# MEEM 101: APPLIED MATHEMATICS

Applications of Laplace Transform in solving Ordinary Differential Equations, Simultaneous Differential Equations, Difference Equations, Integral Equations.

The Z- Transform: Some Elementary Concept, Defination, Properties, Inverse Z-Transform, Convolution Theorem. Fourier Transforms: (Sine, Cosine) & Properties

Numerical Solution of an Ordinary Differential Equations, Numerical solutions of Partial Differential Equations (Laplace, Heat & Wave Equations), Gauss's Quadrature Formula.

Probability Distributions: Binomial, Poisson & Normal; Sampling (Large Sampling): Types of Sampling, Mean and Standard Deviation in simple Sampling of Attribues,, Tests of Significance of Large Samples, Standard Error, Probable error, Comparison of Two Large Samples.

Mathematical Modeling : Modeling through Ordinary Differential Equations of First Order – Linear Growth and Decay (Population Growth Models, Effects of Immigration and Emigration on population Size),Non-linear Growth and Decay (Logistic Law of population Growth, Spread of Technological Innovations and Infectious Diseases).

 **Reference Books:**

1. Sastry, S.S. (2006). *Introductory methods of numerical analysis.* Prentice-Hall of India Pvt.Ltd
2. Kanti B. Datta(2012) Mathematical Methods of Science and Engineering, Cengage Learning.
3. Mathematical Modeling by J.N. Kapur , Wiley Eastern Limited .
4. Ray,Sharma,Chaudhary, Mathematical Statistics, Ram Prases & Sons.
5. Ramana, B.V. *Higher Engineering Mathematics.* Tata McGraw-Hill Publishing Company
6. Kreszig, Ervin.(1998) *Advance Engineering Mathematics(8th ed.).* Wiley publication.
7. Engineering Mathematics By Babu Ram, Pearsons
8. Fourier Transforms by J. N. Sheddon
9. A. G. Hamilton: Linear Algebra, Cambridge University Press
10. B.S. Grewal "Numerical Methods in Engineering & Science".
11. V. Rajaraman "Computer Oriented Numerical Methods".
12. Iyenoyr M.K. Jain & R.K. Jain "Numerical Methods for scientific and engineering computation", Wiley Eastern (New Age)
13. E.V. Krishnamurthy & S.K. Sen "Computer Based Numerical Algorithms".

# MEEM 102: Power Generation, Transmission & Distribution

Electrical Energy Generation, concepts, various types of generating stations and their locations. Study of Thermal, Hydel, Nuclear and Non Conventional energy generation schemes. Block diagram of various power stations- schemes and sub systems.

Steam Power Plants: Types of power plants, steam power plant: Design Operation & Thermodynamic Analysis, steam turbine power output, Power Plant Performance Monitoring & Testing, Heat Rate, Efficiency, Optimization of Performance

Steam Generators: Boiler and steam Generator construction types, Energy Balance and efficiency of steam Generator, Furnace & burners, steam Generators with fluidized based Combustion (FBC): fluidized bed types; emissions reduction in Fluidized bed furnaces, Steam turbines, Condensers, feed Water Heaters and Cooling Water systems

Gas Turbine Power Plants: Air standard joule Cycle, Actual efficiency of the Gas Turbine Power Plant, Enhancing the Gas Turbine Plant Performance: increasing the compression Pressure Ratio and Turbine inlet Temperature

Hydro Power Generation, Hydro Turbine, Large medium and small hydro power station, Micro Hydel Nuclear power generation and peaceful uses of nuclear energy.

Generation:synchronous generator, operation, power angle characteristics, and the infinite bus concept, dynamic analysis and modeling of synchronous machines, excitation systems, prime mover governing systems, automatic generation control, auxiliaries.

AC transmission: Over head cables, transmission line equations, regulation & transmission losses, performance estimation, reactive power compensation, flexible AC transmission, skin, proximity and Ferranti effects, corona phenomena, critical voltages and power loss. HVDC transmission.

