B.Tech.

in

Information Technology

Third Year [TE] ILO Syllabus

Academic Year 2020-21

Department of Electronics and Telecommunication Engineering

Ramrao Adik Institute of Technology

Syllabus

for

Third Year Engineering

Institute Level Optional Subjects [ILO]

Semester V &VI

Department Level Elective I (Sem V)	
Subject Name	**Subject Code**
Computer Communication Networks	ETCDLO5011
Advanced Microcontrollers	ETCDLO5012
Database Management System	ETCDLO5013
Digital & IPTV	ETCDLO5014

Department Level Elective II (Sem V)	
Subject Name	**Subject Code**
Network Protocols & Routing Algorithms	ETCDLO5021
Microelectronics	ETCDLO5022
Image & Video Processing	ETCDLO5023
Broadband Network	ETCDLO5024

Institute Level Open Elective Technical I	
Subject Name	**Subject Code**
Signal Processing and Applications	ILOT5011
Biomedical Signal and Image Processing	ILOT5012
Theory of Automata and Formal Languages	ILOT5013
Mechatronics	ILOT5014
AI for Business Applications	ILOT5015

Institute Level Open Elective Non-Technical I	
Subject Name	**Subject Code**
Project Management	ILON5011
Research Methodology	ILON5012
IPR and Patenting	ILON5013
Entrepreneurship Development & Management	ILON5014
Product Lifecycle Management	ILON5015

Institute Level Open Elective Technical II	
Subject Name	**Subject Code**
Mobile Emerging Technologies and Smart Devices	ILOT6021
Renewable and Distributed Energy Systems	ILOT6022
Industrial Automation	ILOT6023
Wireless Networking	ILOT6024
Online Awareness and Security	ILOT6025

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT5011	Signal Processing & Applications	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT5011	Signal Processing & Applications	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. Engineering Mathematics

Course Objectives

The aim of this course is to provide in-depth treatment on methods and techniques in

1. Introduction to discrete signals and time domain analysis of signals
2. Frequency domain analysis of signals

3. Applications of Signal Processing to real world problems

Course Outcomes After successful completion of the course student will be able to …

1. To understand the sampling theorem and reconstruction of the signals. Aliasing effect in sampling theorem.
2. To analyze the signals in time domain.
3. To understand concept of correlation and convolution.
4. To analyze the signals in time domain.
5. To analyze the concept of FIR and IIR digital filters.
6. To apply appropriate signal processing tools for different applications.

Module	Detailed Content	Hours
1	**Discrete Signals:** Basics of discrete signals, Operations on discrete signals, standard elementary signals, sampling theorem, signal reconstruction and aliasing.	**6**
2	**Time domain analysis:** Discrete time systems, Time invariance, causality and memory, Impulse response. System representation in various forms, Application oriented examples.	**6**
3	**Discrete convolution and correlation:** Analytical evaluation of discrete convolution, convolution of finite sequences, Stability and causality, system response to periodic inputs, discrete correlation.	**8**
4	**Frequency domain analysis:** Introduction, Fourier Series: Representation of Periodic Signals, Fourier Transform: Representation of Nonperiodic Signals, Discrete Fourier Transform, Short-Time Fourier Transform, Fast Fourier Transform (FFT), DIT-FFT, Discrete Cosine Transform (DCT), Applications of the Fourier Transform.	**8**
5	**Digital Filters:** Introduction to digital filters, IIR filters, IIR filter design, linear phase FIR filters, FIR filter design, and problems on filter design.	**6**
6	**Applications of digital signals:** Audio Equalizer, digital audio effect, removal of artefacts from ECG and EEG signals using filters.	**5**

	Total	**39**

Evaluation Scheme:

1. **In-Semester Assessment:**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Ashok Amberdar, “Digital signal processing: a modern Introduction, cengage learning.
2. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing, A Practical Approach”, Pearson Education.
3. Alan V. Oppenheim, Ronald Schafer, “Discrete Time signal Processing”, Pearson Education.

Reference Books:

1. J. Proakis, D. G. Manolakis, D. Sharma, “Digital Signal Processing, Principles, algorithms and applications”, Pearson Education.
2. , Rafeal C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing using Matlab”, Pearson Education.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT5012	Biomedical Signal and Image Processing	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT5012	Biomedical Signal and Image Processing	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. Signals and Systems

Course Objectives

The aim of this course is to provide in-depth treatment on methods and techniques in

1. To understand the fundamentals of Biomedical Signal and Image Processing.
2. To explore different types of filters to remove artifacts from biomedical signals.
3. To introduce the latest imaging modalities.
4. To study biomedical image processing techniques.

Course Outcomes After successful completion of the course student will be able to …

1. Have basic knowledge about the various bioelectric potentials.
2. Apply digital filters to remove noise from biomedical signals.
3. Implementation of various methods to analyze biosignals.
4. Apply the concept of image processing.
5. Have knowledge of imaging modalities such as X-ray, CT, MRI and Ultrasound.
6. Understand the biomedical image processing concepts for real time applications.

