A. Honors in AI TECHNOLOGY:

Semester	***Course Code***	***Name of the Course***	***Engagement Hours***			***Credits***	***FA***	***SA***		***Total***
			L	***T***	***P***		***ESE***	***ISE***	***ICA***	
III	ECEHON-01A	Computational Statistics	3	1		4	70	30	25	125
IV	ECEHON-02A	Python for AI	3		2	4	70	30	25	125
V	ECEHON-03A	Soft computing	3		2	4	70	30	25	125
VI	ECEHON-04A	AI Applications	3		2	4	70	30	25	125
VII	ECEHON-05A	Mini Project			4*	2			50	50
		Total	12	1	10	18	280	120	150	550

*indicates contact hours

FA Formative Assessment
SA Summative Assessment

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – III
ECEHON-01A - Computational Statistics

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE: 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks
	ICA :25 Marks

Course Prerequisite

- **Mathematical Foundations**: Knowledge of basic calculus, linear algebra, and probability.
- **Programming Skills**: Familiarity with Python and libraries such as NumPy and pandas.
- **Basic AI/ML Concepts**: Awareness of basic machine learning and data science concepts is recommended.

Course Objectives

By the end of the course, students will:

1. Understand fundamental statistical methods and their applications in AI.
2. Develop computational skills for analyzing and interpreting data.
3. Explore statistical techniques commonly used in machine learning workflows.
4. Gain hands-on experience with statistical programming tools.

Course Outcomes

After completing this course, students will be able to:

1. Apply statistical methods to real-world data problems in AI.
2. Perform exploratory data analysis (EDA) and visualization.
3. Use computational tools to implement statistical algorithms.
4. Understand and apply statistical reasoning to develop AI solutions.

SECTION - I

Module 1: Introduction to Statistics (4 Hours)

- Definition and importance of statistics in AI.
- Types of data: Nominal, ordinal, interval, and ratio.
- Data visualization: Histograms, box plots, scatter plots.
- Measures of central tendency and dispersion: Mean, median, mode, variance, standard deviation.

Module 2: Probability and Distributions (6 Hours)

- Basic probability concepts: Events, sample space, and probability laws.
- Conditional probability and Bayes' Theorem.
- Random variables: Discrete and continuous.
- Common probability distributions: Binomial, Poisson, Gaussian (Normal).

Module 3: Statistical Inference (6 Hours)

- Introduction to statistical inference: Population vs. sample.
- Point and interval estimation.
- Hypothesis testing: Z-tests, t-tests, and chi-square tests.
- p-values and significance levels.

SECTION - II

Module 4: Regression and Correlation (5 Hours)

- Linear regression basics: Model building and evaluation.
- Correlation analysis and covariance.
- Introduction to logistic regression.
- Residual analysis and model diagnostics.

Module 5: Computational Techniques and Applications (6 Hours)

- Resampling techniques: Bootstrapping and cross-validation.
- Monte Carlo simulations in AI.
- Applications of statistics in AI: Classification, clustering, and anomaly detection.
- Hands-on case studies using Python: pandas, NumPy, matplotlib, and scikit-learn.

Module 6: Advanced Topics and Case Studies (3 Hours)

- Introduction to Bayesian methods.
- Overview of probabilistic graphical models.
- Case studies in healthcare, finance, and image processing.

Internal Continuous Assessment (ICA)

ICA shall consist of minimum Eight practical's must be conducted for the Fundamentals of Python Programming practical. Similarly, four practical must also be conducted for Data Structures and Algorithms in line with course outcome.

Textbooks

1. **"The Elements of Statistical Learning"** by Trevor Hastie, Robert Tibshirani, and Jerome Friedman.
2. **"Introduction to Probability and Statistics for Engineers and Scientists"** by Sheldon M. Ross.

Reference Books

1. **"Bayesian Data Analysis"** by Andrew Gelman, John B. Carlin, Hal S. Stern, et al.
2. **"Practical Statistics for Data Scientists"** by Peter Bruce and Andrew Bruce.
3. **"Think Stats: Exploratory Data Analysis in Python"** by Allen B. Downey.

