

Bureau of Energy Efficiency National Certification Examination for Energy Manager/Energy Auditor Exam

Renjith P C - Certified Energy Auditor –CEA 35069

Green Tech Learning

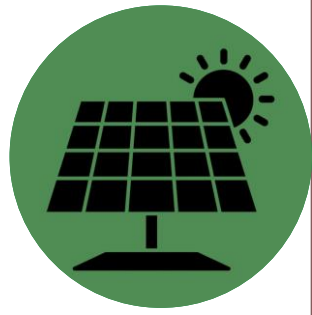
www.greentechlearning.com

Bureau of Energy Efficiency



- The Bureau of Energy Efficiency (BEE) is an agency under the Government of India, Ministry of Power established in 2002 under the Energy Conservation Act, 2001.
- Its primary objective is to promote energy efficiency and conservation across various sectors, thereby reducing energy intensity and ensuring sustainable development.
- The Bureau of Energy Efficiency (BEE) National Certification Examination (NCE) is a standardized professional exam aimed at certifying professionals in the field of Energy Management and Auditing.
- This certification ensures that candidates possess the necessary skills and knowledge to effectively conduct Energy audits, Implement energy efficiency measures, and contribute to the Nation's energy conservation, Sustainability and Net Zero targets

NATIONAL ACTION PLAN ON CLIMATE CHANGE



**NATIONAL SOLAR
MISSION**



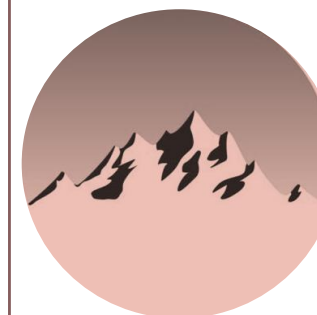
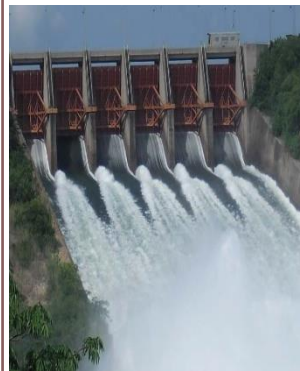
**NATIONAL
MISSION FOR
ENHANCED
ENERGY
EFFICIENCY**



**NATIONAL MISSION
ON SUSTAINABLE
HABITAT**



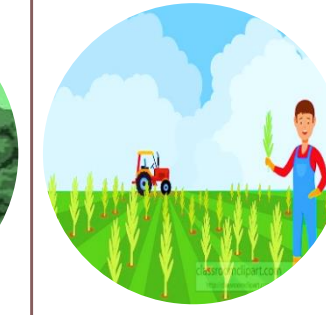
**NATIONAL WATER
MISSION**



**NATIONAL MISSION
FOR SUSTAINING THE
HIMALAYAN ECO-
SYSTEM**



**NATIONAL MISSION
FOR A GREEN INDIA**



**NATIONAL MISSION
FOR SUSTAINABLE
AGRICULTURE**



**NATIONAL MISSION
ON STRATEGIC
KNOWLEDGE FOR
CLIMATE CHANGE**



Schemes of BEE Under EC Act 2001



Energy
Conservation
Building Code
(ECBC)

Standards
& Labelling
(S&L)

Demand Side
Management
(DSM)

Promoting
Energy Efficiency
in Small &
Medium
Enterprises
(SMEs)

Bachat Lamp
Yojana (BEY)

Designated
Consumers
(DCs)

Certification
of Energy
Auditors &
Managers

Duties & Responsibilities of Energy Manager/ Energy Auditor



- Develop, coordinate, and implement energy plans and programs
- Analyze energy consumption patterns and identify areas for cost and energy savings
- Conduct energy audits to evaluate energy use, costs, and conservation measures
- Work with financial departments to develop budgets and cost estimates related to energy management
- Research and keep up to date with energy legislation, environmental laws, and industry trends
- Monitor and verify energy savings and performance contracts

Job Prospects of Energy Manager/ Energy Auditor



- Certified Energy Manager
- Energy Assessment Engineer
- Energy Analyst
- Energy Audit Advisor
- Certified Energy Auditor
- Energy Conservation Representative
- Energy Consultant
- Energy Market Researcher
- Sustainability Consultant
- Carbon Credit Verifier

