

NATIONAL PRODUCTIVITY COUNCIL

PROSPECTUS

for

**One Year Post Graduate Programme In
ENERGY MANAGEMENT**

2009 - 2010



**Dr. AMBEDKAR INSTITUTE OF PRODUCTIVITY
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NATIONAL PRODUCTIVITY COUNCIL

The National Productivity Council, established in 1958 is an autonomous organization registered as a society. It is tripartite in its constitution and representatives of Government, employers and workers and various professional bodies participate in its working. Besides its headquarters at New Delhi, NPC operates through twelve Regional Directorates and three Regional Offices. Its activities are further extended by nation-wide network of 48 Local Productivity Councils.

The objective of NPC is to stimulate productivity consciousness in the country and to provide productivity services with a view to maximizing the utilization of available resources of men, machines, materials and power, to wage war against waste, and to help secure for the people of the country a better and higher standard of living. To this end, NPC collects and disseminates information about the concept and techniques of productivity and management through various publications including periodicals and audio-visual media of films, radio and exhibitions. It organizes and conducts seminars and training programmes for various levels of management in the subjects of productivity and management.

With a view to demonstrating the validity and value application of productivity and management techniques, NPC offers consultancy service (Productivity Survey and Implementation Service) for which the demand has been steadily rising. The service is intended to help industry; departments of Government and service organizations adopt techniques of better management and operational efficiency consistent with the economic and social aspirations of the Nation.

NPC has established various other specialized services, such as Fuel Efficiency Services, Plant Engineering and Production Engineering Services, Productivity Services for public sector undertakings, public utilities, public administration, post-harvest operations in agriculture and small industries; Applied Productivity Research for evolving trends and indices of productivity in the core sector of economy; National Scheme of Supervisory Development under which an examination is held and National Certificate in Supervision is awarded to the successful candidates and Productivity Programmes for Trade Union Leaders and Workers. NPC also conducts institutional training programmes for the development of consultants in Productivity and Management in the areas of Industrial Engineering, Fuel Efficiency, Plant Engineering, Behavioural Sciences, Finance Management, Marketing Management and Agricultural Productivity.

NPC's professional staff consists of about 150 highly qualified and experienced specialists representing various disciplines relevant to management and productivity. NPC possesses a well-equipped Library-cum-Documentation Centre.

BACKGROUND

Energy intensity of Indian industries is by and large, high compared with its counterparts in the developed as well as some developing countries. A recent world bank sponsored study on opportunities for end-use of electricity efficiency in India has estimated the potential of about 20% energy savings. NPC and FICCI studies on Energy Audit also revealed saving potential of 15-25% of thermal and electrical energy. Following liberalization and globalization of economy, Indian industries can no longer ignore the urge of increasing energy productivity at their units.

Our fossil energy sources are not going to continue for a long time. Some renewable energy sources, particularly, biomass and wind energy are now commercially viable. A growing need is felt to increase their use for conserving fossil energy sources and increasing their life span. There is also a growing use of energy in agriculture, farm, commercial building, etc. because of modernization and comforts.

One of the major obstacles for energy efficient programme has been the lack of awareness, training and expertise in organization energy audit and conservation programme. There is an urgent need to strengthen efforts for training engineers in energy management and conservation.

Government of India has introduced Energy Conservation Bill 2000 and it is likely to be passed with Parliament shortly. Under this Bill Energy Audit will be mandatory to key designated Consumers. There is a provision in this bill that only accredited Energy Auditors and carry out the Energy Audit in the Industries. It is estimated that after introduction of Energy Audit Conservation 2000 there will be huge requirements of Energy Auditors. The programme is designed in such a manner, to meet the requirements of Energy Conservation Bill.

Aware of the benefits of increasing energy productivity, NPC has launched its consultancy and training services in Energy Management in 1964 and has on its role 50 consultant-cum-trainer in Energy Management discipline. Recognizing the need of trained engineers in energy management, Government of India has assigned NPC, from time to time, to provide training at postgraduate level and development professionals under the aegis of Science & Technology Plan, Oil Industries Development Board, Petroleum Conservation Research Association, Ministry of Industrial Development, etc. NPC has already trained more than 105 engineers through conduct of eight programmes.

