

**10th National Certification Examination
for Energy Managers and Energy Auditors – July 2010
(under the Energy Conservation Act, 2001)**

**(For Supplementary Candidates and Up gradation from
EM to EA Candidates only)**

**17th & 18th July 2010
Saturday & Sunday**



BUREAU OF ENERGY EFFICIENCY (BEE)

(A Statutory body under Ministry of Power,
Government of India)

National Certifying Agency

NATIONAL PRODUCTIVITY COUNCIL, INDIA

(Under the Department of Industrial Policy & Promotion,
Government of India)





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Under the provisions of the Energy Conservation Act, Bureau of Energy Efficiency has been established with effect from 1st March 2002. The Bureau is responsible for spearheading the improvement of energy efficiency of the economy through various regulatory and promotional instruments. The Mission of Bureau of Energy Efficiency (BEE) is to develop policy and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act (EC Act), 2001 with the primary objective of reducing energy intensity of the Indian economy. This will be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors.

The Bureau is headed by its Director-General. The Director General is responsible to the Governing Council which is headed by the Union Minister of Power and consists of Secretaries of various line Ministries, heads of various technical agencies under the Ministries, members representing industry, equipment and appliance manufacturers, architects, and consumers, and members from each of the five power regions representing the states of the region.

The Bureau of Energy Efficiency has initiated various promotional and mandatory provisions of the Act. The voluntary program of sharing of best practices, undertaking of specific energy consumption targets has full acceptance in the 8 sectors of industry. On the mandatory provisions front, energy managers and energy auditors capacity is being developed and nine certification examinations have been successfully conducted. The programme of fixation of norms under EC Act has also been initiated for cement and pulp & paper sectors. Energy audit study of 8 prestigious Government buildings in Delhi has been completed and implementation of the findings has been implemented in Rashtrapati Bhawan, Shram Shakti Bhawan & Transport Bhawan and PMO through ESCO route. This has encouraged other Building owners to undertake similar efforts. Further, Energy labeling program for frost free and direct cool refrigerators, window air conditioners, distribution transformers and tubular fluorescent lighting systems has been launched by BEE. Energy Conservation Building Code has also been launched by Ministry of Power on 27th May 2007 on voluntary basis.



महानिदेशक
ब्यूरो ऑफ एनर्जी एफिशिएन्सी
भारत सरकार
विद्युत मंत्रालय
DIRECTOR GENERAL
BUREAU OF ENERGY EFFICIENCY
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NEW DELHI-110 066

Foreword

The Indian economy is growing rapidly, and along with it the demand for energy services is also growing in lockstep. The task of meeting these energy services is challenging because conventional approaches through increased mining of our limited fossil fuel reserves and enhanced imports of hydrocarbons would further exacerbate the security of our energy supply, the vulnerability of our economy to external fuel price volatility and shocks and adverse environmental impacts of energy production, transformation and consumption.


Consequently, continuing energy efficiency improvements are at the heart of our new energy strategy, synthesized in the Integrated Energy Policy produced by the Planning Commission in September 2006. Energy efficiency improvements would allow decoupling of economic growth from energy growth, allowing the economy to expand much more rapidly with lower growth rate of energy supply. This would also enable the Indian industry to become more competitive globally - a route that many Indian companies are now beginning to adopt.

The Energy Conservation Act, 2001 has sought to promote energy efficiency in highly energy intensive sectors such as industry, buildings, railways etc., by mandating them as designated consumers to use accredited energy auditors to carry out periodic energy audits, and to employ energy managers to oversee the energy use in the unit, including the implementation of the recommendation of the energy auditors. The Act also charges this Bureau with the responsibility of certifying energy auditors and energy managers.

The Bureau has successfully conducted Nine National Certification Examinations since 2004. The Tenth National Certification Examination is now being launched and we hope that it will further add substantially to the pool of energy managers and energy auditors in the country.

The Bureau has designated National Productivity Council as the national certifying agency for the conduct of the National Certification Examination. National Productivity Council has also prepared guidebooks for the Examination, which would be supplied to all candidates registering for the Examination.