Qualifications for Energy Manager/ Energy Auditor



Candidates appearing for **Energy Manager's** certification examination shall possess any one of the following qualifications:

- i. A Graduate Engineer or Graduate Architect along with Three Years of work experience
- ii. A Post-Graduate in Engineering or Architecture along with Two Years of work experience
- iii. A Graduate Engineer or Graduate Architect with a post-graduate degree in Management or its equivalent along with Two Years of work experience
- iv. Diploma Engineer or “Equivalent” along with Six Years of work experience
- v. Post Graduate in Physics or Electronics or Chemistry (with Physics and Mathematics at graduation level) along with Three Years of work experience

Qualifications for Energy Manager/ Energy Auditor



Candidates appearing for **Energy Auditor's** certification examination shall possess any one of the following qualifications:

- i. A Graduate Engineer or Graduate Architect along with Three Years of work experience
- ii. A Post-Graduate in Engineering or Architecture along with Two Years of work experience
- iii. A Graduate Engineer or Graduate Architect with a post-graduate degree in Management or its equivalent along with Two Years of work experience

26th National Certification Examination for Energy Managers and Energy Auditors

Paper No.	Title of Paper	Time
I	General Aspects of Energy Management & Energy Audit	09.30 AM - 12.30 PM.
II	Energy Efficiency in Thermal Utilities	02.00 PM - 05.00 PM.
III	Energy Efficiency in Electrical Utilities	09.30 AM - 12.30 PM.
IV	Energy Performance Assessment for Equipment and Utility Systems (Open Book Examination)	02.00 PM - 04.00 PM.

Final Time table may change after 26th Notification by BEE

Energy Manager/Energy Auditor

- Energy Manager – Paper1, Paper 2 & Paper-3
- Energy Auditor – Paper1, Paper 2, Paper-3 & Paper-4

Question Paper Pattern (Paper-1,2&3)



➤ Section – I: OBJECTIVE TYPE

Marks: $50 \times 1 = 50$

(i) Answer all 50 questions

(ii) Each question carries one mark

➤ Section – II: SHORT DESCRIPTIVE QUESTIONS

Marks: $8 \times 5 = 40$

➤ (i) Answer all Eight questions

➤ (ii) Each question carries Five marks

➤ Section – III: LONG DESCRIPTIVE QUESTIONS

Marks: $6 \times 10 = 60$

➤ (i) Answer all Six questions

➤ (ii) Each question carries Ten marks

Time Management

➤ Section – I: OBJECTIVE

➤ 50 Questions - Marks $50 \times 1 = 50$ Marks

Section – II: SHORT DESCRIPTIVE QUESTIONS

➤ 8 Questions – Marks $8 \times 5 = 40$ Marks

➤ Section – III: LONG DESCRIPTIVE QUESTIONS

➤ 6 Questions – Marks $6 \times 10 = 60$ Marks

Starting as well as finishing Time (Bonus Time)



Question Paper Pattern (Paper-4)

➤ Section – I: BRIEF QUESTIONS

Marks: $10 \times 1 = 10$

(i) Answer all 10 questions

(ii) Each question carries one mark

➤ Section – II: SHORT NUMERICAL QUESTIONS

Marks: $2 \times 5 = 10$

➤ (i) Answer all two questions

➤ (ii) Each question carries Five marks

➤ Section – III: LONG NUMERICAL QUESTIONS

Marks: $4 \times 20 = 80$

➤ (i) Answer all three questions (first three)

➤ (ii) Answer any one question from four Choices – (Chapter 11-16)

Time Management

➤ Section – I: BRIEF QUESTIONS

➤ 10 Questions - Marks $10 \times 1 = 10$ Marks



Section – II: SHORT NUMERICAL QUESTIONS

➤ 2 Questions – Marks $2 \times 5 = 10$ Marks



➤ Section – III: LONG NUMERICAL QUESTIONS

➤ 4 Questions – Marks $4 \times 20 = 80$ Marks



Tips for cracking the Exam

- Know about exam pattern
- Start preparation in Structured Manner
- Understand the basic concepts
- Improve the understanding by doing numerical problems two or three times
- Clear about various unit conversions
- Revise last Ten years question papers
- Score maximum marks in Objective questions
- Proper Time management in Exam