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – IV
ECEHON-02A Python for AI

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE - 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE - 30 Marks
	ICA - 25 Marks

Introduction:

Python has become the most widely used programming language in artificial intelligence (AI) due to its simplicity, vast libraries, and active community. This course provides an in-depth understanding of Python programming, focusing on its application in AI, machine learning, and deep learning. Students will learn to leverage Python libraries such as NumPy, Pandas, Matplotlib, Scikit-Learn, and TensorFlow to analyze data, build models, and develop AI-powered applications. The course aims to bridge the gap between theoretical AI concepts and their practical implementation using Python.

Course Prerequisite:

- Basic Programming Knowledge
- Understanding of Data Structures and Algorithms
- Fundamentals of Mathematics and Statistics

Course Objectives:

1. To introduce Python programming concepts for AI applications.
2. To develop an understanding of Python libraries for AI, including NumPy, Pandas, Matplotlib, and TensorFlow.
3. To implement machine learning algorithms using Python.
4. To apply Python in real-world AI applications.

Course Outcomes:

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

1. Understand and apply Python programming concepts for AI development.
2. Use Python libraries for data analysis, visualization, and manipulation.
3. Implement machine learning models using Python.
4. Develop AI applications using Python frameworks and tools.

SECTION - I

Unit 1: Introduction to Python for AI

- Basics of Python: Variables, Data Types, Operators, Control Structures
- Functions and Modules
- File Handling and Exception Handling

Unit 2: Python Libraries for AI

- NumPy: Arrays and Matrix Operations
- Pandas: Data Manipulation and Analysis
- Matplotlib and Seaborn: Data Visualization

Unit 3: Data Preprocessing and Feature Engineering

- Handling Missing Data
- Data Cleaning, Normalization, and Standardization
- Feature Selection and Dimensionality Reduction

SECTION - II

Unit 4: Machine Learning with Python

- Supervised Learning: Regression and Classification
- Unsupervised Learning: Clustering and Association
- Model Evaluation and Performance Metrics

Unit 5: Deep Learning with Python

- Introduction to Neural Networks
- Implementing Deep Learning Models using TensorFlow and Keras
- Training and Optimizing Deep Learning Models

Unit 6: AI Applications Using Python

- Natural Language Processing (NLP)
- Computer Vision
- Reinforcement Learning
- Case Studies and Real-World AI Applications

Internal Continuous Assessment (ICA):

ICA shall include 10 practical assignments and mini projects based on:

- Python programming exercises.
- Implementation of AI algorithms.
- Application of Python in real-world AI problems.
- Presentation and report submission.

Textbooks:

1. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili.
2. "Deep Learning with Python" by François Chollet.
3. "Python Data Science Handbook" by Jake VanderPlas.

Reference Books:

1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron.
2. "Artificial Intelligence with Python" by Prateek Joshi.
3. "Data Science from Scratch with Python" by Joel Grus.

B. Honors in the INTERNET OF THINGS (IOT) AND SMART SYSTEMS:

Semester	***Course Code***	***Name of the Course***	***Engagement Hours***			***Credits***	***FA***	***SA***		***Total***
			L	***T***	***P***		***ESE***	***ISE***	***ICA***	
III	ECEHON-01B	IoT architecture and protocols.	3	1		4	70	30	25	125
IV	ECEHON-02B	Sensors, actuators and embedded systems	3		2	4	70	30	25	125
V	ECEHON-03B	Cloud computing for IoT applications	3		2	4	70	30	25	125
VI	ECEHON-04B	IoT security and privacy	3		2	4	70	30	25	125
VII	ECEHON-05B	Applications in healthcare, agriculture and smart cities			4*	2			50	50
		Total	**12**	**1**	**10**	**18**	**280**	**120**	**150**	**550**

*indicates contact hours

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – III
ECEHON-01B - IoT architecture and protocols.

