols (UN EDI FACT / GTDI, ANSI X – 12), Data Encryption (DES / RSA).	**2**	
10	Risk of E – Commerce: Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.	**4**	
11	Software, re-engineering work processes for IT applications, Business Process Redesign, Knowledge engineering and data warehouse. Business Modules: Finance, Manufacturing (Production), Human Resources, Plant Maintenance, Materials Management, Quality Management, Sales & Distribution ERP Package, ERP Market: ERP Market Place, SAP AG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation ERP-Present and Future: Enterprise Application Integration (EAI), ERP and E-Commerce, ERP and Internet, Future Directions in ERP	**10**	

Textbooks:

1. E-Commerce: Fundamentals and Applications," Henry Chan, Raymond Lee, Tharam Dillon, Elizabeth Chang, Wiley"
2. ERP Demystified," Alexis Leon, Tata McGraw-Hill"

Reference Books

1. E-Commerce: Strategy, Technologies and Applications," David Whiteley, McGraw-Hill Education"
2. E-Business and E-Commerce Management," Dave Chaffey, Pearson Education.

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. Describe the fundamentals, advantages, limitations, and legal aspects of E-Commerce, including cyber laws, threats, and managerial perspectives.
2. Explain the technologies and infrastructure supporting E-Commerce, including internet, intranet, extranet, EDI systems, wireless applications, mobile commerce, and web security.
3. Analyze various E-Commerce business models and strategies, including B2B, B2C, C2B, C2C, E-Governance, and the Four C's framework (Convergence, Collaborative Computing, Content Management, Call Centers).
4. Evaluate E-Commerce applications in Supply Chain Management and E-Payment systems, including e-logistics, SCP & SCE tools, and digital payment mechanisms with their associated threats and protections.
5. Apply security techniques and standards in E-Commerce, such as cryptography, firewalls, digital certificates, key management, and risk assessment for secure online transactions.
6. Demonstrate understanding of ERP systems and modules, including business process reengineering, enterprise application integration, ERP vendors (SAP, Oracle, etc.), and the future direction of ERP in the digital era.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**ENERGY STORAGE SYSTEM**

Course Code: **OE-ECS 702B**	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand the different energy storage technologies and its applications to Electric Vehicle and Micro Grid.
Pre-Requisite:	
1.	Basic concepts of Power System

Unit	Content	Hrs	Marks
1	Introduction to energy storage for power systems: Applications of energy storage systems, Components of Energy Storage Systems, Types of storage technologies: Thermal, Mechanical, Chemical, Electrochemical, Electrical. Efficiency of energy storage systems. Overview on Electrical energy storage: Batteries, Super capacitors, Superconducting Magnetic Energy Storage (SMES).	**12**	
2	**Energy storage systems-** configurations and applications. Charge and discharge mechanism of Batteries, Comparison of storage systems - Energy density, power density Storage for renewable energy Integration: Solar energy, Wind energy, Electric vehicle. Energy storage in Microgrid and Smart grid.,	**13**	
3	Management of storage systems, Battery Management Systems, Management of Hybrid Energy Storage Systems (HESS), Increase of energy conversion efficiencies by introducing energy storage, Storage technology for energy management, Economics of Energy storage.	**14**	

Textbooks:

1. A.G. Ter-Gazarian, “Energy Storage for Power Systems”, 2nd Edition, The Institution of Engineering and Technology (IET) Publication, UK, 2011. (ISBN - 978-1-84919-219-4),
2. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt, “Energy Storage in Power Systems” Wiley Publication, Mar 2016. ISBN: 978-1-118-97130-7,
3. A. R. Pendse, “Energy Storage Science and Technology”, SBS Publishers & Distributors Pvt. Ltd., New Delhi, 2011. (ISBN - 13:9789380090122),
4. Electric Power Research Institute (USA), “Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits” (1020676), December 2010.

Reference Books:

1. Paul Denholm, Erik Ela, Brendan Kirby and Michael Milligan, "The Role of Energy Storage with Renewable Electricity Generation", National Renewable Energy Laboratory (NREL) - A National Laboratory of the U.S. Department of Energy - Technical Report NREL/ TP6A2-47187, January 2010.

