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NATIONAL SMART GRID MISSION
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ISGF

India Smart Grid Forum

Online Training Program on ARTIFICIAL INTELLIGENCE and ROBOTICS for UTILITIES and SMART CITIES

14 September - 04 November 2020



INTRODUCTION

The lockdowns owing to COVID-19 around the world have dramatically changed the way we live and work within a short span of time. The operations and work style of governments, city/local administrations, businesses and utilities (electricity, water and gas) have changed drastically in the past few months. There is a greater need for governments, city managers and local authorities as well as all utilities to deploy advanced automation, remote working, remote monitoring, robotics and artificial intelligence to handle day-to-day operations. Artificial Intelligence (AI), Data Science (DS), Machine Learning (ML), Virtual Reality (VR), Augmented Reality (AR), Drones and other types of Robots could play crucial roles in various infrastructure and services in city management including utility operations. These new technologies and tools could make the operations more efficient, faster, reliable and economical. For example, artificial intelligence (AI) will be able to balance electricity grids, manage demand, negotiate actions, enable self-healing functions and facilitate a host of new products and services leading to the energy transition. It will also enable more efficient and effective utility operations by helping to analyze the massive amounts of data gathered from the digital devices. Robotic Process Automation (RPA) could automate all measurable, repeatable and predictable transactions in all domains of city management and utility operations.

Today, India operates the third largest power system in the world with an installed capacity of 375GW serving 750 million consumers covering a geographical area of over 3 million square kilometers operating in same frequency as one integrated grid. The share of renewable energy is presently (RE) is about 87GW which is targeted to be enhanced to 450GW by 2030. With the increasing share of renewable energy on the grid, flexibility in both demand and generation is essential for stable grid operations. Digital technologies will play crucial role for the stable grid operations. The high voltage transmission grid in India already deploy advanced automation and digital technologies and the electricity distribution companies have also embarked on their digital journey in the recent past through several programs promoted by the Ministry of Power (MoP), Government of India. However, post COVID-19, the pace of digitalization efforts in all businesses including utilities are gaining rapid momentum and officials are getting used to the paper-less operations. The digital devices (including the proposed 250 million smart meters) will generate humongous volume of data in each utility which would require AI tools to analyze and transform into business intelligence.

The 100 Smart Cities program in India has also gained considerable momentum and the city command and control centers operational in several of these smart cities are being leveraged for COVID-19 monitoring and management very efficiently. With advanced AI tools, these command and control centers could predict trends and suggest most optimized actions in a variety of scenarios for efficient management of the cities. Since inception in 2011, India Smart Grid Forum (ISGF) has been spearheading the movement towards digitalization in utilities. Although, the actual implementation in many utilities may still be in its infancy, there is already a unanimous voice for taking this journey to full digitalization. In the aftermath of COVID-19, the digital platforms have become the coveted assets for utilities in their business continuity and resiliency; and this movement towards digitalization is irreversible. Emerging technologies like Artificial Intelligence, Machine Learning, Data Science and Advanced Analytics, Blockchain, Virtual Reality, Augmented Reality and Robotics, will radically revolutionize the city management and utility operations and overall governance in every domain in the near future. ISGF has been working with eminent stakeholders in the AI and Robotics domains to create awareness and empower the city managers and utilities with domain knowledge for adoption of these technologies. **With this background ISGF is pleased to announce an Online Training Program on Artificial Intelligence and Robotics (AI&R) for Utilities and Smart Cities from 14 September - 04 November 2020.**

OBJECTIVES

1. To create awareness in utility officials, regulators and government officials regarding the potential of AI&R technologies such as Artificial Intelligence, Machine Learning, Data Science and Advanced Analytics, Blockchain, Virtual Reality, Augmented Reality and Robotics in the management of cities and utility (electricity, water and gas) operations
2. To give an overview of different applications of AI&R technologies in smart city management and utility business and explain them with actual use cases
3. To create empowered teams on AI&R technologies in utilities who could critically evaluate different solutions for their business needs
4. To build capacity in the industry, academia and amongst the student community to design and implement AI&R solutions in smart cities and utilities

COURSE MODULES

This course is designed for "Non Coders " who can choose the level of depth in different topics. Tutorials (Practical Sessions) are also included which will give hands-on experience to the participants on some of the most popular applications. The course is structured in 5 Modules as briefed below:

- MODULE - A: Introductory Module (Chapters: 1 to 5)**
 The first five Introductory Chapters in Module-A are common for all participants.
- MODULE - B: Foundation Module (Chapters: 6 to 10) – OPTIONAL**
 The Foundation Chapters in Module - B are optional and cover the technologies and tools of Data Science, Machine Learning, Deep Learning, Reinforcement Learning, Virtual Reality, Augmented Reality and Robotics in detail.
- MODULE - C: AI & Robotics-Applications and Case Studies (Chapters: 11 to 17)**
 Module-C covers applications of AI, Data Science, Machine Learning, Deep Learning, Reinforcement Learning and Robotics in utilities with potential Use Cases and Case Studies of successful projects.
- MODULE - D: Tutorials (10 Practical Sessions) – OPTIONAL**
 Module-D Tutorials will provide the participants opportunities to perform hands-on tutorials. Access to different technology platforms will be arranged by ISGF and our Tutors. Elementary knowledge of Python, R, MATLAB and Simulink is desirable for those opting for the Tutorials. Those who do not have such skills can opt to attend the MODULE-E: Tutorial Preparatory Classes (4 sessions that are optional and complimentary). Tutorials will be held on weekends (Saturdays and Sundays) while the Module C classes are in progress.
- MODULE - E: Preparatory Classes for Tutorials – OPTIONAL for those opting the Tutorials**
 Preparatory classes will be scheduled based on the number of participants opting for the classes.

DETAILED COURSE MODULES

MODULE – A: INTRODUCTORY MODULE

Chapter-1: Introduction to Artificial Intelligence

- 1.1 What is AI?
- 1.2 AI Techniques
- 1.3 AI Frameworks
- 1.4 Social, Legal and Ethical Aspects of AI

Chapter-2: Data Driven Smart Utilities - A Paradigm Shift in Utility Operations

- 2.1 Business and Technology Drivers of AI
- 2.2 Need of AI in Utilities
- 2.3 Key Benefits of AI Applications for Utilities
- 2.4 How AI can be applied in existing systems in Utilities
- 2.5 Overview of Tools
- 2.6 List of Use Cases

MODULE - A: INTRODUCTORY MODULE

Chapter-3: Programming Languages and Tools

- 3.1 Languages
- 3.2 Machine Learning Tools
- 3.3 Deep Learning Tools
- 3.4 Analytical Tools
- 3.5 Visualization Tools
- 3.6 Natural Language Processing (NLP) Tools
- 3.7 Signal Processing Tools
- 3.8 Other Tools

Chapter-4: Introduction to Robotics

- 4.1 What is Robotics?
- 4.2 AI and Robotics
- 4.3 Use Cases of Robotics in Utilities

Chapter-5: Infrastructure Requirements for AI & ML

- 5.1 Data Platforms and Architecture
- 5.2 Choices of Tools and Platforms for different Applications
- 5.3 Deploying AI Solutions on the Cloud

MODULE - B: FOUNDATION MODULE (OPTIONAL)

Chapter-6 (Part 1): Data Science and Analytics

- 6.1 Cleaning, Wrangling and Visualizing the Data
- 6.2 Analytics, Statistics, Probability and Statistical Inference
- 6.3 Regression Techniques
- 6.4 Classifications

Chapter-6 (Part 2): Data Science and Analytics

- 6.5 Decision Tree Models
- 6.6 Neural Networks
- 6.7 Ensemble Modelling and Ensemble Learning

Chapter-7 (Part 1): Machine Learning: Introduction, Approach and Landscape

- 7.1 Introduction
- 7.2 Machine Learning Approach and Landscape

Chapter-7 (Part 2): Machine Learning: Introduction to Popular Algorithms

- 7.3 Functions and Algorithms

Chapter-7 (Part 3): Machine Learning: Types of Machine Learnings

- 7.4 Supervised Learning
- 7.5 Unsupervised Learning
- 7.6 Ensemble Learning
- 7.7 Automated Machine Learning (AutoML)

MODULE - B: FOUNDATION MODULE (OPTIONAL)

Chapter-7 (Part 4 - A): Machine Learning: Deep Learning – Convoluted Neural Network (CNN)

- 7.8 Deep Learning
- 7.9 You Only Look Once (YOLO)