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks
	ICA: 25 Marks

Introduction:

The Internet of Things (IoT) is a transformative technology that connects physical devices to the internet, enabling them to communicate and share data. This course provides a comprehensive understanding of IoT architecture and the protocols that facilitate communication between devices. Students will learn about the design principles, layers of IoT architecture, and the various protocols used in IoT systems.

Course Prerequisite:

- Basic knowledge of computer networks and communication protocols.
- Familiarity with embedded systems and programming.

Course Objectives:

1. To understand the fundamental concepts of IoT architecture.
2. To study the various communication protocols used in IoT.
3. To analyse the design and implementation of IoT systems.
4. To explore the challenges and solutions in IoT communication.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Describe the layers and components of IoT architecture.
2. Identify and compare different IoT communication protocols.
3. Design a basic IoT system using appropriate protocols.
4. Evaluate the performance and security aspects of IoT protocols.

SECTION - I: IoT Architecture

Unit 1: Introduction to IoT Architecture

- Definition and characteristics of IoT
- IoT architecture layers: Perception, Network, Middleware, Application
- IoT enabling technologies

Unit 2: IoT Devices and Gateways

- Sensors and actuators
- Embedded systems in IoT
- Role of gateways in IoT architecture

Unit 3: IoT Communication Models

- Request-Response model
- Publish-Subscribe model
- Push-Pull model
- Comparison of communication models

SECTION - II: IoT Protocols

Unit 4: Network Protocols

- IPv6 and 6LoWPAN
- RPL (Routing Protocol for Low-Power and Lossy Networks)
- CoAP (Constrained Application Protocol)

Unit 5: Data Protocols

- MQTT (Message Queuing Telemetry Transport)
- AMQP (Advanced Message Queuing Protocol)
- HTTP/HTTPS

Unit 6: Security Protocols

- DTLS (Datagram Transport Layer Security)
- TLS (Transport Layer Security)
- Security challenges in IoT protocols

Internal Continuous Assessment (ICA):

- **Assignments:** Regular assignments on IoT architecture and protocol analysis.
- **Quizzes:** Periodic quizzes to assess understanding of key concepts.
- **Practical Sessions:** Hands-on labs to implement IoT protocols and analyze their performance.
- **Project:** A mini project to design and simulate an IoT system.

Textbooks:

1. **"Internet of Things: Architecture and Protocols"** by Charles Bell
2. **"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things"** by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry

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Reference Books:

1. **"Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry"** by Maciej Kranz
2. **"IoT and Edge Computing for Architects: Implementing Edge and IoT Systems from Sensors to Clouds with Communication Systems, Analytics, and Security"** by Perry Lea

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – IV
ECEHON-02B - Sensors, actuators and embedded systems

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks
	ICA : 25 Marks

Introduction:
This course delves into the fundamental components of IoT systems: sensors, actuators, and embedded systems. Students will gain a thorough understanding of how these components interact to collect, process, and act on data in IoT applications. The course covers the design, functionality, and integration of sensors and actuators with embedded systems, providing a hands-on approach to building and troubleshooting IoT devices.

Course Prerequisite:
- Basic knowledge of electronics and microcontrollers.
- Familiarity with programming languages such as C or Python.

Course Objectives:
1. To understand the principles and operation of various sensors and actuators.
2. To learn the design and implementation of embedded systems for IoT applications.
3. To explore the integration of sensors and actuators with embedded systems.
4. To develop practical skills in building and testing IoT devices.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Identify and describe the functionality of different sensors and actuators.
2. Design and implement embedded systems for specific IoT applications.
3. Integrate sensors and actuators with embedded systems to create functional IoT devices.
4. Troubleshoot and optimize the performance of IoT devices.

SECTION - I: Sensors and Actuators

Unit 1: Introduction to Sensors and Actuators
- Overview of sensors and actuators
- Types of sensors: temperature, pressure, proximity, motion, etc.
- Types of actuators: motors, relays, solenoids, etc.