I invite you to register for the 10th National Certification Examination (for Supplementary Candidates and Upgradation from EM to EA Candidates only), and wish you all the very best for your success in the Examination,


Dr. Ajay Mathur

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Annexure – 1 : Syllabus

01. Background

The Government of India has enforced **The Energy Conservation Act, 2001** (No 52 of 2001, 29th September 2001) with effect from 1st March 2002. The Act provides mainly for efficient use of energy and its conservation and for matters connected therewith or incidental thereto. As per the Energy Conservation Act 2001, it is mandatory for all the **designated energy consumers** to get energy audit conducted by an **Accredited Energy Auditor** [under clause 14(h) and 14(i)] and to designate or appoint an **Energy Manager** [under clause 14(l)]. The Government of India has notified the list of designated consumers and the details are available at the following link: [http://www.bee-india.nic.in/sidelinks/Exams07/Gazette_of_IndiaPartIIISec3Sub-sec\(ii\)19_03_2007.pdf](http://www.bee-india.nic.in/sidelinks/Exams07/Gazette_of_IndiaPartIIISec3Sub-sec(ii)19_03_2007.pdf)

Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India, is empowered to specify the regulations and mechanism to meet the above objectives. BEE has retained the **National Productivity Council (NPC)** as the National Certifying Agency, which would conduct the National Level Certification Examination for Energy Managers & Energy Auditors under the aegis of Bureau.

02. Need for National Level Certification Examination

The essential qualification for a Certified Energy Manager and Certified Energy Auditor would be the passing of a National Level Certification Examination, which will be conducted under the aegis of Bureau of Energy Efficiency. The national level certification examination, conducted by a National Certifying Agency, will establish a uniform criterion for the certification of energy managers/energy auditors and will also ensure that services of qualified persons, having the requisite knowledge on the subject, are available to the industry.

The certification examination will be conducted based on the syllabus/curriculum approved by the Bureau. The proposed syllabus will go under modifications from time to time based on the feed back received and future developments. The requisite modifications will be incorporated by the national level certification agency in the syllabus in consultation with the Bureau from time to time.

03. Energy Auditor – Role and Importance

Energy audit involves a systematic study undertaken on major energy consuming sections and equipments including construction of heat and mass balance with a view to identify the flow of energy, efficient use of energy in each of the steps and pin-point wastage of energy. A well-conducted energy audit would reveal the areas of wastage of energy and it would lead to suggestions for possible energy savings in all sectors.

The Energy Conservation Act requires that the every designated consumer, as notified, may get the energy audit done through an Accredited Energy Auditor in a manner and interval of time as specified. **The Certified Energy Auditor, as such, is not authorized to conduct such mandatory energy audits under the EC Act. (Certification may be one of the prerequisites along with other conditions, which have to be fulfilled by an energy auditor before applying for accreditation)** The energy audit report is to contain recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption [Clause 14(i)]. The conduct of energy audit and implementation of its recommendations on cost-benefit basis through accredited energy auditors is expected to help the designated energy consumers to achieve significant reduction in their energy consumption levels.

Responsibilities and Duties of Energy Auditor are highlighted below:

- Carry out a detailed energy audit
- Quantify energy consumption and establish base line energy information
- Construct energy and material balance
- Perform efficiency evaluation of energy & utility systems
- Compare energy norms with existing energy consumption levels
- Identify and prioritization of energy saving measures
- Analyse technical and financial feasibility of energy saving measures
- Recommend energy efficient technologies and alternate energy sources
- Report writing, presentation and follow up for implementation

04. Energy Manager – Role & Importance

Energy manager occupies an important position and is the focal point of all the activities pertaining to energy management in the organization. The energy manager provides leadership in the development of policy on Energy Management Action Plan and plays a key role in the formulation of corporate energy policy. Energy managers also perform the activities related with Energy Management, Project Management, Personnel Management and Financial Management at the plant level. He also prepares the information to be submitted to the Designated Agency with regard to the energy consumed and action taken on the recommendation of the Accredited Energy Auditor [Clause 14(k)].