Module	Detailed Content	Hours
1	**Bio-Potential measurements: Human Cell:** Structure of Cell, Origin of Bio-potentials (ECG, EEG, EMG), Generation of Action Potentials	04
2	**Filtering for Removal of artifacts:** Digital filters - IIR and FIR - Notch filters, Filters to remove noise from electrocardiogram (ECG) signals and Electroencephalogram (EEG) signals	07
3	**Biomedical signal Analysis:** Derivative based Approach for QRS Detection: Pan Tompkins Algorithm, Analysis of EEG Signal.	06
4	**Introduction to Digital Image Processing:** Introduction – Origin – Steps in Digital Image Processing – Components, Methods of Image enhancement: Spatial Domain and frequency domain, Segmentation	08
5	**Biomedical Imaging:** Introduction to Xray, CT scan, MRI, Ultrasonic Imaging, Molecular Imaging, SPECT and PET, Texture in Medical Images,	08

6	**Applications:** A survey of different applications of medical image processing, Role of Artificial Intelligence and Machine Learning in biomedical signal and image processing.	**06**
	Total	**39**

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   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son's publication, 2001.
3. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
4. Handbook of Biomedical Instrumentation: R S. Khandpur. (PH Pub)
5. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)

Reference Books:

1. Paul Suetens, *"*Fundamentals of Medical Imaging*"*, 2017, 3rd edition, Cambridge University Press, Cambridge, New York.
2. D C Reddy, *"*Biomedical Signal Processing*"*, McGraw Hill, 2005.
3. Katarzyn J. Blinowska, Jaroslaw Zygierewicz, *"*Practical Biomedical Signal Analysis Using MATLAB*"*, 1st Edition, CRC Press, 2011.
4. Pianykh, Oleg S., Digital Imaging and Communications in Medicine *(*DICOM*)*, A Practical Introduction and Survival Guide, Springer
5. Branstetter IV, Barton F., Practical Imaging Informatics Foundations and Applications for Medical Imaging, Springer

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT5013	Theory of Automata and Formal Languages	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT5013	Theory of Automata and Formal Languages	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. Engineering Mathematics

Course Objectives

The aim of this course is to provide in-depth treatment on methods and techniques in

1. To explore the formal languages and classify machines by their power to recognize languages
2. To focus on the study of abstract models of computation.
3. To understand computability theory as well as the complexity theory.
4. To develop the ability to form abstract computing models.

5. To solve complex problems in science and engineering through computing.
6. To design computation models and understand their properties.

Course Outcomes After successful completion of the course student will be able to …

1. Design deterministic and non-deterministic finite Automata for given problem.
2. Design regular expressions representing or generating a certain language
3. Simplify automata and context-free grammars
4. Design push down automata for given complex CFL.
5. Design Turing machine as acceptor and verifier for mathematical computations.
6. Understand the concept decidability.

Module	Detailed Content	Hours
1	**Finite Automata:** Alphabets, strings, languages, Deterministic finite automata, non-deterministic finite automata, finite automata with epsilon transitions, DFA minimization, finite automata with output: Mealy and Moore machines	**10**
2	**Regular Expressions and Regular Grammar:** Regular expressions, DFA to regular expressions, regular expressions to finite automata, Regular Grammar, Right linear grammar, left linear grammar, interconversion.	**6**
3	**Context-Free Grammars and Languages:** CFGs, Properties of Context-Free Languages derivation trees(parse tree), Ambiguous grammar, simplification, Chomsky normal forms, Greibach normal forms	**6**
4	**Pushdown Automata:** Formal Definition, designing PDA's, acceptance by empty stack, acceptance by final state relationship between PDA and context free languages	**6**
5	**Turing Machine:** Turing Machines: The Turing machine model, computable languages and functions, techniques for Turing machine construction, modification of Turing machines, Universal Turing Machine	**6**

6	**Un-decidability:** Properties of recursive and recursively enumerable languages, universal Turing machines, post correspondence problem Chomsky Hierarchy: regular grammars	**5**
	Total	**39**

Evaluation Scheme:

1. **In-Semester Assessment:**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Introduction to Automata Theory, Languages and Computation, Hopcroft, Motwani, and Ullman, Pearson Publishers, Third Edition, 2006
2. P. Linz, Introduction to Formal Language and Computation, Narosa , 2nd Ed, 2006.

Reference Books:

1. Automata and Computability, Dexter C. Kozen, Springer Publishers, 2007.
2. Mishra & Chandrasekharan, Theory of computer science: Automata language and computation, Prentice Hall of India , 3rd Ed, 2007.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT5014	Mechatronics	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT5014	Mechatronics	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. None

Course Objectives

The aim of this course is to provide in-depth treatment on methods and techniques in

1. To learn the architecture of the mechatronics system design

2. To introduce broad spectrum characteristics of the mechanical
3. and electrical actuators and their selection for mechatronic systems.
4. To familiarize development of process plan and templates for design of mechatronic systems.

Course Outcomes After successful completion of the course student will be able to …

1. Develop the mechatronic system.
2. Analyze the concept of system modeling.
3. Identify the suitable sensor and actuator for a mchatronic system.
4. Design feedback and intelligent controllers.
5. Implement mechatronic system validation.
6. Integrate the components in mchatronics system.