Unit 2: Sensor and Actuator Characteristics
- Sensitivity, range, accuracy, and resolution
- Response time and hysteresis
- Calibration and compensation techniques

Unit 3: Signal Conditioning and Interfacing
- Analog and digital signal processing
- Amplifiers, filters, and ADCs/DACs
- Interfacing sensors and actuators with microcontrollers

SECTION – II: Embedded Systems

Unit 4: Embedded System Design

- Microcontroller architecture and selection
- Embedded system development lifecycle
- Real-time operating systems (RTOS) for IoT

Unit 5: Embedded Programming

- Programming languages for embedded systems (C, Python)
- Firmware development and debugging
- Memory management and optimization

Unit 6: Integration and Applications

- Integrating sensors and actuators with embedded systems
- Case studies: smart home, industrial automation, healthcare
- Challenges and future trends in embedded systems for IoT

Internal Continuous Assessment (ICA):

- **Assignments:** Regular assignments on sensor and actuator characteristics, embedded system design, and programming.
- **Quizzes:** Periodic quizzes to assess understanding of key concepts.
- **Practical Sessions:** Hands-on labs to design, implement, and test IoT devices.
- **Project:** A mini project to develop a functional IoT device integrating sensors, actuators, and embedded systems.

Textbooks:

1. **"Sensors and Actuators: Engineering System Instrumentation"** by Clarence W. de Silva
2. **"Embedded Systems: Introduction to ARM Cortex-M Microcontrollers"** by Jonathan W. Valvano

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Reference Books:

1. **"Internet of Things with ESP8266"** by Marco Schwartz
2. **"Making Embedded Systems: Design Patterns for Great Software"** by Elecia White

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C. Honors in Railway Engineering:

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*		*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	
III	ECEHON-01C	Solar and wind energy systems	3	1		4	70	30	25	125
IV	ECEHON-02C	Advanced power converters and inverters	3		2	4	70	30	25	125
V	ECEHON-03C	Grid integration and smart grids	3		2	4	70	30	25	125
VI	ECEHON-04C	AI in renewable energy optimization	3		2	4	70	30	25	125
VII	ECEHON-05C	Mini Project			4*	2			50	50
		Total	**12**	**1**	**10**	**18**	**280**	**120**	**150**	**550**

*Indicates contact hours

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
econd Year B. Tech (Electronics and Computer Engineering) Semester – IV
ECEHON-01C - Railway Engineering: A Beginner's Perspective

Teaching Scheme	Examination Scheme
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks
	ICA : 25 Marks

Railway engineering is a multi-faceted engineering discipline dealing with the design, construction and operation of all types of rail transport systems. It encompasses a wide range of engineering disciplines, including civil engineering, computer engineering, electrical engineering, mechanical engineering, industrial engineering and production engineering. In this course, there is study of Railway signaling with Electronics part. This course is help for new beginners to understand the operation of railway signaling.

Course prerequisite: Prerequisite for this course is Basic electronics and Basic Electrical Engineering.

Course Objectives:

1. To make student aware of Indian Railways System
2. To summarize Railway Transportation and Its Development
3. To understand role of Electrical, Electronics, Computer, Civil, and Mechanical Engineers in Railways
4. To discuss recent trends in Indian Railways
5. To discriminate the Indian Railways as an International Perspective

Course Outcomes:

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

1. Define the Indian Railways System
2. Summarize Railway Transportation and Its Development
3. Understand the role of Electrical, Electronics, Computer, Civil and Mechanical Engineers in Railways
4. Discuss the recent trends in Indian Railways
5. Discriminate the Indian Railways as an International Perspective

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SECTION I

Unit 1-Indian Railways - A Perspective :(05)

General Features of Indian Railways, Important Statistics of Indian Railways, Organization of Indian Railways, Indian Railway Finances and their Control, Commission of Railway Safety, Recruitment Boards of Indian Railways Different Corporations in Indian Railways, Indian Railway Information Systems, Growth of Indian Railways.

