

AC 4-3-2014
Item No. – 4.50

UNIVERSITY OF MUMBAI



Program - Master of Engineering

Course - Electrical Engineering
(POWER PLANT ENGINEERING AND ENERGY MANAGEMENT)

from Academic Year 2014 -15,

Under

FACULTY OF TECHNOLOGY
(As per Credit Based Semester and Grading System)

From Dean's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande
Dean,
Faculty of Technology,
Member - Management Council, Senate, Academic Council
University of Mumbai, Mumbai

Preamble:

The overall technical education in our country is changing rapidly in manifolds. Now it is very much challenging to maintain the quality of education with its rate of expansion. To meet present requirement a systematic approach is necessary to build the strong technical base with the quality. Accreditation will provide the quality assurance in higher education and also to achieve recognition of the institution or program meeting certain specified standards. The main focus of an accreditation process is to measure the program outcomes, essentially a range of skills and knowledge that a student will have at the time of graduation from the program that is being accredited. Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Electrical Engineering of University of Mumbai, happy to state here that, Program Educational Objectives (PEOs) were finalized for undergraduate program in Electrical Engineering, more than twenty senior faculty members from the different institutes affiliated to University of Mumbai were actively participated in this process. Few PEOs were finalized for undergraduate program in Electrical Engineering are listed below;

- To provide the overall strong technical foundation to formulate, solve and analyse engineering problems during undergraduate program.
- To prepare students to demonstrate an ability to identify, formulate and solve electrical based issues.
- To prepare students to demonstrate an ability in the area of design, control, analyse and interpret the electrical and electronics systems.
- To prepare students for successful career in industry, research and development.
- To develop the ability among students for supervisory control and data acquisition for power system application.
- To provide opportunity for students to handle the multidisciplinary projects.
- To create the awareness of the life-long learning and to introduce them to professional ethics and codes of professional practice.

The affiliated institutes may include their own PEOs in addition to the above list

To support the philosophy of outcome based education, in addition to stated PEOs, objectives and expected outcomes are also included in the curriculum. I know, this is a small step taken to enhance and provide the quality education to the stake holders.

**Chairman,
Board of Studies in Electrical Engineering,
University of Mumbai**

University of Mumbai
Program Structure for
M.E. Electrical Engineering
(POWER PLANT ENGINEERING AND ENERGY MANAGEMENT)
(From 2014-2015)
Semester I

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned						
		Theory	Pract.	Tu t.	Theory	Prac t.	Tut.	Total			
PPC101	Power Plant Engineering	04	--	--	04	--	--	04			
PPC102	Power Plant Erection, Commissioning and Operation	04	--	--	04	--	--	04			
PPC103	Energy Scenario, policy and Environment #	04	--	--	04	--	--	04			
PPC101X	Elective-I	04	--	--	04	--	--	04			
PPE102X	Elective-II	04	--	--	04	--	--	04			
PPL101	Laboratory I	--	02	--	--	01	--	01			
PPL102	Laboratory II	--	02	--	--	01	--	01			
Total		20	04	--	20	02	--	22			
Subject Code	Subject Name	Examination Scheme									
		Theory					End Sem. Exam.	Exam. Duration (in Hrs)	Term Work	Pract./oral	Total
		Internal Assessment			Avg.	Exam.					
		Test1	Test 2	Avg.							
PPC101	Power Plant Engineering	20	20	20	80	03	--	--	100		
PPC102	Power Plant Erection, Commissioning and Operation	20	20	20	80	03	--	--	100		
PPC103	Energy Scenario, policy and Environment #	20	20	20	80	03	--	--	100		
PPC101X	Elective-I	20	20	20	80	03	--	--	100		
PPE102X	Elective-II	20	20	20	80	03	--	--	100		
PPL101	Laboratory I	--	--	--	--	--	25	25	50		
PPL102	Laboratory II	--	--	--	--	--	25	25	50		
Total		--	--	100	400	--	50	50	600		

Subject Code	Elective I	Subject Code	Elective II
PPE1011	Computational Fluid Dynamics #	PPE1021	Energy System Modeling and analysis #
PPE1012	Energy Measurement and Control Instruments #	PPE1022	Environmental Engineering & Pollution Control
PPE1013	Power Plant Instrumentation	PPE1023	Energy Conservation

Common for Energy Engineering and management (Mechanical Engineering) & Power Plant Engineering and Energy Management

Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theor y	Pract.	Tut.	Theory	Pract.	Tut.	Total	
PPC201	Energy Planning Management and Audit \$	04	--	--	04	--	--	04	
PPC202	Power Plant Performance, Monitoring & Testing	04	--	--	04	--	--	04	
PPC203	Power generation and System Planning	04	--	--	04	--	--	04	
PPC203X	Elective-III	04	--	--	04	--	--	04	
PPE204X	Elective-IV	04	--	--	04	--	--	04	
PPL201	Laboratory III	--	02	--	--	02	--	01	
PPL202	Laboratory IV	--	02	--	--	02	--	01	
Total		20	04	--	20	04	--	22	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract./oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
PPC201	Energy Planning Management and Audit \$	20	20	20	80	03	--	--	100
PPC202	Power Plant Performance, Monitoring & Testing	20	20	20	80	03	--	--	100
PPC203	Power generation and System Planning	20	20	20	80	03	--	--	100
PPE203X	Elective-III	20	20	20	80	03	--	--	100
PPE204X	Elective-IV	20	20	20	80	03	--	--	100
PPL201	Laboratory III	--	--	--	--	--	25	25	50
PPL202	Laboratory IV	--	--	--	--	--	25	25	50
Total				100	400	--	50	50	600

Subject Code	Elective III	Subject Code	Elective IV
PPE2031	Grid Integration of Renewable Energy	PPE2041	Nuclear Power Plant \$
PPE2032	Environment & Safety Engineering \$	PPE2042	Steam and Gas Turbine \$
PPE2033	Control System Design \$	PPE2043	Power Plant Maintenance

\$ Common for Energy Engineering and management (Mechanical Engineering) & Power Plant Engineering and Energy Management

Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
PPS301	Seminar	--	06	--	--	03	--	03	
PPD301	Dissertation I	--	24	--	--	12	--	12	
Total		--	30	--	--	15	--	15	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract.	Oral
		Internal Assessment			End Sem.Exam.				
		Test1	Test 2	Avg.					
PPS301	Seminar	--	--	--	--	50	50	100	
PPD301	Dissertation I	--	--	--	--	100	--	100	
Total		--	--	--	--	150	50	200	

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
PPD401	Dissertation II	--	30	--	--	15	--	15	
Total		--	15	--	--	15	--	15	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /Oral	Total
		Internal Assessment			End Sem.Exam.				
		Test1	Test 2	Avg.					
PPD401	Dissertation II*	--	--	--	--	100	100	200	
Total		--	--	--	--	100	100	200	

* The Term Work and Oral of Project II of Semester IV should be assessed jointly by the pair of Internal and External Examiners

Note- The Contact Hours for the calculation of load of teacher are as follows
 Seminar - 01 Hour / week / student
 Project I and II - 02 Hour / week / student

Subject Code	Subject Name	Credits
PPC 101	Power Plant Engineering	04

Module	Detailed Contents	Hrs
01	Steam Power Plants Classification, Layout, Essential requirements of Power Station Design, Site Selection, Capacity, Plant arrangement, Useful life of SPP components, SPP pumps, Advantages and Disadvantages, Cost and Economics of SPP	6
02	Gas Turbine Power Plants: , Classification, layout, Components fuels, Operation, thermal efficiency. Hydro-Electric Power Plants, HePP: Different components, Underground HePP, Advanced HePP, Safety measures and preventive maintenance, Cost of HePP and power. Comparison of GTPP, HePP over SPP	10
03	Nuclear Power Plant: Economics of NPP, Safety measures for NPP, Future of NPP, Useful byproducts of Nuclear power generator and their uses advantages of combined Operation of Plants.	8
04	Solar thermal plants, conversion devices, Economics, Design considerations. Solar photovoltaic plants, Economics, Design considerations, applications.	9
05	Wind Power Plant: Wind energy potential measurement, wind mill design, economics and demand side management, energy wheeling, and energy banking concepts Biogas: Concept and present status, properties of biogas.	7
06	Fuel cell based power plants, tidal and wave energy plant design, OTEC power plants. Geothermal energy: hot springs and steam ejection site selection, power plants, and economics.	8

REFERENCES:

1. El-Walkil M M, Power Plant Engineering, McGraw Hill, New York, 1985
2. Power Plant Familiarization, Manual of Central Training Resources Unit of NTPC India, 1991
3. P K Nag, Power Plant Engineering, TMH, New Delhi, 1998
4. A Text Book of Power Plant Engineering / Rajput / Laxmi Publications
5. M G Jog, Hydro-Electric and Pumped Storage Plants, New Age International Publishers
6. S.P.Sukhatme, Solar Energy – Principles of Thermal Collection and Storage, 3rdedition, Tata McGraw Hill, New Delhi, 1996.
7. J.A.Duffie and W.A.Beckman, Solar engineering of Thermal processes, 2ndedition, John Wiley, New York, 1991.
8. D.Y.Goswami, F.Kreith and J.F.Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000.
9. Joshua Earnest, Wind Power Technology, PHI Learning, 2014
10. C S Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, 2nd Edition, PHI Learning, 2013
11. D.D.Hall and R.P.Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.
12. Mukund R Patel, Wind and Solar Power Systems, CRC Press, 1999.

13. J F Manwell, J.C.McGowan, A.L.Rogers, Wind Energy Explained: Theory, Design and Application, John Wiley and Sons, May 2002.
14. and Application, John Wiley and Sons, May 2002.
15. R D Begamudre, Energy Conversion Systems, New Age International (P) Ltd., Publishers, New Delhi ,2000.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPC102	Power Plant Erection, Commissioning and Operation	04

Module	Contents	Hours
1	Preparation of commissioning, trial run of various equipment, commissioning of valves, air and gas tightness test of boiler. Chemical cleaning boiler, preparation for boiler light up, thermal flow test of water walls and economizers, steam blowing.	5
2	Safety valves setting, reliable run of boiler. Hydraulic test of boiler. Alkaline flushing and commissioning of regenerative system, acid cleaning of oil pipe lines, oil flushing procedure of lubricating oil and governing system. Turbine Lubricating oil flow testing steam blowing, reheater safety valve, vacuum tightness test, ejector testing.	8
3	Commissioning of governing system and ATRS & ATT, and TSE. Commissioning of generator and auxiliaries (Generator testing, rotor and stator cooling system, excitation system) Commissioning of electrical system (Circuit breakers, isolators, CT and PT, rectifiers, switchgear, DC System). C&I Commissioning activities (Minimum instrumentations required for major C&I commissioning, commissioning of control valve, tuning of control valves). Discussion/ Appraisal.	9

4	Power Plant Operation: Availability of electrical supply to the equipment (source feeder of each equipment, points of isolation of the equipment, locking during isolation, permit to work system). Boiler pre light up checks. (Meaning of light up, shut down, tripping, starting etc., 1 No pending permits, local checks). Operation of service auxiliaries (cooling water pump, compressors, auxiliary steam, fuel oil pump). Operation of air-pre heater and ID fan) (Rechecks, flow path line up, permissives, interlocks).	9
5	Operation of FD & PA Fans (pre checks, flow path line up permissives, interlocks). Mill operation (pre checks, flow path line up, permissives, interlocks). FSSS (Secondary air, burner tilt, fuel and air control). Drum level control, Super Heater, Re-Heater, temperature control and their interlocks. Operation of turbine lubricating system and barring gear. Operation of condensate and feed water system (BFP, Heaters CEP). HP/LP Bypass operation and turbine heating. Turbine rolling and synchronization.	9
6	Operation of generator cooling system (stator and hydrogen cooling). Operation of Generator excitation system AVR. Operation of Turbine governing system. Integrated operation of unit (unit loading and shut down sequence) Operational difference between cold start-up, warm start up and hot start up. Load dispatching and coordination with load dispatch center.	8

REFERENCES:

1. Power plant operation/ NPTI Publication
2. Power Plant Engineering/P.K.Nag/TMH
3. BHEL manual
- 4.CEGB Manual on power Plant Operation

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPC 103	Energy Scenario, Policy and Environment	04