Module	Detailed Content	Hours
1	**Introduction to mechatronics systems:** Definition and evolution levels of mechatronics, integrated design issues in mechatronics, key elements of mechatronics, mechatronics design process- modeling and simulation, prototyping, deployment /life cycle, advanced approaches in mechatronics.	**06**
2	**Modeling and Simulation of physical systems:** Simulation and block diagrams, Analogies and impedance diagrams, electrical system-bridge circuit system, transformer, mechanical translational and rotational systems-sliding block with friction, elevator cable system, mass-damper system, automobile suspension system, mechanical lever system, geared elevator system, electromechanical coupling- DC motor, fluid systems-three tank liquid system, hydraulic actuator and hydraulic pressure regulator.	**09**
3	**Hardware components:** Sensors: motion and position measurement, force, torque and tactile sensors, ultrasonic and range sensors, fiber optic sensors, micro sensors. Actuators: Pneumatic and hydraulic-directional and pressure control valves, cylinders, servo proportional control valves, rotary actuators,	**09**

	Electrical actuation: A.C and DC motors, stepper motors, mechanical switches and solid state switches. Mechanical Actuation: types of motion, kinematic chain, cams, gears, ratchets and pawl, belt and chain drives, bearings, mechanical aspects of motor selection, piezoelectric actuators, magnetostrictive actuators, memory metal actuators, Programmable Logic Controller	
4	**Intelligent control:** Automatic control methods, Artificial Neural Network(ANN) – Modeling, basic model of neuron, characteristics of ANN, perceptron, learning algorithms, fuzzy logic – propositional logic, membership function, fuzzy logic and fuzzy rule generation, defuzzification, time dependent and temporal fuzzy logic.	**07**
5	**Components based modular design and system validation:** Components based modular design view, system validation, validation methodology- integrated and design dependence, distributed local level, validation schemes, fusion technique	**04**
6	**Integration:** Advanced actuators, consumer mechatronic products, hydraulic fingers, surgical equipment, industrial robot, autonomous guided vehicle, drilling machine	**04**
	Total	**39**

Evaluation Scheme:

1. **<u>In-Semester Assessment:</u>**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **<u>End-Semester Examination:</u>**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Devdas Shetty and Richard Kolk, “Mechatronics System Design”, Thomson Learning, 2nd reprint, 2010.
2. W. Bolton, “Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering”, Pearson Education Ltd, 6th edition, 2018.
3. Nitaigour Mahalik, “Mechatronics- Principles, Concepts and Applications”, Tata McGraw Hill, 2004.

Reference Books:

1. Stamatios V. Kartalopoulos, “Understanding Neural Networks and fuzzy Logic”, PHI,3rd reprint, 2013.
2. Zhijun Li, Shuzhi Sam Ge, “Fundamentals in Modeling and Control of Mobile Manipulators", March 30, 2017, by CRC Press.
3. Sergey Edward Lyshevski, “Mechatronics and Control of Electromechanical Systems", May 30, 2017, by CRC Press.
4. Bodgan Wilamowski, J. David Irwin, “Control and Mechatronics", October 12, 2017, by CRC Press.
5. Takashi Yamaguchi, Mitsuo Hirata, Justin Chee Khiang Pang, "High-Speed Precision Motion Control", March 29, 2017, by CRC Press.
6. David Allan Bradley, Derek Seward, David Dawson, Stuart Burge, “Mechatronics and the Design of Intelligent Machines and Systems", November 17, 2000, by CRC Press.
7. Clarence W. de Silva, Farbod Khoshnoud, Maoqing Li, Saman K. Halgamuge, “Mechatronics: Fundamentals and Applications", December 12, 2018, by CRC Press.
8. Clarence W. de Silva, “Mechatronics: A Foundation Course", June 4, 2010 by CRC Press.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT5015	AI for Business Applications	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT5015	AI for Business Applications	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. None

Course Objectives

The aim of this course is to provide in-depth treatment on methods and techniques in

1. To understand the carious AI technologies and analyse their role in business applications.
2. To understand the Cognitive AI, analyse various strategies and their role in business applications

3. To understand and analyse the AI technology impact on companies, business processes, jobs, success and failure, disruption and future.

Course Outcomes After successful completion of the course student will be able to …

1. To select right AI technologies, analyse their role and apply them to business applications.
2. To analyse Cognitive AI and apply various strategies to business applications.
3. To analyse the AI technology impact on companies' performance.
4. To analyse AI Tasks, Organizational Structures, and Business Processes
5. To analyse the impact of AI on Jobs and Skills in a World of Smart Machines and will be able to use technology intelligently.
6. To understand the implications of AI on Organization, Society and Ethics. Also, able to judge the AI's Success and Failure, Disruption and its Future.

Module	Detailed Content	Hours
1	**Introduction to AI** Introduction, Machine Learning, Neural Networks, Deep Learning, Natural Language Processing (NLP), Rule-Based Expert Systems, Recommendation Engines, Employing AI in Business	7
2	**Cognitive AI** Cognitive technologies, working, key attributes, Technical Approaches to Cognitive Technologies, Cognitive AI: Usecase, Applications, Enterprise Strategy, Economy Strategy.	7
3	**AI for Companies** AI in the Vendor Community, AI in the Enterprise, AI capabilities, Engaging in Cognitive Work Redesign, Cognitive strategies- Customer-Focused Strategies, Making Better Internal Decisions, Developing New or Enhanced Product/Service Offerings, AI-Driven Business Models.	7
4	**AI Tasks, Organizational Structures, and Business Processes**	7