Unit 2- Railway Transportation and Its Development :(07)

Terminology- Locomotive, Engine, Bogie, Coach, Freight train, Wheel Arrangement (WA), Driving Cab, Pantograph, Gauge, Transmission, Traction Motors, Coupler, Crossing, Diamond crossing, Junction, Terminal, Fishplate, Permanent way, Rolling stock
Evolution of Different Facets of the Railways

a. Rails Types of rail section: D.H. Rails, B.H. Rails and F.F. Rails, Standard rail sections, Comparison of rail types, Track structure and different gauges.
b. Sleepers , comparison of different types of sleepers and components of track
c. Bridges evolution of iron to steel, arch ,rcc, psc, steel
d. Mode of traction steam, diesel, electric
e. Locomotives evolution of locomotives of each type Various propulsion systems
f. Bogies and coaches

Unit 3- Role of Electrical, Electronics & Computer Engineering in Railways(09)

Introduction to Electrical Engines, Working of Locomotives, Overhead (OHE) Equipment's in Railways, Braking Systems in Railways, Power Supply System & Technology in Railways, Introduction to the Electronic System in Indian Railway, Electrical Switches and Relays used in Indian Railway, Display Control and Mechanism in Railway, Electronics Communication System in Railways, Safety Measures in Indian Railways, Software's in Indian Railways

SECTION II

Unit 4- Role of Civil and Mechanical Engineering in Railways(08)

Fundamentals of Geology, Tracking System, Layers of material on Tracks, Overview of Civil Engineering in Railway Systems, Introduction to Ballast, Rails, Sleepers, Points of Crossings, and Points of Switches, Maintenance of Railway Tracks. Mechanical System used in Railway Engine & Bogies. Construction of Bogies, Material Used for Railing systems, Mechanisms in Railway Locomotive, Study of Railway Engines, Maintenance of Railway Tracks

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Unit 5- Recent Trends in Indian Railways (08)

Introduction, Modernization of traction, Speed trends, modernization of track, Trends in trackvehicles, container transport service, Automation in operation, High powered locomotives,Miscellaneous development. Introduction to the Clean Energy in Indian Railways, Overview ofFaster Trains in India, Overview of Bullet Trains and Metro, Concept of Anubhuti Coaches inIndian Railways, and Introduction to the Bio Toilets in Indian Railway.

Unit 6- Review of Railways - An International Perspective (05)

Overview of International Railways, Development of Railway Systems, Recent Trends inInternational Railways, and Overview of Maglev Technology.

Internal Continuous Assessment (ICA):

1. Case Study: Case Studies on Recent Trends in Railways (15 hrs)
2. Industrial Visits on Railway Workshops/Institutes/Industries (15 hrs)

References:

1. Satish Chandra and M.M. Agarwal, Railway Engineering, Oxford University Press, 2007.
2. Christos N. Pyrgidis, Railway Transportation Systems: Design, Construction and Operation, Oxford, New York, Philadelphia

3. M.A. Chowdhary and A. Sadek, Fundamentals of Intelligent Transportation systems planning. Artech House Inc., US, 2003
4. S.C. Rangawala, Principles of Railway Engineering, Charotar Publication, 2015.
2. V. D. Kodgire, Sushil Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House
3. Handbook of Railway Vehicle Dynamics, Taylor & Francis Group
4. J. S. Mundrey, Railway Track Engineering, McGraw Hill Publication, 2009
5. R.. B. Gupte, Text Book Of Engineering Geology, Pune Vidyarthi Griha Prakashan
6. G. Shanmugam and M. S. Palanichamy, Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 1996.
7. R. K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.
8. Robert Sneddon, Material Technology, Heinemann Library, 2002 12. James A. Jacobs & Thomas Kilduff, Engineering Materials Technology: Structures, Processing, Properties, and Selection, Pearson; 5th edition, 2004
9. David A. Dornfeld, Green Manufacturing: Fundamentals and Applications, Springer; 2012 edition
10. Nand K. Jha, Green Design and Manufacturing for Sustainability, CRC Press; first edition, 2015
11. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Education; 1st edition, 2017
12. V. Ganeshan, Internal Combustion Engine, McGraw Hill Education; 4th edition, 2017
13. S.C. Saxena, S.P. Arora, A Text Book Of Railway Engineering, Dhanpat Rai Publications (p) Ltd.-new Delhi, 2010.