Responsibilities and Duties of Energy Manager are highlighted below:

- Establish an energy conservation cell & prepare an annual activity plan
- Develop and manage training programme for energy efficiency at operating levels
- Develop integrated system of energy efficiency and environmental improvement
- Initiate activities to improve monitoring and process control to reduce energy costs
- Co-ordinate implementation of energy audit/efficiency improvement projects through external agencies
- Establish / participate in information exchange with other energy managers of the same sector through association
- Provide information to BEE and Designated Agency of the respective States as demanded in the Act.

05. Examination Papers and Scheme

a) The examination Papers for Energy Managers and Energy Auditors are given below:

Paper No	Name of the Paper	Duration	Max Marks
I	General Aspects of Energy Management & Energy Audit.	3 Hrs	150
II	Energy Efficiency in Thermal Utilities	3 Hrs	150
III	Energy Efficiency in Electrical Utilities	3 Hrs	150
IV	Energy Performance Assessment for Equipment and Utility systems (Open Book Examination)**	2 Hrs	100

- b) The candidate appearing for Energy Manager Examination has to pass all the above **THREE papers**, viz., Paper-I, Paper-II and Paper-III and obtain a minimum of 50% of the maximum marks in each paper.
- c) The candidate appearing for Energy Auditor Examination has to pass all the above **FOUR papers** viz., Paper-I, Paper-II, Paper-III & Paper-IV and obtain a minimum of 50% of the maximum marks in each paper.
- d) **Question Papers for Energy Manager and Energy Auditor are common for the first three papers viz. Paper-I, Paper-II and Paper-III. Energy Auditor candidate passing the above three papers shall be eligible for award of Energy Manager Certification.** This clause is **not applicable** to the supplementary candidates of the 1st National Certification Examination for Energy Managers and Energy Auditors conducted in 2004.
- e) **The degree of difficulty in Paper-IV will be comparatively much higher than other papers.**
- f) Medium of examination is English.
- g) Paper-I, Paper-II and Paper-III shall consist of objective and descriptive type questions.

- h) The Paper-IV for Energy Auditors will be an open book examination and shall consist of descriptive and numerical questions.

**** The candidates can refer only the guide books supplied, at the time of their registration, during the paper IV examination. No other reference books and written material will be allowed.**

- i) The syllabus for all the papers is given in Annexure – I.

j) Up gradation of EM Certification to EA Certification

Bureau of Energy Efficiency has approved the Up gradation of Energy Manager Certification to Energy Auditor Certification. This clause is **not applicable** to the candidates registered for the 1st National Certification Examination for Energy Managers and Energy Auditors conducted in 2004.

The candidates who have qualified for Energy Manager certification and who fulfill the eligibility criteria for writing the Energy Auditor Certification [**Refer item 05 (b)**] as given above are eligible for upgrading EM Certification to EA Certification.

The choice for issue of exercising this option to an eligible Certified Energy Manager is restricted within a period of 5 years from the date of issue of his/ her Energy Manager Certification.

Those eligible candidates need to appear only for Paper-4 - Energy Performance Assessment for Equipment and Utility Systems (Open Book Examination). The candidates can register online and send the printout of filled-in application along with the requisite examination fee.

06. Minimum Marks for Award of Certificates

- a) **For Certification of Energy Managers:**
50% of the maximum marks in each paper in Paper-I, Paper-II and Paper-III
- b) **For Certification of Energy Auditors:**
50% of the maximum marks in each paper in Paper-I, Paper-II, Paper-III & Paper-IV.

Note: 1. A candidate qualifying as Certified Energy Auditor automatically qualifies for Certified Energy Manager as well. Such persons can be considered for appointment or designated as Energy Manager under the EC Act, 2001 by the Designated Consumers.

07. Supplementary Candidates

A registered candidate, who fails or fails to appear in any one or more papers in his first National Examination, shall be eligible to re-write the same paper(s) by appearing in a **maximum number of five subsequent examinations within six years from the date of first registration**, by paying prescribed supplementary examination fee.