To cater to the growing needs of industries faced by challenges of liberalization and globalization of economy, a substantial increase in energy audit conservation and management activities are recommended. Therefore, the strength of energy specialists who are exposed to multifarious activities interfaced with energy management, industrial, agricultural, farm and commercial building situations need to be augmented.

OBJECTIVE

The programme is practice-oriented and aims at to fulfill the following:

1. To fully equip and developed trainees for taking up challenging assignments as consultants in NPC and as energy managers in industries, central/state energy development agency, Energy consulting firms, Energy Management centers, etc.
2. To evolve suitable strategy for efficient energy management.
3. Ability to carry out energy audit and work out suitable action plans for effecting energy savings and their implementation.
4. Take up macro level energy surveys, prepare data base and work out models and programme for wide application, awareness etc.

ELIGIBILITY

Candidates should have acquired at least Bachelor's Degree in Engineering/Technology in the following branches: Mechanical, Electrical, Chemical, with an aggregate of 55% marks. Preference will be given to candidates with practical experience. Candidates appearing at the final degree examination can also apply, but must produce final mark sheet before appearing for Eligibility Test. They must have excellent analytical and creative bent of mind, aptitude for applied work and good personality

Candidates should be below the age of 28 years on 1.11.2009. Age is relaxable by 5 years for SC/ST candidates.

AWARD OF CERTIFICATE

Candidates who qualify in examinations, project studies and other evaluation will be awarded a Postgraduate Certificate in Energy Management. The PG is widely recognised and accepted by Industry.

The following medals are awarded:

1. NPC Chairman's Gold Medal to the best candidate.
2. NPC Director General's Silver Medal to the second best candidate.

SELECTION

After Screening of applications, candidates will appear at their own cost for written examination at one of the centres specified. Those qualified will be called for group

discussions and personal interview and for which second class sleeper train fare/state road transport bus fare will be reimbursed.

VENUE

Dr. Ambedkar Institute of Productivity, National Productivity Council, 6, (Old No.31-B), SIDCO Industrial Estate, Ambattur, Chennai-600 098.

HOSTEL

The Institute has Hostel facilities which have thirty single rooms and eight double rooms to accommodate the participants and the faculty. The hostel is equipped with Kitchen Recreation and other amenities.

CURRICULUM

The selected candidates will undergo intensive, comprehensive and practice oriented classroom training at the Institute lasting about a year. The curriculum prescribed for the course is the outcome of blending experience of training and consultancy work that NPC has accumulated for about forty years. The broad coverage of subjects is given separately.

FACULTY

The Institute has a core faculty group. The Institute also draws the chief/senior consultants of NPC who possess wide practical experience from its various Offices. Experienced guest speakers from industries, business organisations, institutions and professional bodies are also invited to share their experience. A list of core faculty is given at the end.

METHOD OF TRAINING

The training is imparted through class-room lectures, group discussions, case studies, business games, role plays, audiovisual aids, self & group learning methods, etc.

PROJECT WORK & ON THE JOB TRAINING(OJT)

Each candidate will undertake one in-plant project in industrial/commercial organisations at the end of first semester & undergo OJT in any of the NPC offices at the end of second semester. This will provide them opportunity to gain confidence by applying techniques learnt to live problems.

PROGRESS

The progress of each candidate will be monitored through examinations, quiz, exercises, project work, and practical training. In case of poor performance, indiscipline, misbehaviour, lack of interest, poor conduct, etc. training may be terminated without assigning any reasons. In cases of excessive absence, the training may also be extended.

LIBRARY

The Institute library holds about 4500 books, journals, in addition to numerous consultancy, project and thesis report and seminar proceedings. The Institute has loan facility with libraries of IIT, British Council, American Library etc.