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – IV
ECEHON-02C - Data Communication and Signaling in Railway

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30
	Marks ICA : 25 Marks

Course Objectives:

1. To make students aware of Data communication
2. To summarize Railway Transportation and Its Internet Facility
3. To understand the role of Electrical, Electronics in Railways
4. To discuss recent trends in signaling in Indian Railways
5. To discriminate against the Indian Railways from an International Perspective

Course Outcomes:

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

1. Define the Data communication
2. Summarize Railway Transportation and Its Internet Facility
3. Understand the role of Electrical, Electronics in Railways
4. Discuss the recent trends in signaling in Indian Railways
5. Discriminate the Indian Railways as an International Perspective

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SECTION I

Unit 1 - Data Communication (07)

Introduction of data communication Fundamentals such as data, signals, etc., types of Transmission Medias, Types of Network cables: Twisted Pair cable, Coaxial Cable, Fiber Optic Cable

Unit 2 -Internet (07)

IP Addressing: Physical, Logical Internet & Intranet, Components of the Internet, World Wide Web, E-Mail, Telnet, FTP, Understanding the World Wide Web, Hypertext: The Motion of the Web, Retrieving Documents on the Web: The URL, Real-Time Communication.

Unit 3 - Basics of Electrical and Electronics (07)

Passive Components, Basics of AC and Electrical Cables, Cells & Batteries, Transformers, AC & DC measurements, Soldering & De-soldering and switches, Rectifiers, IC Regulators, Different Batteries, 110 DC Voltage, Electromagnetic theory, Electric Discharge Different types of fuzes

SECTION II

Unit 4 - Basic Signaling in Railway (07)

Introduction to Signal, Objects of Signals, Types of Signals, Classification of Signals according to functions, Classification of Signals according to Location, Special Signals. Principles of Signaling, Concepts of points. Location of point and range of operation. Signaling Plan- Control Table, Characteristics OF Electro-Magnetic Relay, Classification Of Signaling Relay

Unit 5 - Computer Network (06)

Introduction to Computer Network, Networking Devices, Client-Server Communication, Installation & Configuration of DHCP, DNS, FTP, TELNET, Introduction to Network security & GPS

Unit 6 - Railnet (Railway Intranet)(08)

An Installation, Equipment used in Railnet, Installation of the equipment, Connectivity Diagram, IP Planning, E-Mail addressing, Software based on Railnet, Failure & Troubleshooting

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Internal Continuous Assessment (ICA):

1. ICA shall consist of minimum six to eight assignments based on entire curriculum
2. Industrial Training/Internship

References:

1. Computer Networks (Principles, Technologies and Protocols for network design) - Natalia Olifer, Victor Olifer (Wiley Publications)
2. Internetworking with TCP/IP Vol III. Client-Server Programming & Applications: Douglas E. Comer
3. Data Communication and Networking: Behrouz A. Forouzan
4. Satish Chandra and M.M. Agarwal, Railway Engineering, Oxford University Press, 2007.
5. Christos N. Pyrgidis, Railway Transportation Systems: Design, Construction and Operation, Oxford, New York, Philadelphia
6. S.C. Rangawala, Principles of Railway Engineering, Charotar Publication, 2015.
7. TCP/IP Protocol Suite: Behrouz A. Forouzan (Fourth Edition)
8. Internetworking with TCP/IP Vol III. Client-Server Programming & Applications: Douglas E. Comer
9. Engineering Circuit Analysis. Hayt W. H. & Kemmerly J. E. McGraw-Hill. 1993.
10. Circuits, Devices & Systems. Smith R. J. & Dorf R.C., John Wiley & Sons.1992.