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. Explain the role and applications of energy storage systems in power systems, including their components and the classification of various storage technologies.
2. Describe the working principles, charge-discharge mechanisms, and efficiencies of different electrical energy storage systems such as batteries, supercapacitors, and SMES.
3. Compare different energy storage technologies based on key parameters such as energy density, power density, and suitability for various applications.
4. Analyze the integration of energy storage systems with renewable energy sources like solar and wind, and evaluate their role in electric vehicles, microgrids, and smart grids.
5. Explain the design and operation of Battery Management Systems (BMS) and Hybrid Energy Storage Systems (HESS**)** for safe and efficient energy storage operation.
6. Assess the economic and energy efficiency impacts of incorporating storage technologies in power systems, and evaluate their role in energy management and system optimization.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**CYBER SECURITY**
Course Code: **OE-ECS 702C**	Semester: 7th

Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam:
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To develop an understanding of modern network architectures from a design and performance perspective.
2.	To understand the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3.	To provide an opportunity to do network programming
4.	To provide WLAN measurement ideas.
Pre-Requisite:	
1.	Linear Algebra, Theory of Computation

Unit	Content	Hrs	Marks
1	**Introduction**: Introduction to Cyber Security, Importance and challenges in Cyber Security, Cyberspace, Cyber threats, Cyberwarfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cybersecurity – Organizational Implications.	**6**	
2	**Hackers and Cyber Crimes:** Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Worms, Trojans, Viruses, Backdoors.	**7**	
3	**Ethical Hacking and Social Engineering:** Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modelling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing, Types of Social Engineering, Insider Attack, Preventing Insider Threats, Social Engineering Targets and Defence Strategies.	**8**	
4	**Cyber Forensics and Auditing:** Introduction to Cyber Forensics, Computer Equipment and associated storage media, Role of forensics Investigator, Forensics Investigation Process, Collecting Network based Evidence, Writing Computer Forensics Reports, Auditing, Plan an audit against a set of audit criteria, Information Security Management System Management. Introduction to ISO 27001:2013	**10**	
5	**Cyber Ethics and Laws**: Introduction to Cyber Laws, E-Commerce and E-	**5**	

	Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000, Intellectual Property Rights in Cyberspace. at Network Layer-IPSec		

Text book and Reference books:

1. Cyber security , Nina Gobole & Sunit Belapune; Pub: Wiley India.
2. Information Security and Cyber Laws, Pankaj Agarwal
3. Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., Enterprise Cybersecurity -How to Build a Successful Cyberdefense Program Against Advanced Threats, A-press
4. Nina Godbole, SumitBelapure, Cyber Security, Willey
5. Hacking the Hacker, Roger Grimes, Wiley
6. Cyber Law By Bare Act, Govt Of india, It Act 2000.
7. Information Security & Cyber Laws, Gupta & Gupta, Khanna Publishing House, (AICTE Recommended Textbook- 2018)

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. Explain the fundamentals of cyber security including its importance, challenges, key concepts like the CIA Triad, and its implications for critical infrastructure and organizations.
2. Identify various types of hackers and cyber threats including malware, sniffing, privilege escalation, and other techniques used to perform and conceal cyber-attacks.
3. Demonstrate understanding of ethical hacking and social engineering by analyzing attack vectors, threat modeling, and security frameworks used for organizational protection.
4. Apply cyber forensics techniques to investigate digital incidents, collect and analyze evidence, and generate forensic reports in compliance with auditing standards.
5. Interpret the legal aspects of cyber security, including cyber laws, e-commerce governance, IT Act 2000 offenses, and intellectual property rights in cyberspace.
6. Evaluate the importance of security management systems such as ISMS and ISO 27001:2013, and outline the process of planning and conducting information security audits.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**PRINCIPLE OF MANAGEMENT**
Course Code: **HM 701**	Semester: 7th

Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand basic concept and approaches to management
2.	To understand planning and decision making processes. .
3.	To understand organizational design and structure.
4.	To understand various aspects of leadership.
Pre-Requisite:	
1.	English (HM- HU 201)