DATE OF COMMENCEMENT

The programme commences on 16.11.09

APPLICATION

The application form is available on web site www.aipnpc.com . The candidate should take a print out of the same, fill it and send it along with a fee of Rs 800/- (Rs400/- for SC/ST) by demand draft in favour of National productivity council payable at Chennai along with copies of proof of educational qualification, date of birth, caste certificate if applicable. Please write your name & application Number on reverse of DD

COURSE FEE

- 1. Self Sponsored candidates- Rs.1,00,000/- per year (Rs.50,000/- per semester**
- 2. Industry sponsored candidates- Rs.2,00,000/- per year**

SYLLABUS

1) REFRESHER MODULES

1. Heat Transfer :

Introduction, heat transfer processes, thermo physical properties, formulation of heat transfer problem, dimensional analysis, engineering heat-transfer-conduction, convection and radiation; application-fin design, heat exchangers, numerical methods and digital computer solutions.

2. Fluid Mechanics :

Basic concepts and conservation laws: Momentum of fluids in motion and theories, model studies-dimensional analysis similitude-geometric, kinetic and dynamic similarity; concepts of boundary layer, energy loss due to friction, sources of other losses, equivalent length techniques, mach number, adiabatic flow of gases in nozzles; flow of non Newtonian fluids; fluid flow problems in the operation of ratio-dynamic machines.

3. Thermodynamics :

Definitions, concepts; Zeroth law of thermodynamics work, work transfer; first law of thermodynamics; first law analysis of stationary system; first law analysis of steady flow; second law of thermodynamics; entropy energy; general thermodynamic relations; thermodynamic properties of liquids, vapours and real gasses; non-reactive mixtures. Reactive System-combustion; homogeneous equilibrium; power and refrigeration cycles.

4. Electrical Engineering (Fundamentals) :

Ohm's law and Kirchoff's laws, alternating currents, vector treatments, circuit relationship, power watt-meters and energy-meters, load-factor, power factor and their improvements.

II) FOUNDATION MODULES

1.Productivity and Economics :

Concept and philosophy of productivity and standard of living. Productivity measurement and productivity techniques; sharing the gains of productivity, Micro-economics, Macro-economics; Theories of production and distribution; planning growth and economic development; econometric models.

2. Facility Planning and Design:

Plant location; types of layout; evaluation of different layout; theory of safety; electrical, physical, chemical hazards; safety device and guards; principles of storage horizontal and vertical space; principles of material handling; selection of material handling equipment; integrated plant layout and materials handling systems.

3.EDP, Systems Analysis and Design:

Introduction to data processing; computer hardware and software; programming languages; VB, C, etc. exercises on flow charts and simple programmes; system analysis and design, document flow charts; SWOT analysis, input/output design; Data flow diagram and exercises; development of computer oriented maintenance systems (COMS)

- ❖ Client / Server Technology
- ❖ Internet, Intranet, E-commerce

4. Training Techniques & Communication :

Determination of training needs; designing and administering training programmes; training methods, training aids; evaluation of training programmes; principles of learning and motivating the learner; programmed instructions and development of lessons, computer interactive learning.

5. General Management and Behavioural Science :

Theories and principles of organization, its objectives and structure, transactional analysis, principles of management delegation and accountability, communication and leadership, work planning and time management, team building, discipline and grievance handling, morale and motivation.

6. Personnel Management :

Human resources management and planning, selection placement, induction and training, personnel function, policies and procedures, factories Act & ID Act, management by objectives, personnel records, counseling and participative management, IR & Trade Union Act, personal appraisal and merit rating, organization analysis and development.

7. Financial Management, Cost & Budgetary Control :

Principles of accountancy, classification of accounts and records; debit and credit; trial balance; balance sheet; profit & loss A/c. financial ratios and analysis.

Elements of manufacturing cost; standard costing; overhead distribution; budgeting for control of costs and revenues.

Equivalence and interest formulae; application of annual cost and present worth method; break-even analysis and applications: DCF and rate of return studies.