Paper -1 General Aspects of Energy Management and Energy Audit



- Chapter-1 Energy Scenario
- Chapter-2 Energy Conservation Act-2001 and Related policies
- Chapter-3 Basics of Energy and its various forms
- Chapter-4 Energy Management and Energy Audit
- Chapter-5 Material and Energy Balance
- Chapter-6 Energy Action Planning
- Chapter-7 Financial Management
- Chapter-8 Project Management
- Chapter-9 Energy Monitoring and Targeting
- Chapter-10 Energy Efficiency and Climate Change
- Chapter-11 New and Renewable Energy Sources

Paper -2 Energy Efficiency in Thermal Utilities



- Chapter-1 Fuels and Combustion
- Chapter-2 Boilers
- Chapter-3 Steam System
- Chapter-4 Furnaces
- Chapter-5 Insulation and Refractories
- Chapter-6 FBC Boilers
- Chapter-7 Cogeneration
- Chapter-8 Waste heat Recovery
- Chapter-9 Heat Exchangers

Paper -3 Energy Efficiency in Electrical Utilities



- Chapter-1 Electrical System
- Chapter-2 Electric Motors
- Chapter-3 Compressed Air System
- Chapter-4 HVAC and Refrigeration System
- Chapter-5 Fans and Blowers
- Chapter-6 Pumps and Pumping System
- Chapter-7 Cooling Tower
- Chapter-8 Lighting system
- Chapter-9 Diesel/Natural Gas Power Generating Station
- Chapter-10 Energy Conservation in Buildings and ECBC

Paper -4 Energy Performance Assessment for Equipment & Utility Systems



- Chapter-1 Boilers
- Chapter-2 Furnaces
- Chapter-3 Cogeneration Systems
- Chapter-4 Heat Exchangers
- Chapter-5 Electric Motors and Variable Speed Drives
- Chapter-6 Fans and Blowers
- Chapter-7 Pumps
- Chapter-8 Compressors
- Chapter-9 HVAC System
- Chapter-10 Financial Analysis

Paper -4 Energy Performance Assessment for Equipment & Utility Systems



- Chapter-11 Thermal Power Station
- Chapter-12 Steel Industry
- Chapter-13 Cement Industry
- Chapter-14 Buildings and Commercial Establishments
- Chapter-15 Textile Industry
- Designated Consumers

Section – I: OBJECTIVE TYPE

1. A 415V, 15KW 3 phase induction motor operates at full load 88% efficiency and 0.85 pf lagging. The current drawn by the motor is
- a) 42.5 A
 - b) 48.32 A
 - c 40 A
 - d) 27.9 A

Ans: Input Power = $15/0.88 = 17.045$ KW

$$\text{Current drawn} = 17.045 / (\sqrt{3} \times 415 \times 0.85) = 27.9\text{A}$$

Section – I: OBJECTIVE TYPE

2. The actual measured load of 1000 k VA transformer is 400 k VA. Find out the total transformer loss corresponding to this load if no load loss is 1500 Watts and full load Copper Loss is 12,000 Watts

- a) 1920 watts
- b) 1500 watts
- c) 3420 watts
- d) 13500 watts

Ans: Total Transformer Loss = No load loss+ $(X \text{ kVA}/\text{Rated kVA})^2 \times \text{Full load Copper loss}$
 $= 1500 + (400/1000)^2 \times 12000 = 3420 \text{ watts}$

Section – I: OBJECTIVE TYPE

3. What is the expected power output in watts from a wind turbine with 6m diameter rotor, a coefficient of performance 0.45, generator efficiency 0.8, a gear box efficiency 0.90 and wind speed of 11m/sec

- a) 4875 Watts
- b) 1100 Watts
- c) 7312 Watts
- d) 73.12 kW

Kinetic Energy from the wind = $\frac{1}{2} \times \text{mass} \times \text{velocity}^2$

Mass = $\rho \times A \times V$

Ans: Wind Power $P = \frac{1}{2} \times \rho \times A \times C_p \times N_g \times N_b \times V^3 = \frac{1}{2} \times 1.2 \times ((\pi/4) \times 6^2) \times 0.45 \times 0.8 \times 0.9 \times 11^3$
 $= 7312 \text{ Watts}$

Section – II: SHORT DESCRIPTIVE QUESTIONS

1. Estimate the cooling tower capacity (TR) & Approach with the following parameters

Water flow rate through CT = $120\text{m}^3/\text{hr}$.