Distribution system: distribution system, conductor's size, Kelvin's law performance calculations and analysis, distribution inside industrial & commercial buildings entrance terminology, substation & feeder circuit design considerations, distribution automation.

**References:**
1. Power Generation Technology-Dr.V.K.Sethi, Sudit Publication
2. Thermal Power Technology - Dr.V.K.Sethi, Sudit Publication
3. Generation, distribution and utilization of electrical energy by C.L. Wadhwa, New Age International.
4. Elements of power system analysis- William Stevenson Mc-Graw Hill
5. Modern power system analysis- I..S. Nagrah and D.P. Kothari, Tata Mc Graw Hill.
6. Power system analysis- John Grainger and willian Stevenson, Mc- Graw Hill.
7. Electrical power transmission system: Analysis and Design- Turan Gonen, John Wiley & sons.
8. Theory and problems of electric power systems by S. A. Nasqr

# MEEM 103:  Solar Power Generation

**Solar Power:** Introduction, Solar Photovoltaic, History and projection,Advantage & disadvantage of Photovoltaic Systems, Application of Photovoltaic Systems, Overview of SPV programme in India, Solar potential, solar mission of GoI,Role of MNRE, IREDA etc,. Energy from Sun,Insolation available on earth; Global Radiation distribution on an inclined plane.

**Solar Photovoltaics:** Basic principle of power generation in a PV cell ; Band gap and efficiency of PV cells ;Component of PV System, Solar Cells; Types; Working; I-V characteristics; losses. Solar PV panel; Balance of Systems; Fabrications of Modules; Economics of PV Systems; Future prospects; Applications of Photovoltaic: Domestic lighting Systems; Remote Applications; Hybrid; Grid linked PV Systems.

**Designing of Solar Photovoltaic Systems:**  Designing of PV systems, Need for different cell design, The technology route for making solar cells, costing of PV systems, Operation & Maintenance of PV Systems; Battery Storage: Types and Properties of monocrystalline, polycrystalline and multicrystalline cells,Amorphous silicon thin film cells; Photovoltaic materials.

**CSP technologies:** Parabolic trough collector technology, Linear Fresnel collector technology, solar tower technology and Stirling dish technology; the solar resource, CSP plant design and performance; Solar field sizing, latest trends in design of Mega Solar Power Plants.

**Solar Thermal:** thermal storage; Solar thermal applications **-** water and space heating; solar ponds; dryers; distillation; solar cooker; Passive solar design; solar thermal collectors - Glazing, evacuation, selective surfaces, concentrators; case studies of solar power plants.

References:
1.    Solar Energy fundamentals & applications; by H.P. Garg, J Prakash
2.    Solar Energy Technologies; by Chetan Solanki, IIT, Bombay
3.    Solar Electricity; by Wiley
4.    From Sunlight Electricity by Shirish Sinha Teri
5.    Concentrating Solar Power: RENEWABLE ENERGY TECHNOLOGIES: COST ANALYSIS SERIES, *Volume 1: Power Sector,* Issue 2/5 IRENA 2012

# MEEM 104: HYDRO & NUCLEAR POWER GENERATION

**Fundamental of Hydraulic Engineering** – Water resource and its potential. Hydrology-Hydrological cycles, hydrograph, steam flow characteristics, flow duration curve, mass curve storage, pond age, site selection. Environmental Impacts and its mitigation- Burdens and impacts identification, impacts in the construction phase; Hydropower Economics.

**Hydro Power:** Potential, Hydropower Generation and Distribution, Mini and Microhydel Power (MHP) Generation: Classification of hydel plants, Concept of micro hydel, merits, MHP plants: Components, design and layout, Turbines - Classification and selection criteria, efficiency and performance characteristics, Status in India. Integrated Energy systems and their cost benefit analysis; case studies of hydro power plants.