11. Electronic Devices & Circuit Theory. Boylestad R. L. & Nashelsky L. 6th Ed. Prentice HallIndia. 2001.
12. Principles of Communications: Systems, Modulation & Noise. Ziemer R. E. & Tranter W. H. 5th Ed. John Wiley & Sons. 2001.
13. Communication Systems. Haykin Simon. 4th Ed. John Wiley & Sons. 2001.
14. Digital & Analog Communication Systems. Shanmugam K. Sam. John Wiley & Sons. 1979.
15. Signals and Systems A.V. Oppenheim and A. S. Wilsky, 2nd edition [Pearson Education]
16. Signals and Systems Simon Haykin and Barry Van Veen, 2nd edition [Wiley and Sons]
17. Signals and Systems, I. Ravi Kumar, PHI

D. **Honors in RENEWABLE ENERGY AND POWER ELECTRONICS:**

Semester	***Course Code***	***Name of the Course***	***Engagement Hours***			***Credits***	***FA***	***SA***		***Total***
			L	***T***	***P***		***ESE***	***ISE***	***ICA***	
III	ECEHON-01D	Solar and wind energy systems	3	1		4	70	30	25	125
IV	ECEHON-02D	Advanced power converters and inverters	3		2	4	70	30	25	125
V	ECEHON-03D	Grid integration and smart grids	3		2	4	70	30	25	125
VI	ECEHON-04D	AI in renewable energy optimization	3		2	4	70	30	25	125
VII	ECEHON-05D	Mini Project			4*	2			50	50
		Total	**12**	**1**	**10**	**18**	**280**	**120**	**150**	**550**

*Indicates contact hours

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – IV
ECEHON-01D - Solar and wind energy systems

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks
	ICA : 25 Marks

Introduction:

This course provides an in-depth understanding of solar and wind energy systems, which are pivotal in the transition to renewable energy. Students will learn about the principles, design, and operation of solar photovoltaic (PV) systems and wind turbines. The course also covers the integration of these systems into the power grid and their role in sustainable energy solutions.

Course Prerequisite:

- Basic knowledge of electrical engineering and power systems.
- Familiarity with energy conversion principles.

Course Objectives:

1. To understand the fundamentals of solar and wind energy systems.
2. To study the design and operation of solar PV systems and wind turbines.
3. To explore the integration of renewable energy systems into the power grid.
4. To analyse the performance and optimization of solar and wind energy systems.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Explain the principles and components of solar and wind energy systems.
2. Design and evaluate solar PV systems and wind turbines.
3. Integrate solar and wind energy systems with the power grid.
4. Assess the performance and optimize the efficiency of renewable energy systems.

SECTION - I: Solar Energy Systems

Unit 1: Introduction to Solar Energy

- Solar radiation and its measurement
- Solar energy conversion technologies
- Overview of solar PV systems

Unit 2: Solar PV System Design

- Components of solar PV systems: panels, inverters, batteries
- Design considerations: sizing, orientation, tilt angle
- Performance analysis and efficiency improvement

Unit 3: Solar Energy Storage and Grid Integration

- Energy storage technologies: batteries, supercapacitors
- Grid-connected and off-grid solar PV systems
- Net metering and feed-in tariffs

SECTION - II: Wind Energy Systems

Unit 4: Introduction to Wind Energy

- Wind energy principles and resource assessment
- Types of wind turbines: horizontal axis, vertical axis
- Wind turbine components and operation

Unit 5: Wind Turbine Design and Control

- Aerodynamics of wind turbines
- Control strategies: pitch control, yaw control
- Performance optimization and maintenance

Unit 6: Wind Energy Integration and Environmental Impact

- Grid integration of wind energy systems
- Environmental and social impacts of wind energy
- Case studies of wind energy projects

Internal Continuous Assessment (ICA):

- **Assignments:** Regular assignments on solar and wind energy system design and analysis.
- **Quizzes:** Periodic quizzes to assess understanding of key concepts.
- **Practical Sessions:** Hands-on labs to design and evaluate solar PV and wind turbine systems.
- **Project:** A mini-project to develop and present a renewable energy system solution.