Specific heat of water = $1\text{ kcal/kg}^\circ\text{C}$

Inlet water temperature = 37°C

Outlet temperature = 32°C

Ambient WBT = 29°C



➤ **Ans:** Cooling Tower Capacity (Kcal/hr) = Mass flow rate of water (kg/hr) $\times$ Specific heat (kcal/kg $^\circ\text{C}$) $\times$ Temp difference ($^\circ\text{C}$)

$$= 120 \times 1000 \text{ (kg/hr.)} \times 1 \text{ (kcal/kg}^\circ\text{C)} \times (37-32)^\circ\text{C} = 6,00,000 \text{ Kcal/hr}$$

$$= 6,00,000/3024 = \underline{198 \text{ TR}}$$

Approach = Outlet temp- Wet bulb temp = $32 - 29 = 3^\circ\text{C}$

Section – II: SHORT DESCRIPTIVE QUESTIONS

2. A 415 V, 15kW, 3-ph, 50Hz Induction motor operates at full load, with 88% efficiency and 0.85 power factor lagging:

a) Find the current drawn by the motor

b) If this motor is replaced by 92.5% energy efficient motor with 0.92 power factor, what will be the power savings in terms of k W and kVA?

a) Kw in (Input power) = $15 / 0.88 = 17.05 \text{ kW}$

$$\text{Line current} = 17.050 / (\sqrt{3} \times 0.415 \times 0.85) = 27.91 \text{ Amp}$$

$$\text{kVA in} = 17.05/0.85=20.06 \text{ kVA OR } (\sqrt{3} \times 415 \times 27.91)$$

b) For the same output of 15 kW

Input power with 92.5 % efficiency will be = $15/0.925 = 16.216 \text{ kW}$ and

Input kVA at 0.92 power factor will be = $16.216 / 0.92 = 17.62$

Therefore, saving will be $17.05 - 16.216 = 0.834 \text{ kW}$ $20.06 - 17.62 = 2.44 \text{ kVA}$

Section –III: LONG DESCRIPTIVE QUESTIONS

1. An efficiency assessment test was carried out for a standard 4 pole squirrel cage induction motor in a chemical plant. The motor specifications are as under:

Motor rated specification: 3 phase delta connected, 50HP, 415 Volt, 60 Amps, 1475 rpm,

The following data was collected during the no-load test on the motor:

Voltage = 415 Volts Current = 18 Amps Frequency = 50 Hz

Stator resistance per phase = 0.27 Ohms No load power = 1080 Watts Amp Temp = 35°C

Calculate the following:

- (i) Iron plus friction and windage losses.
- (ii) Stator resistance at 120°C.
- (iii) Stator copper loss at operating temperature of 120°C.
- (iv) Full load slip and rotor input assuming rotor losses are slip times rotor input.
- (v) Motor input assuming that stray losses are 0.5% of the motor rated output power.
- (vi) Motor full load efficiency and Full load PF

Section –III: LONG DESCRIPTIVE QUESTIONS



2 : A food processing plant has a contract demand of 2500 kVA with the power supply company. The average maximum demand of the plant is 2000 kVA at a power factor of 0.95. The maximum demand is billed at the rate of Rs.300/kVA. The minimum billable maximum demand is 75 % of the contract demand. An incentive of 0.5 % reduction in energy charges component of electricity bill are provided for every 0.01 increase in power factor over and above 0.95. The average energy charge component of the electricity bill per month for the company is Rs.10 lakhs. The plant decides to improve the power factor to unity. Determine the power factor capacitor kVAr required, annual reduction in maximum demand charges and energy charge component. What will be the simple payback period if the cost of power factor capacitors is Rs.800/kVAr ?

Problems – 20 marks

An Energy audit of electricity bills of a process plant was conducted. The plant has contract demand of 5000kVA with the power supply company. The average Max Demand of the Plant is 3850kVA/month at a Power Factor of 0.95. The max demand is billed at the rate of Rs 600/kVA/month. The minimum billable max demand is 75% of Contract demand. An incentive of 0.5% reduction in energy charges component of electricity bill are provided for every 0.01 increase in power factor over and above 0.95. the average energy charge component of the electricity bill per month for the plant is Rs 18 Lakhs.