	Prediction and Classification Models, Perform Structured Digital Tasks, Manipulate Information, Understand Human Speech and Text, Plan and Optimize Operations, Perceive and Recognize Images, Assess Human Emotions, The Need for Process Architecture.	
5	**Jobs and Skills in a World of Smart Machines** Large-Scale Automation, Large-Scale Augmentation, Moving Forward with Augmentation or Automation, Company and Job-Specific Skills Strategies,	**5**
6	**Implications of AI** Organizational, Social and Ethical implications, AI Success and Failure, Disruption, Future.	**6**
	Total	**39**

Evaluation Scheme:

1. **<u>In-Semester Assessment:</u>**
    a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
    b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **<u>End-Semester Examination:</u>**
    - Question paper will comprise of full syllabus.
    - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Thomas H. Davenport, “THE AI ADVANTAGE How to Put the Artificial Intelligence Revolution to Work”, The MIT Press, 2018.
2. Ajit K Jha, “Artificial Intelligence for Business Leaders”, Amazon Asia-Pacific Holdings Private Limited, 2020.
3. Rajendra Akerkar, “Artificial Intelligence for Business”, Springer Nature, 2019.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILON5011	Project Management	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILON5011	Project Management	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. None

Course Objectives

1. To familiarize the students with the use of a Project Management techniques and tools used in various industry sectors for achieving success in projects.
2. To understand and be able to apply processes and techniques throughout the life cycle of a project from initiation to closure.

Course Outcomes After successful completion of the course student will be able to …

1. Understand what are projects and what is the importance of management and the project manager.
2. Analyse and initiate projects based on numeric and non-numeric criteria. Design a project proposal and build project teams.
3. Analyze the effect of different organizational structures on the execution of projects. Perform Project estimation and budgeting. Understand role of project management office.
4. Perform project planning activities including risk planning, scheduling, team building and resource allocation.
5. Perform project control activities like monitoring & control, auditing, reporting, tracking, risk mitigation & control.
6. Perform proper closure of different types of projects. Apply the techniques learned in the course in the execution of real-life projects.

Module	Detailed Content	Hours
1	Project Management Fundamentals: Definition of a project, Necessity of project management, Triple constraints, Project life cycles, Project phases, Qualities of project manager, Role of project manager. Leadership and Ethics, Project management in various organization structures.	**06**
2	Project Initiation: How to get a project started? Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth, Conflicts and Negotiations.	**06**
3	Project Budgeting and Estimation: Project Plan, Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination, Project cost estimation and budgeting, Top down and bottoms up budgeting. Work element costing	**06**
4	Project Planning and Management: Project Scheduling, GANTT Chart, Networking and Scheduling techniques. PERT and CPM. Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Project procurement management. Change Management	**09**
5	Project Monitoring and Control: Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project	**06**

	meetings. Earned Value management techniques for measuring value of work completed. Using milestones for measurement change requests and scope creep. Project audits.	
6	Project Closure: Customer acceptance. Reasons of project termination, Various types of project terminations, Process of project termination. Completing a final report, doing a lessons learned analysis, acknowledging successes and failures. Project management templates and other resources. Case studies of successful and failed projects.	**06**
	Total	**39**

Evaluation Scheme:

1. **In-Semester Assessment:**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, WileyIndia, 10th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 6th ed., Project Management Institute PA, USA.

Reference Books:

1. Harold Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 12th Ed, Wiley

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILON5012	Research Methodology	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILON5012	Research Methodology	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. None

Course Objectives

1. To understand Research and Research Process

2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation
4. To understand and apply different techniques for formulating research problem

Course Outcomes After successful completion of the course student will be able to …

1. Understand basics of research concepts including objectives, issues and problems
2. Summarize and compare different types of research
3. Prepare a preliminary research design for projects in their subject matter areas
4. Accurately collect, analyze and report data
5. Present complex data or situations clearly
6. Review and analyze research findings

Module	Detailed Content	Hours
1	**Introduction and Basic Research Concepts** 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**09**
2	**Types of Research** 2.1. Basic Research 2.2. Applied Research 2.3. Descriptive Research 2.4. Analytical Research	**07**

	2.5. Empirical Research 2.6 Qualitative and Quantitative Approaches	
3	**Research Design and Sample Design** 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling 3.3 Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
4	**Research Methodology** 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: A. Identification and Selection of Research Problem B. Formulation of Research Problem C. Review of Literature D. Formulation of Hypothesis E. Formulation of research Design F. Sample Design G. Data Collection H. Data Analysis I. Hypothesis testing and Interpretation of Data J. Preparation of Research Report	**08**
5	**Formulating Research Problem** 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, 5.2 Analysis of data, Generalization and Interpretation of analysis	**04**
6	**Outcome of Research** 6.1 Preparation of the report on conclusion reached 6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation	**04**
	Total	**39**

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   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1990, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education
4. Best and Kahn, Research Methodology, PHI Limited.