On the basis of his results of the re-written paper(s), the candidate shall be declared to have passed the examination, provided he secures minimum of 50% marks in each of the re-written papers as applicable. In case, he does not secure minimum of 50% marks in each re-written paper(s) as stipulated above, he shall be deemed to have failed in the said National Certification Examination for which the candidate has registered.

The candidate, however, shall have the option to apply and register himself as a fresh candidate in subsequent National Certification Examinations.

However, as stated above at 6 (d), **Energy Auditor candidates passing the paper I, II and III shall be eligible for award of Energy Manager Certification.** This clause is **not applicable** to the supplementary candidates of the 1st National Certification Examination for Energy Managers and Energy Auditors conducted in 2004.

08. Validity of the Certificate

The certificate shall be valid for life time until it is cancelled, subject to the condition of attending of an authorized refresher training course of short term duration by the candidate in a designated /approved institute or organization (to be announced by the Bureau) once in a 5 year time period, commencing from the date of award of certificate. A six- month's grace period will also be provided to the certified energy manager and energy auditors after the expiry of 5-year period. The Candidate will be required to inform the BEE about the attendance of the refresher course on a specified format so that a fresh certificate is issued to the candidate for another 5-year period.

09. Revocation of Certificate

The Certificate can be revoked on the ground of proved instances of unprofessional / unethical practices followed by a Certified Energy Manager and Certified Energy Auditor. The Bureau shall constitute a Committee for this purpose, which will investigate the matter. The concerned Certified Energy Manager and Energy Auditor will be informed of the charges against him and given a reasonable opportunity of being heard in respect of such charges.

10. Examination Centres

a) The proposed centres for conduct of the written examination are: –

Ahmedabad, Bangalore, Bhopal, Bhubaneswar, Chandigarh, Chennai, Cochin, Dehradun, Delhi/NCR, Goa, Guwahati, Hyderabad, Jabalpur, Jaipur, Kanpur, Kolkata, Mumbai, Nagpur, Patna, Pune, Raipur, Ranchi, Thiruvananthapuram and Vadodara.

c) The applicant will have to give three choices of examination centres in the order of preference.

d) If the number of applicants for a particular centre is found to be less than the minimum required number, the examination centre for those applicants can be shifted to next preferred centres.

11. Examination Schedule

Paper No	Examination Paper	Examination Date	Time
I	General Aspects of Energy Management & Energy Audit.	17 th July 2010	0930-1230 Hrs
II	Energy Efficiency in Thermal Utilities	17 th July 2010	1400-1700 Hrs
III	Energy Efficiency in Electrical Utilities	18 th July 2010	0930-1230 Hrs
IV	Energy Performance Assessment for Equipment and Utility systems (Open Book Examination)	18 th July 2010	1400–1600 Hrs

12. Fee

FOR SUPPLEMENTARY CANDIDATES

Application Fee: Nil

Supplementary Examination Fee:

Rs.1500 /- per paper for both Self-sponsored & Company Sponsored candidates (Rs.750/- per paper for Self-sponsored candidates belonging to SC/ST/OBC having annual income not more than Rs.4.5 lakhs).

FOR UP GRADATION FROM ENERGY MANAGER TO ENERGY AUDITOR

Up gradation Fee: Rs. 1500/- for Self-sponsored candidates (Rs.750/- for self-sponsored candidates belonging to SC/ST/OBC having annual income not more than Rs.4.5 lakhs).

Note: Those Candidates claiming fee concession has to submit copies of necessary supporting documents.

- ◆ Prospectus can be downloaded and the candidate **has to apply online** accessing the websites www.aipnpc.org or www.em-ea.org or www.energymanagertraining.com or www.bee-india.nic.in and take the printout of the filled in application form and send it along with requisite fee by Demand Draft in favour of “**Bureau of Energy Efficiency**” payable at “**Chennai**” along with Application Form for Registration.

13. Guide Books

The Guide Books will not be supplied to supplementary candidates as the fee for written examination has been reduced by Rs. 500 per paper for General candidates and by Rs. 250 for SC/ST/OBC candidates. The supplementary candidates can refer the books supplied to them at the time of their registration.