**Nuclear Engineering:**
Introduction, Why Nuclear Power for Developing Countries, Radioactivity and Radioactive Change Rate of Radioactive Decay, Irradiation of Medical products and other application of artificial radioactive, Mass – Energy Equivalence, Binding Energy, Release of Energy by Nuclear Reaction, types of Nuclear Reactions, Initiation of Nuclear Reaction, Nuclear Cross – section, Nuclear Fission, The Fission Chain Reaction, moderation, Fertile Materials and Breeding. Fick's law.

**Nuclear Materials:** Introduction, Fuels, Cladding and Structural Materials Coolants, Moderating and Reflecting Materials, Control Rod Materials, Shielding Materials; Fuel rod design.
**Safety Rules:** Personal Monitoring, Radiation Protection (Radiation Workers, Non-Radiation Workers, Public at large), Radiation Dose (Early effect, Late effect hereditary effect); Nuclear Safety regulation & Standards;

**Nuclear Reactors:**
Introduction, General Components of Nuclear Reactor, General Problems of Reactor Operation, Different Types of Reactors, Pressurised Water Reactors (PWR), Boiling Water Reactors (BWR), Heavy Water – cooled and Moderated CANDU (Canadian Deuterium Uranium) Type Reactors, Gas-cooled Reactors, Breeder Reactors, Reactor Containment Design, Location of Nuclear Power Plant, Nuclear Power Station in India, India's 3-stage Programme for Nuclear Power Development; Peaceful application of Nuclear Energy –Power Generation and Isotope application; case studies of Nuclear power plants.

**Reference:**
1. Layman's Guidebook on how to develop a small hydro site
2. Finn R. Forsund – Hydropower Economics
3. Hydro Power an Indian Perspective Author-Cum-Editor Dr. B.S.K. Naidu , Director General , NPTI.
4. Micro Hydroelectric Power Stations – By L.Monition, Power Stations- By L.Monition , Mle Nir, J.Roux translated by Joan Mc Mullan, John Wiley & Sons.
5. Nuclear Physics by J.B. Rajam
6. Introduction to Nuclear reactor theory, Wesley, 1966 by J.R. Lamrash
7. M.M. E1-Wakil: Nuclear Power Engineering, McGraw Hill, 1962.
8. R.L. Murray: Introduction to Nuclear Engineering, Prentics Hall, 1961.

# MEEM 105: Environmental Issues, Policy, Standards & Regulations

**Global environmental concerns:** The Scenario, The Changing Global atmosphere &common concerns. United Nations Framework Convention on Climate Change
(UNFCC), Kyoto Protocol, Conference of Parties (COP), Various Clean Development Mechanism (CDM), Prototype Carbon fund (PCF), Earth Summit, Sustainable development**.
Green Certificate**

The Global Program for protected area management, Strategies for environmental improvement plan.  Organizations working in the field of energy and environment -
UNEP, IPCCC, CPCB etc. Basic features of ISO 14000.

**Water Quality:** Parameters: Physical, Chemical and Bacteriological .Potable Water Standards,Waste Waster Effluent Standards. Minimal National Standards (MINAS).

**Environment Policies**: Water Act 1974, The Air Act, 1981, Environmental (Protection) Act.-1986, M. P. State Environment Policy, Municipal Solid Waste (Management & Handling) Rules, 1998, Biomedical Waste (Management & Handling ) Rules 1998.

**References:**
1. Environmental Issues and Polices, Prentice Hall—Stephon Ison, Stephen Peake, Stuart Wall
2. ISO 14000 Environmental Management by Goetsch, Davis. Prentice Hall
3. Standard methods for the Examination of Water and Wastewater. (1989).17thEd. APHA, Washigton. D.C., 2-12
4. Energy Management by Paul O'Callaghan –McGraw Hill
5. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council
6. Training material on 'Environmental concerns' prepared by National Productivity Council
7. Parivesh, October 2002 – Central Pollution Control Board
www.epa.org
www.uneptie.org
www.cpcb.nic.in
www.wri.org
www.safeclimate.net
www.globalwarming.org, Bureau of Energy Efficiency 186