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEssPublications. 2 volumes.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILON5013	IPR and Patenting	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILON5013	IPR and Patenting	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. None

Course Objectives

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications
4. To get familiarize with different patent databases

Course Outcomes After successful completion of the course student will be able to …

1. Understand Intellectual Property Rights and importance
2. Demonstrate enforcement of intellectual property rights
3. Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting
4. Inspect emerging issues in IPR
5. Assist individuals and organizations in capacity building
6. Understand national and international patent filing procedure

Module	Detailed Content	Hours
1	**1.1 Introduction to Intellectual Property Rights (IPR):** Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **1.2 Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development.	**06**
2	**2.1 Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **2.2 Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	**05**
3	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	**07**
4	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc.), Process Patent and Product Patent,	**07**

	Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rightsand infringement, Method of getting a patent	
5	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	**07**
6	**6.1 Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement **6.2 Patent databases:** Important websites, Searching international databases	**07**
	Total	**39**

Evaluation Scheme:

1. **In-Semester Assessment:**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India.
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge

University Press

5. Cornish, William Rodolph&Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell.

Reference Books:

1. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
2. PrabhuddhaGanguli, 2012, Intellectual Property Rights, 1st Edition, TMH
3. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
4. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
5. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
6. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights.
7. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
8. Indian Patent Acts and Rules (Online – Indian patent office)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILON5014	Entrepreneurship Development and Management	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILON5014	Entrepreneurship Development and Management	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. None

Course Objectives

1. To motivate the students to become and/or work for entrepreneurship and start-ups
2. To understand and be able to apply processes, problem-solving techniques and legal clauses for success in venture

Course Outcomes After successful completion of the course student will be able to …

1. Understand the ideation process and the importance of innovative thinking
2. Develop Business plans, financial analysis and perform market analysis for their venture
3. Familiarize with Legal matters
4. Understanding government schemes and support
5. Prepare proper pitch for funding
6. Use tools and techniques for solving problems

Module	Detailed Content	Hours
1	**Ideation:** Idea Identification and Assessment. Idea Validation. Documentation of Ideas and Feasibility Analysis. Introduction to Entrepreneurship and Business Startups.	**6**
2	**Business Planning and Financial Basics**: Learn how to build an effective Business Plan for your venture. Understand the fundamentals of finance & accounting comprising of financial statements. Break-even analysis. Risk Assesment. Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements. Capital and its Importance to the Entrepreneur Starting a New Business, Buying an Existing Business, New Product Development, Business Growth.	**9**
3	**Legal Foundations:** Define the right legal foundation for your company and explore fundamentals like Company Registration, Compliances and Patents. Entrepreneur Law and its Relevance to Business Operations.	**6**
4	**Government support**: Indian Environment for Entrepreneurship: key regulations and legal aspects, Schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc.	**6**
5	**Fund Raising**: Company valuation, Fundraising, Equity Management. Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship.	**6**

6	**Small Business**: Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business rectangular games without saddle point – mixed strategy for 2 X 2 games, 2Xn and mX2 games.	**6**
	Total	**39**

Evaluation Scheme:

1. **In-Semester Assessment:**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. PoornimaCharantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi

Reference Books:

1. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
2. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILON5015	Product Lifecycle Management	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILON5015	Product Lifecycle Management	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. None

Course Objectives

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.

Course Outcomes After successful completion of the course student will be able to …

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM Feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for molding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plan.
5. Integration of environmental aspects in product design.
6. Carry out Life Cycle Assessment and Life Cycle Cost Analysis.

Module	Detailed Content	Hours
1	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management **(**PLM**)**, Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre**-**PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications**.** PLM Strategies**:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM**.**	**09**
2	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development **(**NPD**)** and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process**.**	**08**
3	**Product Data Management (PDM):** Product and Product Data, DM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation**.**	**04**

4	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies**.**	**06**
5	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design**.**	**06**
6	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis**.**	**06**
	Total	**39**

Evaluation Scheme:

1. **<u>In-Semester Assessment:</u>**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **<u>End-Semester Examination:</u>**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. John Stark, “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 2004. ISBN: 1852338105.
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, “Product Design for the environment-A life cycle approach”, Taylor & Francis 2006, ISBN: 0849327229.

Reference Books:

1. Saaksvuori Antti, Immonen Anselmie, “Product Life Cycle Management”, Springer, Dreamtech, ISBN: 3540257314.
2. Michael Grieve, “Product Lifecycle Management: Driving the next generation of lean thinking”, Tata McGraw Hill, 2006.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT6021	Mobile Emerging Technologies and Smart Devices	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT6021	Mobile Emerging Technologies and Smart Devices	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. Engineering Mathematics
2. Logic Circuits

Course Objectives

1. To make students aware about the evolution of mobile technologies.
2. To expose students to the latest mobile technology architectures from 2G to 5G.
3. To study core technological advancements in smart devices.

Course Outcomes After successful completion of the course student will be able to …

1. Understand the cellular fundamentals and different types of multiple access technologies.
2. Study the system architecture of 2G and 2.5G.
3. Study the system architecture of 3G.
4. To develop the concepts of emerging technologies for 4G standards and beyond
5. Understand the global market trends and future forecasts of Smart devices.
6. To study the core technology and components of the world's most popular smartphones.