Chapter-7 (Part 4 - B): Machine Learning: Deep Learning – RNN and ANN

- 7.10 Recurrent Neural Networks (RNN)
- 7.11 Automated Neural Networks (ANN)
- 7.12 App based Deep Learning Workflow

Chapter-7 (Part 4 - C): Machine Learning: Reinforcement Learning

- 7.13 Classical Reinforcement Learning Algorithms
- 7.14 Deep Reinforcement Learning Algorithms
- 7.15 Career Building in Machine Learning

Chapter-8 : Virtual Reality (VR) and Augmented Reality (AR)

- 8.1 Gesture Recognition
- 8.2 Virtual Reality (VR)
- 8.3 Augmented Reality (AR)
- 8.4 Autoencoders

Chapter-9 (Part 1): Data Science and Advanced Analytics

- 9.1 Hadoop and Big Data Ecosystem and Architecture
- 9.2 Hadoop Data Integration Flume, SQOOP, Restful API Framework
- 9.3 Hadoop – HDFS and MAP REDUCE
- 9.4 Big Data Visualization and Dash Boards

Chapter-9 (Part 2): Data Science and Advanced Analytics

- 9.5 Time Series Forecasting
- 9.6 Understanding Forecasting Accuracy
- 9.7 Career Building in Data Science

Chapter-10 (Part 1): Robotics

- 10.1 Robot Design
- 10.2 Robot Autonomy

Chapter-10 (Part 2): Robotics

- 10.3 Robotics Software
- 10.4 Applied Robotics
- 10.5 Robot Operation Centre (ROC)
- 10.6 Career Building in Robotics

MODULE - C: AI AND ROBOTICS – APPLICATIONS AND USE CASES FOR UTILITIES AND SMART CITIES

Chapter-11: AI and ML Applications for Utilities: Forecasting Solutions

- 11.1 Forecasting Energy Production
- 11.2 Forecasting Energy Demand
- Case Study-1A: Forecasting Solar Generation
- Case Study 1B: Forecasting Solar and Wind Generation; Case Study from Hawaii
- Case Study-2A: Forecasting Energy Demand in a Distribution Utility
- Case Study- 2B: Weather based Energy Forecasting and Outage Management

Chapter-12: AI and ML Applications for Utilities: Monitoring Solutions

- 12.1 Drone based Monitoring of Assets and Operations
- 12.2 Monitoring of Operations with Inputs from Sensors
- 12.3 Digital Twins
- Case Study-3: Drone based Monitoring of Distribution Lines and Substations
- Case Study-4: Predictive Maintenance with inputs from Sensors and Digital Twins

Chapter-13: AI and ML Applications for Utilities: Part 3

- 13.1 Prediction and Optimization Solutions
- Case Study -5A: Virtual Power Plants/Energy Management Systems
- Case Study -5B: Asset Performance Management and Vegetation Management
- Case Study -6: City Gas Distribution LUAG Analysis through Machine Learning methodology
- Case Study -7: Water Distribution – NRW and UFW Analysis through Machine Learning methodology

Chapter-14: Data Science Applications for Utilities: Part-1

- Case Study-8A: Role of Revenue Recognition/Revenue Maximization from Billing/Payment/Payment mode/Customer
- Case Study -8B: AMI Analytics Case Studies from North America and Europe
- Case Study 8C: AI/ML Driven Global Customer behaviour to Address Energy Efficiency and Water Conservation- Case Studies from MNWD (Water), SWG (Gas), WSC (Electric + Water), Simply (Electric), GGL (Gas)

Chapter - 15: Data Science Applications for Utilities: Part 2

- Case Study-9A: Approach to Transformer Ageing
- Case Study -9B: Total Transformer Monitoring and Analytics
- Case Study-10: False Alarm Suppression Using Predictive Modelling

Chapter-16: AI and ML Applications for Utilities: Part 3

- Case Study-11: AI Driven Road Safety by monitoring and controlling over speeding of vehicles
- Case Study-12: Road Pot Hole Condition Analysis using AI
- Case Study-13: IoT Controlled Street Lighting for better Vehicle Movement and De-congestion
- Case Study-14: Loss Reduction/Power Theft Modelling Using Machine Learning

Chapter-17 (Part 1): Robotics Case Studies
Case Study-15: Robotic Process Automation and Virtual Tour of a Robot Operations Centre (ROC)
Chapter-17 (Part 2): Robotics Case Studies
Case Study-16: Other Robotics Applications for Utilities