Unit	Content	Hrs	Marks
1	**Concept & approaches to management:** Meaning & Definition of the term Management, Management as a Science or an Art, Management as a Profession, Management as a Process, Difference between Management & Administration; Levels of Management, Roles of a Manager, Quality of a good Manager, Significance of Management, Limitations of Management, Business Environment and its interaction with Management. Approaches to Management – Classical, Neo-classical and Modern Contributors to Management Thought – Taylor and Scientific Theory, Fayol's and Administrative Theory, Peter Drucker and Management Thought. Various Approaches to Management (i.e. Schools of Management Thought) Indian Management Thought.	**8**	
2	**Planning & decision making:** Planning: Meaning, Definition, Process, Types, Principles, Significance & Limitations of Planning; Strategic Planning – Meaning & Process, MBO – Meaning, Process and Requirements for Implementation, Planning Premises – Meaning & Types, Forecasting – Meaning & Techniques. Decision Making – Meaning, Types, Process, Significance & Limitations	**8**	
3	**Organization design & Structure:** Organization – Meaning, Process, Principles, Organization Structure – Determinants and Forms: Line, Functional, Line & Staff, Project, Matrix and Committees; Formal and Informal Organization; Departmentation – Meaning and Bases; Span of Control – Meaning and Factors Influencing; Authority, Responsibility and Accountability; Delegation – Meaning, Process; Principles; Centralization and Decentralization – Meaning; Degree ofDecentralization; Difference between Delegation and Decentralization.	**8**	
4	**Directing:** Motivation – Meaning , Definition, Significance &Limitations; Financial and non-financial incentives of Motivation Leadership - Meaning, Definition, Significance of Leadership,Leadership styles Type, Process	**8**	

	and Barriers of Communication, Strategies to overcome the Barriers		
5	**Customer Management** – Market Planning & Research, MarketingMix, Advertising & Brand Management. **Operations & Technology Management** – Production & Operations Management, Logistics & Supply Chain Management,TQM, Kaizen & Six Sigma, MIS.	**8**	

Text books:

1. Essentials of Management. H. Koontz and H. Weihrich, 7th Edition, Tata McGraw Hill
2. Principles of Management, Premvir Kapoor, Khanna Publishing House, 2019
3. Principles of Management - Text and Cases, Dipak Kumar Bhattacharyya. Pearson EducationIndia, 2011.

Reference books:

1. Management-Text & Cases, V.S.P Rao & Hari V. Krishna, Excel Books, 2005
2. Principles of Management, T. Ramaswami, Himalaya Publishing House, 2014
3. Management of Technology and Operations, R. Ray Gehani, Wiley, 1998

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Describe the fundamental concepts and approaches to management**, including classical, neo-classical, modern, and Indian management thoughts, and distinguish between management and administration.
2. **Apply planning and decision-making processes**, including strategic planning, MBO, forecasting techniques, and planning premises, to solve business problems.
3. **Analyze and design organizational structures**, evaluating the principles of organization, types of structures, span of control, authority-responsibility relationships, delegation, and decentralization.
4. **Demonstrate understanding of directing functions** through the application of motivation techniques, leadership styles, and effective communication strategies to manage organizational dynamics.
5. **Evaluate customer management strategies**, including market research, marketing mix, advertising, and brand management, for effective marketing decision-making.
6. **Examine operations and technology management practices**, such as logistics, supply chain management, TQM, Kaizen, Six Sigma, and MIS, for improving organizational efficiency and quality.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**INTERNET OF THINGS LABORATORY**
Course Code**: PC-ECS 791**	Semester: 7th

Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: Nil	Continuous Internal Assessment:40
Tutorial: Nil	External Assessment: 60
Practical: 2 hrs/week	
Credit Points: 1	

	Laboratory Experiments:
1	Familiarization with Python and writing programs in PyCharm IDE using Anaconda Framework
2	Program to implement Paho MQTT client in Python.
3	Program simple web server in Python using Flask framework.
4	Familiarization with Arduino IDE and writing a program using Arduino IDE for LED blinking
5	Study of LM35/DHT-11 temperature sensors and write programs to monitor them with Arduino with Thing Speak
6	Setup Raspbian on the Raspberry Pi and write a program to blink an LED using Python
7	Interfacing digital sensors and relay boards with Raspberry Pi
8	Familiarization with Python and writing programs in PyCharm IDE using Anaconda Framework.

Course Outcome:

After completion of this course, the learners will be able to

1. **Develop and execute basic Python programs using PyCharm IDE integrated with the Anaconda framework** for data handling and analysis in IoT applications.
2. **Design and implement IoT communication using the MQTT protocol** by developing publisher and subscriber clients using the Paho MQTT library in Python
3. **Build and deploy a simple web server using the Flask framework** to display or manage IoT sensor data through a web interface.
4. **Demonstrate proficiency in using the Arduino IDE** by writing, uploading, and testing a basic LED blinking program.
5. **Interface temperature sensors (LM35/DHT-11) with Arduino** and **upload sensor data to a cloud platform (ThingSpeak)** using Wi-Fi-enabled modules.
6. **Set up and configure Raspberry Pi with Raspbian OS** and **write Python scripts to control GPIO devices**, such as blinking an LED.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.