Module	Detailed Content	Hours
1	**Fundamentals of Mobile communication** **1.1:** Cellular concept design fundamentals, Frequency reuse, Channel Assignment Strategies, Interference and System Capacity, Improving Coverage and Capacity in Cellular Systems **1.2:** Multiple access techniques: Frequency division multiple access (FDMA), time division multiple access (TDMA), space spectrum multiple access (SSMA), space division multiple access (SDMA), OFDM-PAPR.	**06**
2	**2G Technologies** **2.1:** GSM, GPRS And EDGE- architecture, IS-95 , GSM Network architecture, GSM signaling protocol architecture, identifiers used in GSM system, GSM channels, frame structure for GSM. **2.2:** GPRS And EDGE- architecture, Architecture of CDMA system, CDMA air interface, power control in CDMA system, power control, handoff, rake receiver.	**08**
3	**3G Technologies:** **3.1:** UMTS: Objectives, standardization and releases, network architecture.	**05**

	3.2: Cdma2000 cellular technologies: Forward And Reverse Channels, Handoff And Power Control.	
4	**4G & 5G Technology:** **4.1:** Advanced techniques for 4G deployment: Multi-antenna Techniques, Smart antennas, multiple input multiple output systems. **4.2:** Cognitive radio: Architecture, spectrum sensing, Relaying multi-hop and cooperative communications: Principles of relaying, fundamentals of relay. **4.3:** 5G network architecture: The NR (New Radio) access network and NGC (Next Generation Core), types of 5G deployment scenarios based on various NSA (Non-standalone) options, the flat, flexible, distributed and sliced 5G network characteristics along with the enabling SDN.	**08**
5	**Mobile Business Rankings & Analysis:** **5.**1: Smart Device & Mobile Services Rankings & Products: future trend of smart devices and mobile services based on rankings and products. **5.2**: CAGR (Compound Annual Growth Rate): Definition, market analysis, market analysis of the global market share based on market share by country, smartphone venders and global mobile subscription technology. **5.3**: Forecast of the global mobile application: APP (Application) download, in-APP payment, and in-APP advertisements.	**06**
6	**Smart Devices:** **6.1:** Core technology & components: Samsung Galaxy Note, Apple iPhone and smart watches. **6.2:** Functionality of thread based multi-core scheduling, processing, and relations with the smartphone OS (Operating System) Android and iOS.	**06**
	Total	**39**

Evaluation Scheme:

1. **<u>In-Semester Assessment:</u>**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.

b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Theodore S. Rappaport ―wireless communications - principles and practice‖, PEARSON, Second edition.
2. T L Singal ―wireless communications‖, Mc Graw Hill Education.
3. Andreas F. Molisch ―wireless communications‖ WILEY INDIA PVT LTD, Second edition.

Reference Books:

1. Upena Dalal ―Wireless and Mobile Communications‖, Oxford University Press.
2. Vijay K. Garg ―Wireless Communications and Networking, Morgan–Kaufmann series in Networking-Elsevier

E-Resources:

1. https://www.my-mooc.com/en/mooc/smart-device-mobile-emerging-technologies/
2. NPTEL: http://nptel.ac.in/courses/117104099/
3. Coursera: https://www.coursera.org/learn/smart-device-mobile-emerging-technologies

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT6022	Renewable and Distributed Energy Systems (RDES)	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT6022	Renewable and Distributed Energy Systems (RDES)	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. Environmental Study
2. Fundamentals of Energy

Course Objectives

1. Recognize current and possible future role of renewable energy sources.
2. Adequate inputs on a variety of issues in harnessing renewable Energy.
3. Awareness' about renewable Energy Sources and technologies.

Course Outcomes After successful completion of the course student will be able to …

1. Understand the renewable energy source
2. Analyse wind power plants
3. Understand and analyse Solar Photo Voltaic (SPV) systems
4. Explore the use of biomass energy as a renewable energy source
5. Apply Knowledge of working principle of geothermal energy systems
6. Evaluate and explore the capability of tidal, hydrogen and hybrid energy systems

Module	Detailed Content	Hours
1	**Global and National Energy Scenario:** Overview of conventional & renewable energy sources, need, potential & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Energy for sustainable development, renewable electricity and key elements, Global climate change, CO2 reduction potential of renewable energy-concept of Hybrid systems.	**08**
2	**Wind Energy:** Power in the Wind, Nature of the wind, Wind Energy Conversion, Wind Data and Energy Estimation, Site selection, Types of wind turbines, Wind farms, Wind Generation and Control, classification of wind, characteristics, offshore wind energy, Types of Wind Power Plants (WPPs), Components of WPPs, Working of WPPs, Grid integration issues of WPPs, Hybrid systems, wind energy potential and installation in India. Automation in Wind Farm.	**07**
3	**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Solar Electrical Power Generation, general Solar Photo Voltaic (SPV) system components and their characteristics, Stand alone and Grid Connected SPV systems. Solar Photovoltaic systems: Basic Principle of solar photovoltaic conversion, types of PV Systems, Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics,	**07**

	Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, applications. Automation in Solar Plant.	
4	**Biomass Energy and Geothermal Energy:** Introduction, Biomass resources, Principles of Bio-Conversion, Biomass Cogeneration, Environmental Benefits, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.	**06**
5	**Geothermal Energy:** Resources, types of wells, methods of harnessing the energy, potential in India.	**06**
6	**Other Energy Sources:** Tidal Energy: Energy from the tides, Types of Tidal power systems, wave power devices, Ocean Thermal Energy Conversion (OTEC).Hydrogen Production and Storage: Principle of working, various types, construction and applications, Energy Storage System, Hybrid Energy Systems.	**05**
	Total	**39**