MODULE -D TUTORIALS (OPTIONAL)

Practical-1 : Revenue Recognition from Utility's Billing Information: Hands-on working with Data to apply Revenue Recognition approach on the Tool
Practical-2 : Hands-on Working Scenarios for Predictive Modelling
Practical-3 : Hands-on Practice on Business Case with Python Open Source Tool
Practical-4 : Hands-on Practice on Business Case with R Tool
Practical-5 : Hands-on Practice with how to tag customer to the Nearest Pole / Feeder / DT /Substation with text Analytics Technique using Python /R
Practical-6 : Hands-on Practice on Dynamics HT Configuration for 11 kV Feeder-Supply Network Node Analysis using Python /R
Practical-7 : Hands-on Practice session on Meter Image Analytics for Automated Billing using Python /R
Practical-8 : Hands-on Practice on False Alarm Suppression using Predictive Modelling using Python /R
Practical-9 : Hands-on Practice on Revenue Maximization using Python
Practical-10 : Hands-on Practical on Loss Reduction using Python

MODULE - E: PREPARATORY CLASSES FOR TUTORIALS – OPTIONAL FOR THOSE CHOOSING TUTORIALS

Class-1 : Data Modelling Using Python
Class-2 : Semantics of Python–Data Preparation and Data Quality
Class-3 : Data Modelling with Python
Class-4 : Introduction to MATLAB and Simulink : Developing AI solutions in MATLAB and Simulink using Data Driven and Physical Modelling Approaches

Program Schedule : 14 September - 04 November 2020

Module A (Chapter 01-05)

14 Sept, 16 Sept, 18 Sept, 21 Sept, 23 Sept

Module B (Chapter 06-10)

25 Sept, 26 Sept, 28 Sept, 30 Sept, 02 Oct, 03 Oct, 05 Oct, 07 Oct, 09 Oct, 10 Oct, 12 Oct, 14 Oct, 16 Oct

Module C (Chapter 11-17)

19 Oct, 21 Oct, 23 Oct, 24 Oct, 26 Oct, 28 Oct, 30 Oct, 31 Oct

Review Class: 02 Nov; **Valedictory Session:** 04 Nov

- The classes for each Modules are scheduled for 2 hours followed by 30 mins of Q&A **(18:30-21:00 Hours IST)**
- Module D Tutorials will be scheduled during the classes of Module-B and Module-C depending on the number of Participants opting for the Tutorials
- Module-E Preparatory Classes for Tutorials will be scheduled depending on the number of Participants opting for the same

Training Methodology

Live Lectures on ISGF WebEx Platform

Recording of live lectures will be available on ISGF Portal to view or access at anytime

Course Material/ Presentations of the Session will be emailed to the participants a day in advance and will be uploaded on the ISGF Training Portal for reference

Post session queries can be posted in Google Form to be answered by tutors in one document and emailed to trainees. Group of trainees can schedule interactive (audio/video) session with tutors as per mutual convenience to clear their doubts

Assessment & Certification

An online examination will be conducted and Certificate of **Merit** will be awarded to the online participants. Participants undergoing Offline Training Course will receive a Certificate of **Participation** after successful completion of examination

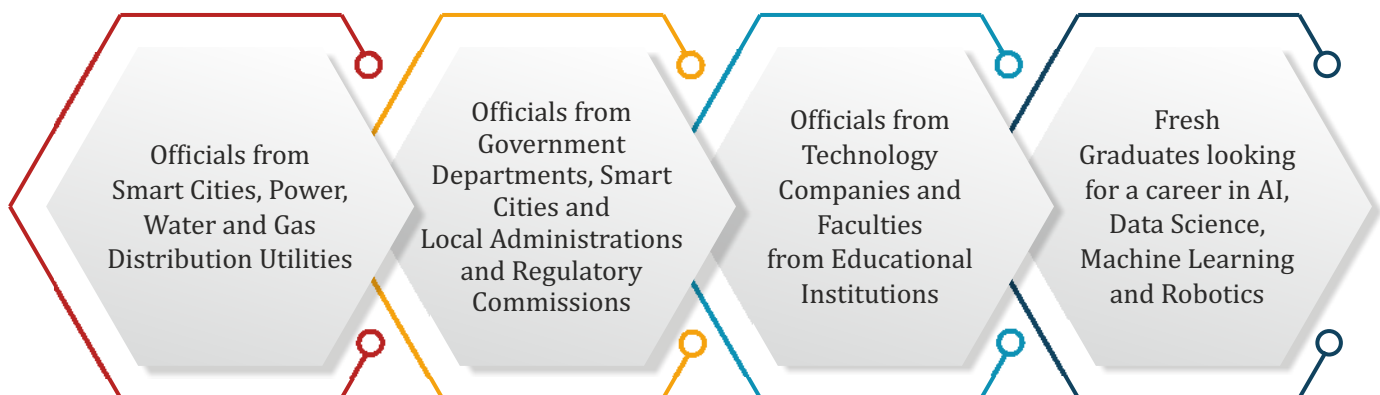
CERTIFICATE OF MERIT (Participants opting for Online {Live} Training)