14. Registration and Certification Process

- Registration for the certification Examination will be done on receipt of the filled-in application form along with requisite fees from the candidates
- **Printout of the Hall Tickets can be taken online at www.aipnpc.org 15 days before the commencement of the examination.**
- The results of the written examination will be communicated to all the candidates and also displayed online at www.aipnpc.org
- Certificates and credentials will be awarded to the successfully passed eligible candidates.

15. Role of NPC as the National Certifying Agency

The Bureau of Energy Efficiency has retained the National Productivity Council (NPC) as the National Certifying Agency, which would conduct the National Level Certification Examination for Energy Managers & Energy Auditors.

NPC will carry out the following activities as a National Certifying Agency: -

- 1) Dr. Ambedkar Institute of Productivity (AIP), NPC, Chennai will receive the applications from the candidates and register them as per the laid down procedures.
- 2) NPC will send all necessary instructions in respect of the Certifying Examination and other details such as the venue of examination, timings, code of conduct for the candidates who are registered for the examination for Energy Managers and Energy Auditors.
- 3) NPC will administer the examination in all the centres.
- 4) NPC would issue the Certificates and Credentials under the seal of Bureau of Energy Efficiency, a statutory body under Ministry of Power, Government of India to the successfully passed eligible candidates.

16. Conditions and instructions to the Candidates

01. Read the prospectus completely.
02. All entries should be correctly filled.
03. Affix self-attested recent passport size photograph in application form.

04. Enclose Demand Draft towards the fees in favor of **Bureau of Energy Efficiency** payable at **Chennai**.
05. Self-sponsored candidates (individual in the category of SC/ST/OBC & having annual income not more than Rs. 4.5 Lakhs/annum) will be required to submit the attested copies of the necessary supporting documents as per the **formats applicable for Govt. of India Postings**. Other formats issued in local languages will not be accepted.
06. **Filled-in application form along with requisite fee should reach the following address on or before 25th June 2010:**

**The Director
Dr. Ambedkar Institute of Productivity
National Productivity Council
6, SIDCO Industrial Estate, Ambattur,
Chennai – 600 098
Tel. No. 044 – 26251808/26255216
Fax No. 044 – 26254904/26255012
Email: ainnpc@vsnl.net**

Note: All correspondence related with Certification Examination should be made to the above address only.

07. Use the Guide books for the Preparation of examination
08. It is not compulsory to undertake any preparatory training program before appearing in the National Certification Examination. Further, BEE has neither authorized any agency to conduct such preparatory training programs nor provides any guarantee on the quality of their training materials.
09. **The fees paid by a candidate who has been admitted to the National Examination, shall not be refunded or adjusted under any circumstances on the basis of medical or any other ground.**
10. The candidates will have the responsibility to cross check the information on allotted examination centres, issue of hall tickets and other instructions issued from time to time, from the below mentioned websites.
11. Any candidate, who does not receive or loses the admission ticket, shall report to the allotted examination centre with documentary evidence of having registered for National Examination. Information on the allotted examination centres may be seen at the web-site(s) mentioned in the prospectus.
12. (a) If a candidate on declaration of the results of National Examination is not satisfied with the marks given in any paper(s) and feels that there is possibility of either omission in marking of any answer(s) or there is possibility of mistake in totaling of the marks in any paper(s), the candidate may seek verification of all or any paper on his submitting an application accompanied by a fee of Rs 200 for each paper, to be paid by DD drawn in favour of “**Bureau of Energy Efficiency**” payable at “**Chennai**”, to the NPC, Chennai **within a month of the declaration of the results** of the said National Examination. The Bureau or the Agency shall entertain no request for such verification after the expiry of the said period of one month.

(b) A candidate shall be eligible to seek verification of paper(s) of the said National Examination for one time only.

(c) The process of verification shall be completed with in a period of one month from the date of receipt of the application by the NPC

(d) The marks obtained by a candidate in individual questions of paper(s) shall not be supplied.

(e) Request for revaluation of evaluated Answer Books will not be entertained.