8. Methodology of Consultancy & Report Writing :

Objective and scope, initial contact, preliminary, diagnostic and sectoral surveys, code of ethics, implementation linkages and report presentation. Purpose of reports: types of reports, preparation of reports, characterization of good reports, checklists for report writing, presentation of reports to top management and others.

9. Project Management :

Goal Oriented Project Planning

Project management phases, drawing of network, time estimates and basic computations, crashing, resource leveling, update, revise and review.

10. Operations Research :

Introduction to OR and model building; linear programming; allocation models; sequencing models; replacement models; queuing models; case exercises on models; dynamic programming.

11. Role of Energy in Manufacturing Operation:

Energy input in process and engineering industry; batch and continuous process; energy intensive processes and products; energy, capital and labour; energy efficiency analysis in common manufacturing operation – forging, foundry, inorganic chemicals, food, dairy, pulp and paper etc.

12. Fuels :

Fossil fuels-solid, liquid and gaseous; processing of fuels; calorimeter of fuels, methods of analysis; fuel storage, handling and preparation.

13. Combustion Technology :

Chemical bonds, bond energy, standard heats of formation, heats of reaction, Adiabatic flame temperature and composition of gases. Chemical kinetics, rate laws, types of chemical reactions, conservation of mass, momentum and energy in reacting mixtures.

Heterogeneous chemical reactions, theories of explosion, reaction at solid surfaces. Flames-laminar and turbulent, diffusion flame length, tube dimension and flow rate.

Unconfined diffusion flames. Heterogeneous diffusion flames, combustion of single droplet of fuel, spray combustion. Principles of combustion, combustion calculation; fuel firing systems oil burners, chain and traveling grate, sprader stoker, excess air control, draft measurement and control, chimney height.

APPLICATION MODULES – PART-I

1. Boilers and Steam Systems:

Steam boilers, basic types; design consideration; heat balance; boiler auxiliaries; special type of boilers; boiler maintenance and operation; load distribution. Thermodynamic properties of steam, steam for process and power generation, efficient distribution of steam, efficient use of steam, steam trapping and air venting; operation, maintenance, selection and installation of steam types; condensate and flash steam recovery systems; vacuum systems.

2. Industrial Water Treatment :

Raw. Industrial boiler feed water composition and analysis; interpretation of water analysis; specification of boiler water and feed water. Feed water treatment-chemicals, clarification, cold and hot process softeners, ion exchangers, demineralisers; theory of degasification, mechanical deaerators, chemical deaerators, cooling water treatment.

3. Industrial Furnaces, Refractoriness and Insulation :

Furnaces, classification, heat transfer principles applicable to industrial furnaces, kilns and ovens; physical laws governing movement of gases; furnace atmospheres – importance, effect and its control; flues and stocks; circulation of gases; furnace construction-strength of roofs, hearths, etc; design considerations for batch and continuous types of furnaces; melting, reheating furnaces; kilns and ovens; electric-furnaces; general fuel economy measure in furnaces. Types, properties of refractories and insulating materials, for low and high temperature application; selection and application; economic thickness of insulation; installation methods; application; economic thickness of insulation, installation methods.

4. Waste Heat Recovery :

Definition, sources of waste heat; determination of waste heat; waste heat recovery devices-design and selection; low temperature waste heat recovery – ORC, heat pipes, energy wheels, absorption systems; economics of WHR and case studies.

5. Electrical Energy End Use:

a) Motors and Variable Speed Drives (VSD)

Types of motors, losses in induction motor, motor efficiency and energy consumption, motor size and energy consumption, factors influencing induction motor characteristics, different types of drive systems, group drive vs individual drive, soft starting types and comparison of VSDs, speed control with ACV SD, energy saving potential and pit-falls.

b) Transformer

Principles of operations, **power** factor efficiency and regulation of transformer, types of insulation, load and no-load losses, satisfactory operation of transformer.

c) Fans, Pumps and Compressors

Properties of air; air flow in pipes, compressed air, fans and blowers-characteristic and laws; testing and performance, selection and application of fans, compressors – types and application, performance, design characteristics, installation, and operation. Compressor accessories governing and control pumps – selection and energy saving options.