Textbooks:

1. **"Solar Energy Engineering: Processes and Systems"** by Soteris A. Kalogirou
2. **"Wind Energy Explained: Theory, Design and Application"** by James F. Manwell, Jon G. McGowan, and Anthony L. Rogers

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Reference Books:

1. **"Renewable and Efficient Electric Power Systems"** by Gilbert M. Masters
2. **"Wind Energy Handbook"** by Tony Burton, Nick Jenkins, Ervin Bossanyi, David Sharpe, and Michael Graham

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PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B. Tech (Electronics and Computer Engineering)
Semester – IV
ECEHON-02D - Advanced power converters and inverters

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	ISE : 30 Marks
	ICA : 25 Marks

Introduction:
This course delves into the advanced concepts of power converters and inverters, which are essential components in modern power electronics and renewable energy systems. Students will explore the design, operation, and control of various types of power converters and inverters, focusing on their applications in renewable energy integration, electric vehicles, and industrial drives. The course combines theoretical knowledge with practical implementation to prepare students for advanced research and industry applications.

Course Prerequisite:
- Basic knowledge of power electronics and electrical circuits.
- Familiarity with semiconductor devices and their applications in power conversion.

Course Objectives:
1. To understand the principles and operation of advanced power converters and inverters.
2. To study the design and control strategies for power converters and inverters.
3. To explore the applications of power converters and inverters in renewable energy systems.
4. To develop skills in simulating and implementing power electronic circuits.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Explain the working principles of various power converters and inverters.

2. Design and analyze power electronic circuits for specific applications.
3. Implement control strategies for efficient power conversion.
4. Evaluate the performance of power converters and inverters in renewable energy systems.

SECTION - I: Power Converters

Unit 1: Introduction to Power Converters

- Overview of power electronic converters
- Types of power converters: AC-DC, DC-DC, DC-AC
- Applications in renewable energy and industrial systems

Unit 2: DC-DC Converters

- Buck, boost, and buck-boost converters
- Isolated DC-DC converters: flyback, forward, push-pull
- Design considerations and efficiency analysis

Unit 3: AC-DC Converters

- Single-phase and three-phase rectifiers
- Power factor correction techniques
- Applications in renewable energy systems

SECTION - II: Inverters

Unit 4: Introduction to Inverters

- Principles of inversion: DC to AC conversion
- Types of inverters: voltage source inverters (VSI), current source inverters (CSI)
- Applications in renewable energy and motor drives

Unit 5: PWM Techniques for Inverters

- Sinusoidal PWM, space vector PWM
- Harmonic analysis and reduction techniques
- Advanced PWM techniques for improved performance

Unit 6: Control of Inverters

- Voltage and frequency control
- Grid-connected inverter control strategies
- Islanding detection and anti-islanding techniques

Internal Continuous Assessment (ICA):

- **Assignments:** Regular assignments on the design and analysis of power converters and inverters.
- **Quizzes:** Periodic quizzes to assess understanding of key concepts.
- **Practical Sessions:** Hands-on labs to simulate and implement power electronic circuits.
- **Project:** A mini project to design and demonstrate a power converter or inverter for a specific application.

Textbooks:

1. **"Power Electronics: Converters, Applications, and Design"** by Ned Mohan, Tore M. Undeland, and William P. Robbins
2. **"Modern Power Electronics and AC Drives"** by Bimal K. Bose

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Reference Books:

1. **"Fundamentals of Power Electronics"** by Robert W. Erickson and Dragan Maksimovic
2. **"Power Electronics: A First Course"** by Ned Mohan

E. **Honors with Research***

Semester	***Course Code***	***Name of the Course***	***Engagement Hours***	***Credits***	***SA***		***Total***
			P		***ICA***	***OE***	
VII	ECERES-01	Research Project Phase-01	9 #	9	100	100	200
VIII	ECERES-01	Research Project during OJT	9 ##	9	100	100	200
		Total	18	18	200	200	400

#Along with 9 hours of engagement hours, 4.5 Hrs. activities for preparation for community engagement and service, preparation of reports, etc.

Along with 9 hours of engagement hours, 4.5 Hrs. activities for preparation for community engagement and service, preparation of reports etc. and independent reading during On Job

Training and preferably related to On Job Training activities.