Evaluation Scheme:

1. **In-Semester Assessment:**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, TMH, New Delhi, 3rd Edition.
2. John Twidell and Tony Weir, Renewable Energy Resources, Taylor and Francis -second edition, 2013.
3. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers

Reference Books:

1. Edited by Godfrey Boyle, Renewable Energy, oxford University, press, 3rd edition, 2013.
2. Ahmed and Zobaa, Ramesh C Bansal, Handbook of renewable technology, World scientific, Singapore.
3. Ramesh & Kumar, Renewable Energy Technologies, Narosa.
4. Chetong Singh Solanki, Renewable energy technologies – A practical guide for beginners, PHI.
5. B.H. Khan, Non-conventional energy source, TMH-2nd edition.
6. Karlsson, Kenneth Bernard; Skytte, Klaus Morthorst, Integrated energy systems modeling, Published in: DTU International Energy Report 2015.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT6023	Industrial Automation	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT6022	Industrial Automation	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. None

Course Objectives

1. To articulate acquaintance about the fundamentals of automation and various automation systems used in the industry.
2. To impart information about the architecture, working, and applications of PLC, DCS, and SCADA.
3. To comprehend the requirements of industrial automation in contemporary industries.

Course Outcomes After successful completion of the course student will be able to …

1. Demonstrate automation, need, importance, and applications in the industry.
2. Identify components of PLC and study the architecture of PLC, proper selection, and sizing criteria.
3. Implement various applications using PLC simulator software.
4. Design SCADA-based applications along with GUI.
5. Recognize the evolution, architecture, and hierarchical control in DCS.
6. Implement industrial applications using DCS programming, and develop graphics.

Module	Detailed Content	Hours
1	**Automation Fundamentals** Automation: Need and its importance, Types, applications, Expectations of automation. Process and factory automation. Types of plant and control – categories in industry, Automation hierarchy – large control system hierarchy, data quantity & quality and hierarchical control.	4
2	**Programmable Logic Controller Hardware** Definition, functions of PLC, Architecture, Scan cycle & Specifications, I/O modules, local and remote I/O expansion modules, Memory & I/O addressing- memory organization, hardware to software interface. PLC selection and configuration for process application**.**	7
3	**Programmable Logic Controller Software** Concept of Relay Logic Ladder Diagram, introduction to PLC Programming, programming devices, IEC standard PLC programming languages, LD programming-basic LD instructions, PLC Timers and Counters: Types and examples, data transfer & advanced PLC instructions, PID Control using PLC.	8
4	**Supervisory Control and Data Acquisition (SCADA)** Introduction, elements, features, MTU- functions of MTU, RTU- Functions of RTU, Protocols, Specifications Communications in SCADA- types & methods used, components, Protocol structure and Mediums used for communications. SCADA-based development for typical applications. Programming for GUI development using SCADA software.	8

5	**Distributed Control System Hardware** Introduction, architecture, Controller, I/O modules, Communication module, data highway, local I/O bus, Workstations, Specifications of DCS, Introduction of Hierarchical control of memory: Task listing, Supervisory computer tasks, DCS configuration, Supervisory computer functions, Control techniques, DCS & Supervisory computer displays, computer interface with DCS.	**7**
6	**Distributed Control System Software** DCS System integration with PLCs computer: HMI, Man-machine interface sequencing, Supervisory control, and integration with PLC, Introduction to DCS Programming, Function Block Diagram method for DCS programming and graphics design.	**5**
	Total	**39**

Evaluation Scheme:

1. **<u>In-Semester Assessment:</u>**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **<u>End-Semester Examination:</u>**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Frank D. Petruzella, “Programmable logic controllers”, McGraw-Hill Education, Fifth Edition. 2019.
2. Stuart A. Boyer, “ SCADA: Supervisory Control and Data Acquisition”, Fourth Edition 4th Edition, February 2016
3. Khushdeep Goyal, “Industrial Automation & Robotics”, Publisher S.K. Kataria & Sons, Fifth Edition, 2015.
4. B.R. Mehta, Y. Jaganmohan Reddy, “Industrial Process Automation Systems Design and Implementation”, Elsevier Science, 2014

Reference Books:

1. Bela G. Liptak, “Instrument engineer ‘s handbook- Process control”, Butterworth-Heinemann, 3rd edition. 2013
2. R.K. Rajput, “Robotics And Industrial Automation”, S. Chand publication, Second Revised Edition 2014.
3. Krishna Kant, “Computer-Based Process Control”, Prentice Hall of India, 2nd Revised edition 2011.
4. Hackworth, “Programmable Logic Controllers Programming Methods and Applications”, Pearson India, January 2011.
5. Gary Dunning, “Introduction to Programmable Logic controller”, Cengage Learning India, Third Edition 2007.
6. S.K. Singh, “Computer-Aided Process Control”, Prentice Hall of India, 2004.
7. John. W. Webb, Ronald A Reis, “Programmable Logic Controllers – Principles and Applications”, 5th edition, Prentice Hall Inc. 2002.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT6024	Wireless Networking	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT6024	Wireless Networking	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. Modulation and Demodulation
2. Computer Network and Security

Course Objectives

1. Understand the fundamentals of wireless networks.
2. Learn and analyze the different wireless technologies.
3. Evaluate Ad-hoc networks and wireless sensor networks.