The plant decided to improve the Power factor to unity. Determine the Power factor capacitor kVAR required, annual reduction in Maximum demand charges and Energy component. What will be the simple payback period if the cost of power factor capacitors is Rs 900/kVAR.

Green Tech Learning Provides

Complete Course Materials for all Four papers

- Power Point Presentation
- Objective Questions with Solutions
- Important Equations
- Last 10 years question Paper with Solutions
- Poll Questions
- Complete Notes
- Practical Discussions of Energy Audit & Analysis (Paper-4)



Green Tech

LEARNING

Website: www.greentechlearning.com

Mailid: greentechlearningsolutions@gmail.com

Mobile: +919037502805

Start Preparation Today for EA/EM Exam



Offer for Online Course

Rs-3000/ - For First Registered Candidates for first Three Papers

Rs-4000/ - For First Registered Candidates for Fourth Paper



QUESTIONS ???



BUREAU OF ENERGY EFFICIENCY

Examination Registration No. **EM-11525/21** Serial Number **17345**
 Certificate Registration No. **17345**



Certificate For Certified Energy Manager

This is to certify that Mr./Mrs./Ms. **RENJITH P C**
 Son/Daughter of Mr./Mrs. **SANKUNNI NAIR V V** who has passed the National
 Examination for certification of energy manager held in the month of **September 2021** is
 qualified as certified energy manager subject to the provisions of Bureau of Energy Efficiency
 (Certification Procedures for Energy Managers) Regulations, 2010.

This certificate shall be valid for five years with effect from the date of award of this certificate
 and shall be renewable subject to attending the prescribed refresher training course once in every
 five years.

His /Her name has been entered in the Register of certified energy manager
 at Serial Number **17345** being maintained by the Bureau of Energy Efficiency under the
 aforesaid regulations.

Mr./Mrs./Ms. **RENJITH P C** is deemed to have qualified
 for appointment or designation as energy manager under clause (f) of Section 14 of the Energy
 Conservation Act, 2001 (Act No.52 of 2001).

Given under the seal of the Bureau of Energy Efficiency, this **28th** day
 of **February, 2022**

Digitally Signed: RAKESH KUMAR RAI
 Wed Feb 23 15:57:03 IST 2022
 Secretary, BEE New Delhi

Secretary
 Bureau of Energy Efficiency
 New Delhi

Dates of attending the refresher course	Secretary's Signature	Dates of attending the refresher course	Secretary's Signature



ऊर्जा दक्षता ब्यूरो

परीक्षा रजिस्ट्रारकरण सं. **EM-11525/21** क्रम सं. **17345**
 प्रमाणपत्र रजिस्ट्रारकरण सं. **17345**



प्रमाणित ऊर्जा प्रबंधक के लिए प्रमाणपत्र

यह प्रमाणित किया जाता है कि श्री / श्रीमती / सुश्री **रेन्जिथ पी सी**
 जो श्री / श्रीमती **संकुन्नी नायर वी वी** के पुत्र / पुत्री हैं जिन्होंने वर्ष **2021**
 मास **सितम्बर** में आयोजित ऊर्जा प्रबंधक प्रमाणन के लिए राष्ट्रीय परीक्षा उत्तीर्ण की है, ऊर्जा दक्षता
 ब्यूरो (ऊर्जा प्रबंधकों के लिए प्रमाणन प्रक्रिया) विनियम 2010 के उपबंधों के अधीन रहते हुए प्रमाणित
 ऊर्जा प्रबंधक के रूप में अर्हक हैं।

यह प्रमाणपत्र, प्रदान किए जाने की तारीख से पांच वर्ष के लिए विधिमान्य होगा और प्रत्येक पांच वर्ष में
 एक बार विहित पुनरुत्थान प्रशिक्षण पाठ्यक्रम में उपस्थित रहने के अधीन रहते हुए पुनः नवीकरण किया जाएगा।