(f) **Photocopies of evaluated Answer Books will not be made available to candidates.**

13. BEE reserves the right to change the examination dates due to some unforeseen reasons and reasons beyond its control.
14. It is compulsory for the registered candidates to give E-mail ID, as most of the communication regarding the examination will be sent by E-mails.
15. For Examination updates visit websites www.aipnpc.org, www.bee-india.nic.in, www.energymanagertraining.com , www.em-ea.org

INSTRUCTIONS FOR CANDIDATES TO APPLY ONLINE

GENERAL INFORMATION:

1. Candidates are advised to go through the prospectus before filling the online application form.
2. You should have an email id (If you don't have an email account please create one in free sites)
3. **The candidates should keep ready and submit the details of Fee payment, Educational Qualification, Experience while filling in the ONLINE APPLICATION.**

How to Apply

- Fill online application form at www.aipnpc.org and click "**Submit**" button for registration. You can have a **preview** of the application form. If any changes are to be done you can go back and make necessary changes. If all the details are correct, click "**confirm**" button. (After confirmation no changes can be done. However, the candidates can fill the online application afresh and submit again. The application form received with fee will alone be accepted)
- **Take a print out of the generated online application form after successful submission of data.**
- Affix, Sign one passport size photo in the application.

Send the printed application form along with requisite fee through post or courier to reach the following address on or before **25th June 2010**:

The Director
Dr.Ambedkar Institute of Productivity
National Productivity Council
6, SIDCO Industrial Estate, Ambattur
Chennai – 600 098
Phone:044-26251808/26255012 Fax: 044-25255012
Email: aipnpc@vsnl.net

- **Applications received after the last date OR in any other format other than the prescribed one OR incomplete will be summarily rejected. Delays in transit would be rejected without assigning any reason.**
- **In all subsequent correspondence make sure that invariably you quote the registration number, which you will receive in your acknowledgment by email.**

For any clarification contact us at aipnpc@vsnl.net

List of Enclosures to be attached with the Application.

- 1 DD towards supplementary exam fee in favor of Bureau of Energy Efficiency payable at Chennai.
- 2 Affix one self-attested recent passport size photograph in application form.
- 3 Proof of SC/ST/OBC certificates as per Govt. of India format in case of claiming fee concession. **Certificates issued in local languages will not be accepted.**
- 4 Proof of Income certificate for self sponsored candidates in the category of SC/ST/OBC & having annual income not more than Rs.4.5 Lakhs.

Syllabus for Energy Managers and Energy Auditors Certification Examination

PAPER-1: GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT

1.1 **Energy Scenario:** Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, re-structuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

1.2 **Basics of Energy and its various forms:** Electricity basics- DC & AC currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

1.3 **Energy Management & Audit:** Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.

1.4 **Material and Energy balance:** Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

1.5 **Energy Action Planning:** Key elements, force field analysis, Energy policy purpose, perspective, contents, formulation, ratification, Organizing – location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability. Motivating-motivation of employees: Information system-designing barriers, strategies; Marketing and communicating-training and planning.

1.6 **Financial Management:** Investment-need, appraisal and criteria, financial analysis techniques-simple pay back period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of ESCOs.

1.7 **Project Management:** Definition and scope of project, technical design, financing, contracting, implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification.

1.8 **Energy Monitoring and Targeting:** Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques -energy consumption, production, cumulative sum of differences (CUSUM).

1.9 **Global environmental concerns:** United Nations Framework Convention on Climate Change (UNFCCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon fund (PCF).

PAPER 2: ENERGY EFFICIENCY IN THERMAL UTILITIES

2.1 **Fuels and Combustion:** Introduction to fuels, properties of fuel oil, coal and gas, storage, handling and preparation of fuels, principles of combustion, combustion of oil, coal and gas.

2.2 **Boilers:** Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities.

2.3 **Steam System:** Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings.

2.4 **Furnaces:** Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.

2.5 **Insulation and Refractories:** Insulation-types and application, economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss.

2.6 **FBC boilers:** Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, retrofitting FBC system to conventional boilers, saving potential.

2.7 **Cogeneration:** Definition, need, application, advantages, classification and saving potentials.

2.8 **Waste Heat Recovery:** Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential.

PAPER 3: ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

3.1 **Electrical system:** Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses.