4. Understand and evaluate emerging wireless technologies and standards
5. Understand design considerations for wireless networks
6. Learn and analyze and evaluate the security threats and related security standards

Course Outcomes After successful completion of the course student will be able to …

1. Explain the basic concepts of wireless network and wireless generations.
2. Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc
3. Appraise the importance of Ad-hoc networks such as MANET
4. Describe and judge the emerging wireless technologies standards such as WLL, WLAN, WPAN, WMAN.
5. Explain the design considerations for deploying the wireless network infrastructure.
6. Differentiate and support the security measures, standards. Services and layer wise security considerations.

Module	Detailed Content	Hours
1	**Fundamentals of Wireless Communication:** Introduction to Wireless Communication - Advantages, Disadvantages and Applications; Multiple Access Techniques - FDMA, TDMA, CDMA, OFDMA; Spread Spectrum Techniques – DSSS, FHSS; Evolution of wireless generations –1G to 5G (Based on technological differences and advancements); 5G – Key requirements and drivers of 5G systems, Use cases, Massive MIMO.	**06**
2	**Wide Area Wireless Networks:** Principle of Cellular Communication – Frequency Reuse concept, cluster size and system capacity, co-channel interference and signal quality; GSM-System Architecture, GSM Radio Subsystem, Frame Structure; GPRS and EDGE – System Architecture; UMTS – Network Architecture; CDMA 2000 –Network Architecture; LTE – Network Architecture.	**07**
3	**Wireless Personal Area Networks and Adhoc Networks:** WLL, WLAN- 802.11 (Wi-Fi), WPAN-802.15.1/3/4 (Bluetooth, Zigbee), WMAN-802.16a (Wimax) , Wi-max and LTE /3GPP comparison, Mi-fi, Ly-fi, Wireless Sensor Network – Design Considerations, Issues and Challenges, WSN Architecture, Applications.	**06**

4	**Ad hoc Networks:** Introduction of Ad hoc Networks – MANET – Characteristics, Applications, Advantages and Limitations; Routing algorithms – Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).	**08**
5	**Wireless Network Design Considerations:** Wireless technology, Cisco Unified Wireless Network, Designing Wireless Networks with Lightweight Access Points and Wireless LAN Controllers.	**08**
6	**Wireless Network Security:** Security in GSM; UMTS Security; Bluetooth Security; WEP; WPA2. Mobile IP, VPN (PPTP, LLTP, IPSec).	**04**
	Total	**39**

Evaluation Scheme:

1. **In-Semester Assessment:**
   a. Assessment consists of two Internal Assessments (IA1, IA2) out of which; one should be compulsory class test (on minimum 02 Modules) and the other is a class test / assignment on case studies / course project.
   b. Mid Semester Examination (MSE) will be based on 40-50% of the syllabus.

2. **End-Semester Examination:**
   - Question paper will comprise of full syllabus.
   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Cellular Communications: A Comprehensive and Pratical Guide, Nishith Tripathi, Jeffery H Reed, Wiley
2. Wireless Mobile Internet Security, 2nd Edition, Man, Young Rhee, Wiley- IEEE press
3. Designing for Cisco Internetwork Solutions (DESGN), 2nd Edition, CCDA, Diane Teare, cisco Press.

Reference Books:

1. Introduction to Digital mobile communication, 2nd Edition, Yoshihiko Akaiwa
2. Wireless Communications and networks, William Stallings, Pearson / Prentice Hall
3. Wireless communication and networking, Vijay Garg

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pr/ Oral.	Total
ILOT6025	Online Awareness and Security	3	-	-	3	-	-	3

Course Code	Course Name	Examination Scheme								
		Theory						TW	Pr/ Oral.	Total
		Internal Assessment				End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.	Mid Sem Exam					
ILOT6025	Online Awareness and Security	20	20	20	20	60	2	-	-	100

Course Prerequisite

1. Computer Network, Operating System

Course Objectives

The aim of this course is to provide in-depth treatment on methods and techniques in

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Course Outcomes After successful completion of the course student will be able to …

1. Understand the concept of online crime and its effect on outside world
2. Interpret various online frauds & Attacks patterns
3. Understand and analyze various tools use in online frauds
4. Interpret and apply IT law in various legal issues
5. Distinguish different aspects of cyber law
6. Apply Information Security Standards compliance during software design and development

Module	Detailed Content	Hours
1	**Introduction** Introduction to Online crime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, A global Perspective on cybercrimes.	5
2	**Online Offenses & Crime** criminal attacks plan, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations.	8
3	**Tools and Methods** Tools and Methods Used in Cyberline Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft).	7
4	**Security Aspect of Cyber Law** The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law.	8
5	**IT Act, 2000 & 2008**	6

	Indian IT Act. Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments.	
6	**Information Security Standard compliances** Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI	**5**
	Total	**39**

Evaluation Scheme:

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   - In the question paper, weightage of marks will be proportional to the total number of lecture hours as mentioned in the syllabus.

Text books:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi

Reference Books:

1. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
2. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
3. Nina Godbole, Information Systems Security, Wiley India, New Delhi