Module	Contents	Hrs.
01	<p>Global Energy Scenario : Role of energy in economic development and social transformation, Energy &GDP, GNP and its dynamics. Energy sources and overall energy demand and availability, Energy Consumption in various sectors and its changing pattern, Exponential increase in energy consumption and projected future demands. Non-Conventional and Conventional Energy Resources: Coal, Oil, Natural Gas, Nuclear Power and Hydroelectricity, Solar, wind and other renewable etc. Depletion of energy sources and impact on exponential rise in energy consumption on economies of countries and on international relations. Energy Security, Energy Consumption and its impact on environmental climatic change</p>	11
02	<p>Indian Energy Scenario Energy resources & Consumption, Commercial and noncommercial forms of energy, Fossil fuels, Renewable sources including Bio-fuels in India and their utilization pattern in the past, present and future projections of consumption pattern, Sector wise energy consumption. Impact of Energy on Economy, Development and Environment, Energy for Sustainable Development, Energy and Environmental policies, Need for use of new and renewable energy sources, present status and future of nuclear and renewable energy, Energy Policy Issues related Fossil Fuels, Renewable Energy, Power sector reforms, restructuring of energy supply sector, energy strategy for future.</p>	10
03	<p>International Energy Policies of G-8 Countries, G-20 Countries, OPEC Countries, EU Countries. International Energy Treaties (Rio, Montreal, Kyoto), INDO-US Nuclear Deal. Future Energy Options, Sustainable Development, Energy Crisis.</p>	08
04	<p>Energy Conservation Act-2001 & its features, Electricity Act-2003 & its features. Frame work of Central Electricity Authority (CEA), Central & States Electricity Regulatory Commissions (CERC & ERCs)</p>	
05	<p>Energy Policy Global energy issues, National & State level energy issues, National & State energy policy, Industrial energy policy, Energy security, Energy vision. Energy pricing & Impact of global variations. Energy productivity (National & Sector wise productivity).</p>	10
06	<p>Environment Concept of environment and ecology, various natural cycles in environment and ecology, effect of human activities on environment and ecology. Environmental Impact Assessment, Methodologies for environmental pollution prevention. Rules, regulations, laws etc. regarding environmental protection, pollution prevention and control, waste disposal etc. Role of government, semi/quasi govt. and voluntary organizations.</p>	09

REFERENCES:

1. Jose Goldemberg, A K N Reddy, Thomas Johnsson, Energy for a sustainable world, Prienceton University
2. B V Desai, Energy policy, Weiley Eastern
3. J K Parikh, Modeling approach to long term demand and energy implication, IIASA Professional Paper
4. TEDDY Year Book Published by Tata Energy Research Institute (TERI),
5. S Rao, Energy Technology, Khanna Publishers
6. International Energy Outlook -EIA annual Publication
7. A.W. Culp, Principles of Energy Conversion, McGraw Hill International edition
8. BEE Reference book: no.1/2/3/4
9. Frank P Lees, Loss Prevention in Process Industries Volume 1, 2 & 3

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE1011	Computational Fluid Dynamics	04

Module	Contents	Hrs.
01	GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD: Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.	09
02	CONDUCTION HEAT TRANSFER: Steady one-dimensional conduction, Two and Three dimensional steady state problems, Transient one- dimensional problem, Two-dimensional Transient Problems.	08
03	INCOMPRESSIBLE FLUID FLOW :Governing Equations, Stream Function - Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite deference approach	07
04	CONVECTION HEAT TRANSFER: Steady one dimensional and two dimensional Convection, Diffusion, Unsteady one-dimensional convection, Diffusion, Unsteady two dimensional convection, Diffusion	08

05	FEM: Introduction to finite element method, Solution of steady heat conduction by FEM, Incompressible flow, Simulation by FEM.	08
06	TURBULENCE MODELS: Algebraic Models, One equation model, K-I Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes	08

REFERENCES:

1. Date A. W., "Introduction to Computational Fluid Dynamics", Cambridge Uni. Press, 2005.
2. Anderson, D.A., Tannehill, I.I., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, Hemisphere Publishing Corporation, New York, USA, 1984.
3. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi 1995.
4. Ghoshdasgupta, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.
5. Subas, V. Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation
6. Taylor, C and Hughes J.B., Finite Element Programming of the Navier Stock Equation, Pineridge Press Ltd., U.K. 1981.
7. Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics 1" Fundamental and General Techniques, Springer-Verlag, 1987.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE 1012	Energy Measurement and Control Instruments	04

Module	Contents	Hrs.
01	Measurement Concepts Introduction to measurements for scientific and engineering application need and goal. Broad category of methods for measuring field and derived quantities. Principles of measurement, parameter estimation, regression analysis, correlations, error estimation and data presentation, analysis of data	10
02	Process Parameter Measurement Measurement of field quantities, measurement of force, pressure, temperature, flow rate, velocity, humidity, noise, vibration, measurement by probe and non instructive techniques.	10
03	Measurement of derived quantities, torque, power, thermo physical properties, radiation and surface properties.	9
04	Automatic Control Systems Control Room Equipments, PLCs and other logic devices, Analytical instrumentation,	8
05	Instrument Selection and Commissioning General considerations, Control valve selection and sizing, Regulators and final control elements	5
06	Limits, Margins and their Relevance to Instrumentation and control, Control Centers, Fire and Safety Instruments	06