3.2 **Electric motors:** Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

3.3 **Compressed Air System:** Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities

3.4 **HVAC and Refrigeration System:** Vapor compression refrigeration cycle, refrigerants, coefficient of performance, capacity, and factors affecting Refrigeration and Air conditioning system performance and savings opportunities.
Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system, saving potential

3.5 **Fans and blowers:** Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

3.6 **Pumps and Pumping System:** Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

3.7 **Cooling Tower:** Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities assessment of cooling towers.

3.8 **Lighting System:** Light source, choice of lighting, luminance requirements, and energy conservation avenues.

3.9 **Diesel Generating system:** Factors affecting selection, energy performance assessment of diesel conservation avenues.

3.10 **Energy Efficient Technologies in Electrical Systems:** Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

PAPER-4: ENERGY PERFORMANCE ASSESSMENT FOR EQUIPMENT AND UTILITY SYSTEMS

Open Book examination on the following energy performance assessments for equipment and utility systems:

- 4.1 **Boilers, Furnaces**
- 4.2 **Cogeneration, Turbines (gas, steam),**
- 4.3 **Heat Exchangers,**
- 4.4 **Electric Motors, Variable Speed Drives,**
- 4.5 **Fans and Blowers, Water Pumps, Compressors,**
- 4.6 **HVAC systems**
- 4.7 **Lighting Systems,**
- 4.8 **Performing Financial Analysis.**
- 4.9 **Applications of Non-conventional & Renewable Energy Sources (NRES)**
- 4.10 **Waste minimization and resource conservation**



NATIONAL PRODUCTIVITY COUNCIL, INDIA

The National Productivity Council is a national level organization, founded in 1958 by the Government of India. NPC is an autonomous, tri-partite, non-profit organization with equal representation from the government, employers and workers' organizations, apart from technical and professional institutions and other interests on its governing council. Besides its headquarters at New Delhi, NPC operates through 14 offices in India with 250 highly qualified and experienced specialists representing various disciplines.

Training Institute: Dr. Ambedkar Institute of Productivity (AIP) is a long-term training wing of the National Productivity Council of India. The Institute plays a wider role of running 2 years P.G Programmes and Short-term programmes in Managerial & Technical areas.

Mission: Development, Dissemination and Application of knowledge and experience in productivity, for promoting consciousness and improvement in productivity, with the objective of strengthening the performance and competitiveness of the national economy as well as of improving the working conditions and quality of working life.

Objectives: NPC is aiming to promote the cause of productivity in industry, agriculture, service, infrastructure and other sectors of the economy. It aims to help in achieving sustained all round development in India, leading to enhancement of quality of life of people in general. The concept of productivity as perceived by NPC encompasses not only a more efficient use of resources, but also of quality, environmental protection and integrated economic and social development. NPC aims at promoting these as a part of its objectives and activities. NPC possesses a well-equipped Library-cum-Documentation centre.

Services: Besides providing training, consultancy and undertaking research in the area of productivity, NPC also implements the productivity promotion plans and programmes of the Tokyo based Asian Productivity Organization (APO) an inter-governmental body of which the Government of India is a founder member.

Thrust Areas: NPC also conducts institutional training programmes for the development of consultants in Productivity and Management in the areas of Industrial Engineering, Energy Management & Energy Audit, Environment Management, Plant Engineering, HRD, TPM, TQM, Financial Management, Marketing Management and Agricultural Productivity.

NPC aims at propagating productivity as an evolving concept, which includes attention to special issues, and concerns relating to quality, environment, energy, integrated rural and community development, women workers etc. NPC's thrust is on providing modern and high quality productivity-related services to sectors not adequately addressed by others, especially the small-scale industry and informal sector.

NPC has been active in the area of Energy Conservation & Management for over three decades and has undertaken numerous studies at macro, sectoral and unit levels through its team of committed professionals. It promotes rational use of energy through: Optimization of Methods Improvement, Technology Upgradation and Application of alternative energy sources.



*“What we know is only handful
What we don't know is oceanful”*

- Avvaiyar, Tamil poet, 2 AD.



For any further details, please contact



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