d) Lighting

Industrial, domestic and street lighting, flood lighting, luminaries, energy efficient lighting schemes, control over décor, maintenance.

e) Air-conditioning and Refrigeration

Refrigeration cycles; refrigerants and properties; refrigeration compressors; steam ejector vacuum refrigeration system; absorption refrigeration. Refrigeration accessories; Brine circulate systems; heat pumps; comparison and selection of refrigeration systems. Conditioned air for industry and building; design of systems, humidification, humidity control; comfort cooling; air conditioning calculations; central air conditioning; industrial ventilation. Thermal storage, options, cooling towers design considerations and operation.

f) Heating and Melting Furnaces

Types of electrical furnaces, components of direct arc furnace, factors influencing energy consumption in arc furnace, over view of induction furnace, design and operational parameters affecting energy efficiency, crucible design, cordless induction furnace.

g) Electrolysis

Principles of electrolysis, electrolysis for production of gases and metal, construction of cathode/anode and diaphragm cell, effect of composition of bath, voltage, pressure, circulation flow rate, etc. on energy.

6. Instrumentation & Control Systems:

Qualities of measurement; measurement of pressure, vacuum, flow and level. Temperature measurement-expansion thermometers thermoelectric temperature measurement, resistance thermometers, radiation temperature measurement. Flue gas measurement—CO₂ O₂ and CO measurement, maintenance of instruments.

Introduction to types of control; concept of feed back control; proportionate integral and derivative control; control of process variable (pressure temperature, flow, PH conductivity, level, etc.) Distributed control.

APPLICATION MODULES – PART II

1. Thermal Power System Generation, Transmission and Distribution:

Introduction to electrical energy systems. Pulverised fuel preparation, power boilers and design consideration, integrated operation of boilers and turbines, condensers and generators.

Generation: Synchronous generator operation, excitation and governing systems. Synchronisation, parallel operation, load sharing, efficiency, temperature rise and cooling. Auxiliaries in power station. Transmission: overhead lines and cables, Insulators. Transmission line equation. Single line diagram and per unit system. Distribution, economic operation; co-ordination of incremental production cost and transmission losses. Hydrothermal co-ordination.

2. Heat Engines :

Power cycles and analysis, diesel and I.C. combustion and combustion chambers for I.C. engine; cooling and lubrication of I.C. engines; super charging; performance tests and characteristics of I.C. engines; diesel engines in road transport and power generating areas; comparison of various I.C. engines, heat recovery.

3. Turbine Cycles and Total Energy Co-generation:

Cycle analysis and heat rate evaluation: factors affecting efficiency of power cycles; analysis of reheat and regenerative cycle; gas turbine cycles and performance; analysis of back pressure, mixed pressure and pass-out cycles, total energy systems – concepts and general consideration; industrial and commercial total energy system; combined cycles; economics of total energy systems.

4. Maintenance Management and Engineering:

Basic concepts of maintenance; maintenance system and control; predictive maintenance, thermo-technology, signature analysis, vibration analysis; tribology; theories of corrosion and corrosion control, corrosion problems in power plants, overhauling of boilers, on-load maintenance, chemical cleaning.

5. Energy Environment Interface:

Need for balanced ecology, effluents, particulate matter, pollution from process and power plants, prevention measures, control devices. Design of wastewater treatment plant, design concepts of cyclones, ESPs, venturi scrubbers.

6. Energy Audit, Monitoring and Targeting:

Introduction to energy audit, preliminary and detailed energy audit and their conduct, instruments for preliminary and detailed energy audit, case studies, different types of monitoring systems, approach to monitoring and targeting data collection, analysis and reporting.

7. Energy Conservation in Unit Operations:

Drying, evaporation, distillation and grinding operations selection design considerations, operation, retrofitting to reduce energy.

8. Energy Utilization in Energy – Intensive Industries:

Consumption of energy in different operations and their improvements in iron and steel fertilizers, refineries and petro-chemicals, pulp and paper, textile, cement aluminum, glass, ceramics and foundries.