REFERENCES:

1. Bela G Liptak, Instrument Engineers' Handbook, Vol I, II, III, 4th Edition, CRC Press
2. Doebelin E.O: Measurement Systems-Application and Design, McGraw Hill Publication Co.
3. Bolton W, Mechatronics-Electronics Control Systems in Mechanical and Electrical Engg.
4. Helfrick A.D. and Cooper W.D. Modern Electronic Instrumentation and Measurement Technique
5. Johnson C.D., Process Control Instrumentation
6. J.P.Holman: Experimental Methods For Engineers, McGraw Hill International Edition, Seventh Edition

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE 1013	Power Plant Instrumentation	04

Module	Contents	Hours
1	Introduction, Fundamentals of generation of Electricity, its transmission and Distribution. Concept of regional and national power grid. Concept of distance protections and Island types of power plant, introduction and comparison of thermal Power plant, Hydro Electric Power Plant, Nuclear Power Plant, Solar Power Plant. Flow sheet of thermal power plant.	7
2	Thermal Power Plant: Unit overview, air and fuel path, boiler instrumentation, Combustion control, air to fuel ratio control, 3-element drum level control, steam temperature and pressure control, oxygen/CO ₂ in flue gases, furnace draft, boiler interlocks, Start-up and shut-down procedures Boiler load calculation, boiler efficiency calculation. Boiler safety standard.	8
3	Non-Conventional Energy Sources: Concept of power generation from nonconventional sources of energy like wind power, Solar Power and Tidal waves. Photovoltaic cells, Hydrogen cells. Criterion for selection of Instrumentation system for wind and solar and tidal wave plant.	8
4	Hydro Power Plant: Overview on units, Types of water turbine. Regulation of speed and voltage. Surge tank level control. Nuclear Power Plant: Overview on units, Concept of energy generated from atomic fission. Block diagram of an Atomic power station. Types of coolants. Control of chain reaction. Radio activity and safety measures. Layout of control rooms. Criterion for selection of Instrumentation system / DCS system for nuclear and hydro power plant.	10
5	Turbine Instrumentation And Control: Elements Of Control Systems Introduction, Importance – Classification – Open and closed systems Servomechanisms–Examples with block diagrams–Temperature, speed & position control systems, Hydraulically controlled speed governing and turbine steam inlet control valve actuation system.	8
6	Condenser vacuum control and steam exhaust pressure control speed, vibration, shell temperature monitoring-lubricating oil temperature control hydrogen generator. Start-up and shut-down, thermal stress control, condition monitoring and power distribution instrumentation. Synchronous, Induction generators cooling system.	7

REFERENCES:

1. Handbook of Instrumentation and Control/H. Kallen/McGraw-Hill Education.
2. Power plant Engineering/F. Morse/Khanna Publishers.
3. Modern Power Plant Engineering/J. Balasubramaniam and R. Jain/Khanna Publishers.
4. O & M manuals of power plant/Bharat Heavy Electricals Ltd.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE 1021	Energy Systems Modeling and Analysis	04

Module	Detailed Contents	Hrs.
01	Modeling Overview: levels of analysis, steps in model development, examples of models.	06
02	Quantitative Techniques: Interpolation-polynomial, Lagrangian, Curve fitting, regression analysis, solution of transcendental equations.	08
03	Systems Simulation: information flow diagram, solution of set of nonlinear algebraic equations, successive substitution, Newton Rhapsion. Examples of energy systems simulation. Numerical solution of Differential equations- Overview, Convergence, Accuracy. Transient analysis- application example	10
04	Optimisation : Objectives/constraints, problem formulation. Unconstrained problems- Necessary & Sufficiency conditions. Constrained Optimisation- Lagrange multipliers, constrained variations, Kuhn-Tucker conditions Linear Programming - Simplex tableau, pivoting, sensitivity analysis. Dynamic Programming. Search Techniques- Univariate / Multivariate	10
05	Case studies of optimisation in Energy systems problems. Dealing with uncertainty- probabilistic techniques. Trade-offs between capital & energy using Pinch Analysis	8
06	Energy- Economy Models: Scenario Generation, Input Output Model	6