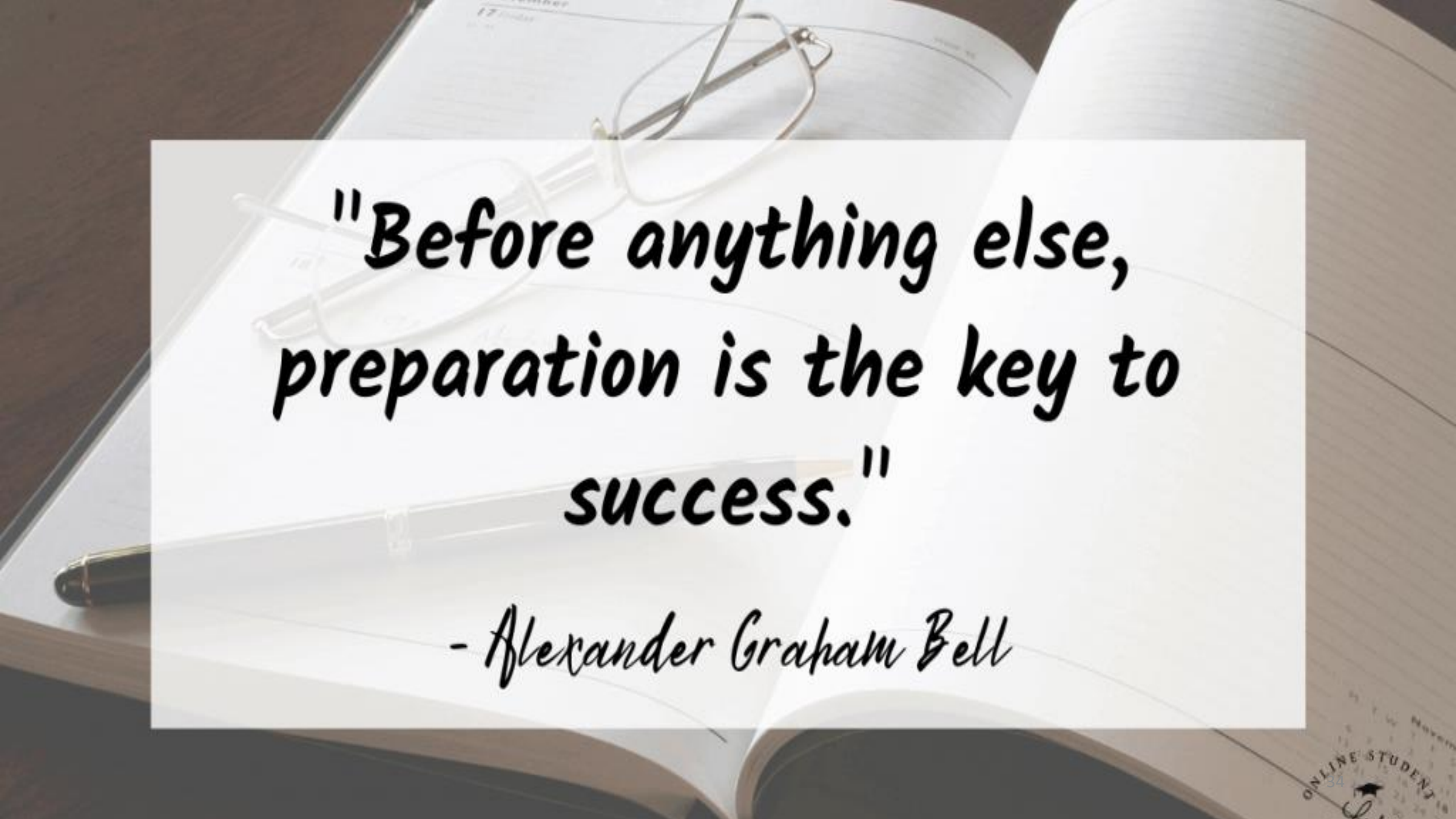
उनके नाम को पूर्वोक्त विनियमों के अधीन ऊर्जा दक्षता ब्यूरो द्वारा अनुरक्षित क्रम संख्या **17345**
 पर प्रमाणित ऊर्जा प्रबंधक के रजिस्टर में प्रविष्ट कर दिया गया है।

श्री / श्रीमती / सुश्री **रेन्जिथ पी सी** ऊर्जा संरक्षण अधिनियम 2001 (2001 का
 अधिनियम संख्यांक 52) की धारा 14 के खंड (f) के अधीन ऊर्जा प्रबंधक के रूप में नियुक्ति या पदनाम के
 लिए अर्हित समझे गए हैं।