MODULES A & C	Level I
MODULES A, B & C	Level II
MODULES A, B, C & D	Level III

CERTIFICATE OF PARTICIPATION (Participants opting for Offline {Recorded} Training)

MODULES A & C	Level I
MODULES A, B & C	Level II

TARGET AUDIENCE



Course Fee (in INR/USD)

COURSE MODULES	Mode of Training Online (Live) Training		Mode of Training Offline (Recorded Video) Training	
	INR	USD	INR	USD
MODULES A & C	7000	96	5000	70
MODULES A, B & C	12000	165	9000	125
MODULES A, B, C & D	15000	205	Not Offered	Not Offered

- 18 % GST APPLICABLE
- Module-E is complimentary for those opting for Module-D
- Module D and E are not offered for Offline (Recorded) Training

Please Register: <https://indiasmartgrid.org/onlinetrainingprogram/>

Special Offers:

- 25% discount for current ISGF Members
- 25% discount for Bonafide Students and Faculties from reputed Educational Institutions
- 25% discount on group booking of more than 4 persons from the same organisation
- 10% discount for sharing this Training Program Banner/Brochure on your any 3 Social Media Accounts (LinkedIn, Facebook, Twitter, Instagram etc)
 - o Banner/Brochure can be downloaded from <https://indiasmartgrid.org/onlinetrainingprogram/>
 - o The links posted have to be shared with ronkini.shome@indiasmartgrid.org to obtain the discount
 - o The above offer is Non Transferable

Please Note:

- Two discount offers cannot be clubbed
- Valid identity proof of Bonafide Students/Faculties need to be emailed to ronkini.shome@indiasmartgrid.org to avail the discount
- ISGF Members have to email to ronkini.shome@indiasmartgrid.org to avail the discount
- Once Payment is made no refund, discount/offer request will be entertained



List of Tutors



Amitava Ghosh
Bidgely



Amit Kumar Pandey
Hanson Robotics



Ashutosh Nataraj
Vidrona



Abhinav Srivastava
Bidgely



Deva P Seetharam
Independent System Researcher



Basant Kumar Pandey
Bidgely



Shishir Shekhar
Mathworks



Sumit Gupta
Assetplus Consulting



Jayanth Balaji
Mathworks



Mayank Sharan
Bidgely



Ratna Gupta
AssetPlus Consulting



Navin Kumar
AssetPlus Consulting



Rohit Kumar
IBM



Rob D'Arienzo
IBM



Himanshu Goel
IBM



Rekha. A
Bentley Systems



Ankur Akash
Bentley Systems



Ralph Dsouza
Bentley Systems



Anish Verma
Smart Energy Water



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About ISGF

India Smart Grid Forum (ISGF) was established as a Public Private Partnership (PPP) initiative of Government of India for accelerated development of smart grid technologies in the Indian power sector in March 2011. It is registered under Indian Societies Registration Act (Act XXI of 1860). ISGF was set-up to provide a mechanism through which academia, industry, utilities and other stakeholders could participate in the development of Indian smart grid systems and provide relevant inputs to the government's grid modernization program.

ISGF work closely with the Ministry of Power, Ministry of New and Renewable Energy, Department of Telecom, Ministry of Heavy Industries, Department of Science and Technology and Ministry of Urban Development and NCIIPC. With 180 + members comprising of ministries, utilities, technology providers, academia and students, ISGF has evolved as a globally reputed think tank in smart grids and smart cities.