REFERENCES:

1. Yogesh Jaluria, Design and Optimization of Thermal Systems, McGraw-Hill international editions, 1998
2. Stoecker W F, Design of Thermal Systems, Mcgraw Hill, 1981
3. S.S.Rao, Optimisation Theory and Applications, Wiley Eastern, 1990
4. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall, 1988
5. P. Meier, Energy Systems Analysis for Developing Countries, Springer Verlag, 1984
6. R.de Neufville, Applied Systems Analysis, Mcgraw Hill, International Edition, 1990
7. Beveridge and Schechter, Optimisation Theory and Practice, Mcgraw Hill, 1970

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE 1022	Environmental Engineering & Pollution Control	04

Module	Detailed Contents	Hrs.
01	Air Pollution Natural and anthropogenic sources of pollution, Primary and Secondary pollutants, Transport and diffusion of pollutants, Gas laws governing the behavior of pollutants in the atmosphere, air sampling methods, Methods of monitoring and control of air pollutants SO ₂ , NO ₂ , CO, SPM	09
02	Effects of pollutants on human beings, plants, animals, materials and on climate, Acid Rain, Ambient Air Quality Standards, Air pollution control methods and equipment.	08
03	Water Pollution Types, sources and consequences of water pollution, Physico-chemical and Bacteriological sampling and analysis of water quality, Standards. sewage and waste water treatment and recycling ASP/STP, Water quality standard, treatment, utilization and disposal of sludge, Government norms	07
04	Land Pollution Sources and classification of land pollutants, Industrial waste effluents and heavy metals, their interactions with soil components, degradation of different insecticides, fungicides and weedicides in soil. Solid waste management, Process and equipments for energy recovery from municipal solid waste and industrial waste, MSW Act 2000.	08
05	Other sources of pollution Noise: Sources of noise pollution, measurement of noise and Indices, exposure levels and standards, Noise control and abatement measures. Impact of noise on human health. Marine : Sources and nature of pollutants, oil pollution, metallic pollutants, status of coastal and estuarine pollution in India, Chemicals and drugs from oceans, sea level rise, cause, effect and control Radiation: Introduction, types of radiation and radioactivity, sources and effects.	08

06	Pollution from power generation Pollutants from power generation points-thermal power plant, Control measures to Reduce them. Environmental considerations in cogeneration and waste heat recovery	08
-----------	--	----

REFERENCES:

1. Rao & Rao, Air Pollution
2. C J Rao, Environmental Engineering, New Age International
3. G. Masters, Introduction to Environmental Engineering & Science, Prentice Hall
4. H S Peavy, D R Rowe, G Tchobanoglous, Environmental Engineering, McGraw Hill
5. DeNevers Noel, Air Pollution control Engineering, McGraw Hill
6. Metcalf & Eddy, Waste Water Engineering: Treatment & Reuse, McGraw Hill

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE1023	ENERGY CONSERVATION	04

Module	Contents	Hours
1	General Aspects: Need for energy conservation and management, first and second law of thermodynamics of energy transfer, availability analysis of various thermodynamics processes/devices/cycles.	6
2	Thermodynamics Of Energy Conservation: Basic principle Irreversibility in combustion, first and second law of combustion, efficiency analysis of systems, Primary energy sources, optimum use of prime-movers, energy efficient housekeeping, thermal insulation, economic thickness of insulation.	7
3	Waste Heat Recovery Techniques: Sources of waste heat and its potential applications, Waste heat survey and measurements, Data collection, Limitations and affecting factors Heat recovery equipment and systems; Heat Exchangers-Shell & Tube compact, Regenerators and Recuperators. Waste Heat boilers. System Integration.	9
4	Load Curve Analysis & Load Management: Energy storage for power systems (Mechanical, Thermal, Electrical & Magnetic) Restructuring of electric tariff from energy conservation consideration, Economic analysis depreciation method, time value of money, Evaluation method of projects, replacement analysis, special problems inflation risk analysis. Pay back period, Energy economics, Cost Benefit Risk analysis.	10
5	Energy Efficient Electric Drives: Energy efficient motors V.S.D. power factor improvement in power system, Energy Conservation in transportation system especially in electric vehicle. Energy flow networks, Simulation & modeling, formulation & Objective & constraints, alternative option, Matrix chart.	8
6	Energy Conservation In Industry: Energy conservation equipments, Co-generation, Energy Conservation in Sugar, Textiles, Cement, Process Industry. Electrical Energy Conservation in building, heating, lighting, domestic gadgets	8