2022 मास **फरवरी** दिन **28** को ऊर्जा दक्षता ब्यूरो के अधीन दिया गया है।

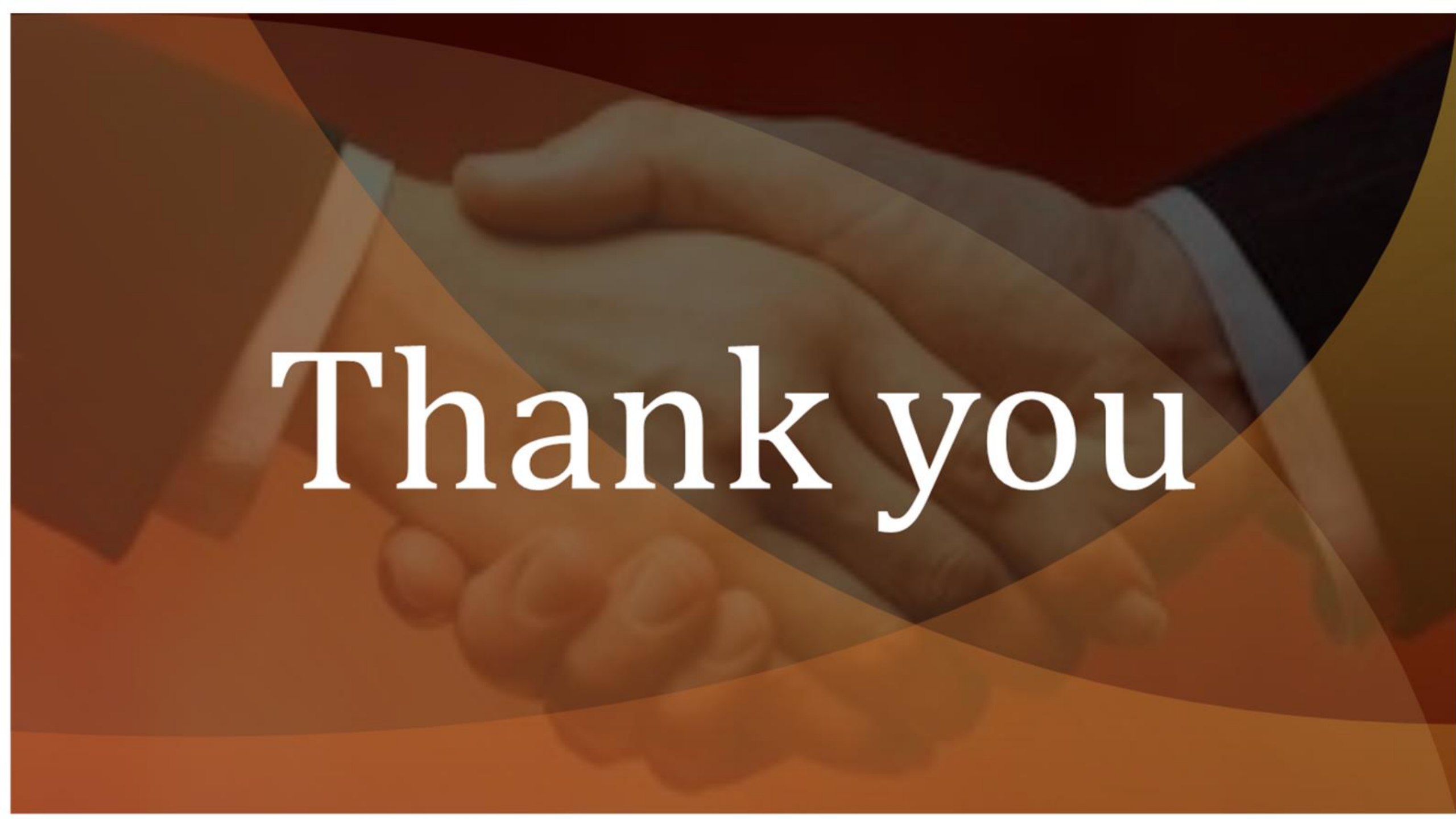
सचिव
 ऊर्जा दक्षता ब्यूरो
 नई दिल्ली

पुनरुत्थान पाठ्यक्रम में उपस्थित रहने की तारीखें	सचिव के हस्ताक्षर	पुनरुत्थान पाठ्यक्रम में उपस्थित रहने की तारीखें	सचिव के हस्ताक्षर



**"Before anything else,
preparation is the key to
success."**

- Alexander Graham Bell



Thank you