9. Computer Application in Energy Management

Introduction to computers, programming languages micro-processors – introduction, programming design, typical application in energy related areas – Computer Organization – Information Technology - Data Base Management Systems – Energy Data Base – Net Working – time sharing concepts – Software engineering – simulation modeling – computer graphics – computer aided design – computer based monitoring and on—line control systems – Data acquisition systems, Expert bases systems for energy management, parallel processing concepts.

ADVANCED MODULES

1. Renewable / new energy sources and their applications:

Bio-gas plant technology and status – solar energy – principle, scope, design and applications – geothermal energy – hot springs, steam ejection, site selection, power plants, advanced concepts – fusion – nuclear reactors, fuels, ignition systems, confinement schemes, current status – fuel cells – principle, scope, application – OTEC – principle, scope and application..

2. Energy Economics

National Overview, economics of exhaustible resources, models of oil prices, reserves and cost estimation; theory of Government of subsidies; energy production models; energy demand-factors influencing; energy conservation economics.

3. Direct Energy Conversion:

Survey of energy conversion problem, basic science of energy conversion. Physics of semiconductor junction for photovoltaic and petrochemical conversion of solar energy, fabrication and evaluation of solar cells. Applications of solar cells in photovoltaic power generation systems. Technology and physics of thermo electric generators. Thermo electric materials and optimisation studies. Basic concepts and design considerations of MHD generators. Cycle analysis of MHD systems. Thermion power conversion and plasma. Thermodynamics and performance of fuel cells and their applications.

4. Bio-conversion and Processing of Waste:

Bio-conversion mechanism, source of waste undergoing industrial photo-synthesis. Energetics and rate process of major biological significance, bio-conversion of substrate into alcohol. Bio-fertilizer from waste-operating parameters and design of various units. Analysis of fermentation and biological pathways. Biogas from various substrate. Design of various biogas plant. Aeration and agitation, scale of concepts. Sterilization and harvesting unicellular growth kinetic and mixed culture dynamics biological treatment of various industrial wastes and their utilization for energy needs, growth, harvesting, processing and utilization of algae and water hyacinth.

5. Energy Technology:

Over-view of existing technologies – coal technology, coal conversion purification processes – gas technology – handling, gasification processes – petroleum technology, transportation, petroleum processing – chemical fuels technologies – nuclear energy technologies – solar energy technologies – power technology – conversion systems, steam – combination, gas diesel and other, electric power transmission, measurement utilization technologies – effluent systems, emission monitoring systems – process technologies – other energy technologies.

FACULTY

1. **Mr. R.Virendra
Director Head(AIP)** Energy Management
2. **Mr. H.R. Jindal,
Director** Energy Management
3. **Mr. V.S.S. Bhaskaramurty, Director,
Coordinator Env Mgt Prog.** Air Pollution Monitoring, Design &
Up-gradation of Control Systems
4. **Mr. P. Dharmalingam Director,
Co-ordinator (EM)** Energy Management
5. **Mr. S. Shivakumar, Director,
Coordinator IE Prog.** Production Management, HRD,
General Mgt., Manufacturing Mgt.
6. **Mr. R. Suryanarayanan
Deputy Director (Sr.)** Environmental Mgt. & Energy Mgt.
7. **Mr. J. Nagesh Kumar
Director** Energy & Environmental Mgt.
8. **Ms. Chitra .P, Asst. Director** Energy Management.
9. **Mr. M. Xavier, Director** Technology Management
10. **Mr. M.Natarajan
Dy. Director** Technology Management
11. **Mr. B.Girish,
Dy.Director** T.Q.M
12. **Mr. R.S. Maharajan,
Dy. Director** Industrial Engineering
13. **Mr. K.Vijayaraju Asst. Director** Industrial Engineering/Energy Mgmt
14. **Mr. V.Velayutham Asst.Director** Energy Management
15. **Mr. Pavan Kumar Riyali Asst.Director** Energy Management