REFERENCES:

1. Energy Management/W.R.Murphy, G.Mckay/Butterworths.
2. Energy Management Principles/C.B.Smith/ Pergamon Press.
3. Energy Economics/A.V.Desai/Wiley Eastern
4. Industrial Energy Management and Utilization/L.C. Witte, P.S. Schmidt, D.R. Brown/Hemisphere Publication/Washington

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPL 101	Laboratory I	01

- **Computer implementation – modeling and problems of Solving power plant Engineering using suitable software packages** for conventional and non-conventional
- A visit to Load Dispatch Center (LDC) / Control Room in Power Plant.

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
PPL 102	Laboratory II	01

1. Measurement of solar radiation and sunshine hours,
2. Measurement of albedo, UV & IR radiation,
3. Measurement of emissivity, reflectivity, transmittivity,
4. Performance testing of solar flat plate water heater (forced flow & thermosyphon systems)
5. Performance testing solar air heater & dryer & desalination unit,
6. Performance testing of solar thermal concentrators,
7. Characteristics of photovoltaic devices & testing of solar PV operated pump,
8. Energy consumption & lumen measurement of lights & ballasts.
9. Properties of fuel oils & biomass,

10. Testing of Gasifier or Wind machines or Fuel cell

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
PPC 201	Energy Planning, Management and Audit	04

Module	Detailed Contents	Hrs.
01	Energy Conservation Initiatives in India, Energy and Economic Development, Energy in National Planning, Concept of Energy Supply and Demand, Energy Supply Planning, Energy Demand Planning, Decision support systems for energy planning, Life Cycle Costing	09
02	Principles and Objectives of Energy Management. Design of Energy Management Programmes. Development of energy management systems, Importance, Indian need of Energy Management, Duties of Energy Manager	06
03	Electrical Energy Management Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC, and FACTS. Demand side: conservation in motors, pumps and fan systems; energy efficient motors	09
04	Thermal energy Management Energy conservation in boilers, steam turbines and industrial heating systems; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management	08
05	Categories of Energy Audit, Types of Energy Audit, Scope of Energy Audit Procedures for Energy Analysis and Audit. Types and Methodology	08
06	Energy Audit Reporting Format; Understanding Energy Costs; Benchmarking and Energy Performance; Matching Energy Usage to Requirement; Maximising System Efficiency; Fuel and Energy Substitution; Energy Audit Instruments; Duties and responsibilities of energy auditors.	08

REFERENCES:

1. AmlanChakrabarti, Energy engineering and management, PHI Learning, New Delhi 2012
2. Mirjana Golusin, Sinisa Dodic, Stevan Popov, Sustainable Energy Management, Academic Press
3. Shaligram Pokharel, Energy Analysis for Planning and Policy, CRC Press, 2014
4. Trivedi P R, Jolka K R, Energy Management, Commonwealth Publications, New Delhi
5. Y P Abbi, Shashank Jain, Handbook on Energy Audit and Environment Management, TERI
6. General Aspects of Energy Management and Energy Audit, Buro of Energy Efficiency

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPC 202	Power Plant Performance, Monitoring & Testing	04

Module	Contents	Hours
1	Elementary details in numerical techniques: Number system and errors, Representation of integers, Fractions, Floating point Arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, Convergence of Sequences.	7
2	Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices.	8
3	Finite Difference Applications in Heat conduction and Convection – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure	7
4	Finite Differences, Discretization, Consistency, Stability, And Fundamentals Of Fluid Flow Modeling: Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods. Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.	10
5	Review of equations governing fluid flow and heat transfer: Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations. Steady flow, dimensionless form of Momentum and Energy equations, Stokes equation, conservative body force fields, stream function - Vorticity formulation.	9
6	Finite Volume Method: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, Upwind interpolation, Linear interpolation and Quadratic interpolation.	7

REFERENCES:

1. Numerical heat transfer and fluid flow / Suhas V. Patankar/Butter-worth Publishers

2. Computational fluid dynamics :Basics with applications /John. D. Anderson / Mc Graw Hill.
3. Computational Fluid Flow and Heat Transfer/ Niyogi/Pearson Publications
4. Fundamentals of Computational Fluid Dynamics /Tapan K. Sengupta / Universities Press

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPC203	Power Generation & System Planning	04

Module	Contents	Hours
1	Overview of Indian power sector, thermodynamic analysis of conventional power plants,advanced power cycle IGCC,AFBC/PFBC	4
2	Steam Turbine - Superheater, reheater and partial condenser vacuum. Combined Feed heating and Reheating. Regenerative Heat Exchangers, Reheaters and Intercoolers in Gas Turbine power plants	5
3	Hydro power plants - turbine characteristics. Auxiliaries - Water Treatment Systems, Electrostatic Precipitator / Flue gas Desulphurisation, Coal crushing / Preparation - Ball mills / Pulverisers, ID/FD Fans, Chimney, Cooling Towers	10
4	Power plant control system-review of control principles, combustion control, pulveriser control, control of air flow, furnace pressure and feed water,steam temperature control,safety provision/interlocks	10
5	Analysis of System load curve -plant load factor, availability, Loss of load Probability calculations for a power system, Maintenance Scheduling Pricing of Power - Project cost components, Analysis of Power Purchase Agreements (PPA), Debt/Equity Ratio and effect on Return on Investment,	10

6	Environmental legislations/government policies , Optimal dispatch , Scheduling of Hydro-thermal Plants, load forecasting-Time series, econometric, end use techniques. Least cost power planning .Integration of DSM, renewable into supply.	9
---	--	---

REFERENCES:

1. R.W.Haywood Analysis of Engineering Cycle,4th Edition Pergamon Press,Oxford,1991
2. D Lindsay Boiler Control systems, Mcgraw Hill International, London,1992
3. H.G.Stoll Least cost Electrical Utility/Planning,John Wiley & Sons, 1989
4. T.M.O'Donovan, Short Term Forecasting: An Introduction to the Box Jenkins Approach, Wiley,Chichester,1983
5. A.B.Gill, Power Plant Performance, Butterworths,1984
6. Wood A.J.,Wollenberg,B.F., Power generation ,Operation & Control, John Wily,New York,1984

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE2031	Grid Integration of Renewable Energy	04

Module	Contents	Hours
1	Dispersed photovoltaic, solar, wind, fuel cell and conventional dispersed generation technologies, economic factors and technical impact on utility distribution systems, interfacing and optimal location of dispersed generation, protective relaying and system interconnection issues, islanding, voltage flicker effects, power quality effects.	8

2	Principles of wind energy extraction, electromechanical energy conversion, characteristics of wind turbines, Photovoltaic and Thermo-solar power generation profiles, Aerodynamics of wind turbines, aerodynamic power controls, pitch, stall, active stall, rotor power characteristics CP- λ , Power curves	8
3	Wind energy conversion systems, Induction generator, Synchronous generator with full scale power electronic block, variable speed operations, doubly fed induction generation.	7
4	Wind data analysis, Weibull distribution, Rayleigh distribution, Energy estimation of wind regimes, Weibull based approach, Rayleigh based approach, Power curve of the wind turbine, Capacity factor, matching the turbine with wind regime, economic dispatch model incorporating wind Power, overestimation and to the cost of underestimation of available wind power, economic emission dispatch.	9
5	Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.	9
6	Wind integration operational issues such as frequency control, load following, reserve requirements, integrating wind in the competitive electricity market.	7

REFERENCES:

1. Wind Energy Fundamentals, Resource Analysis and Economics, Sathyajith Mathew, Springer-Verlag Berlin Heidelberg 2000
2. Wind Energy Explained: Theory, Design and Application: James Manwell, J. F. Manwell
3. Power Conversion of Renewable Energy Systems, Ewald F. Fuchs, Springer Mukund R Patel, Wind and Solar Power Systems, CRC Press, 1999.
4. J F Manwell, J.C.McGowan, A.L.Rogers, Wind Energy Explained: Theory, Design
5. and Application, John Wiley and Sons, May 2002.
6. R D Begamudre, Energy Conversion Systems, New Age International (P) Ltd., Publishers, New Delhi ,2000.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end

semester examination.

Subject Code	Subject Name	Credits
PPE2032	Environment and Safety Engineering	04

Module	Contents	Hours
1	Pollution: Air Pollution Standards; Effects of Air Pollutants on Materials, Vegetation and Health Origin and Fate of Pollutants (Carbon monoxide, Hazardous Air Pollutants, Lead, Nitrogen Dioxide, Photochemical Oxidants, Sulphur Oxides, Particulates) Acid Rain, Ozone depletion & Greenhouse effect. Waste Water Treatment Waste water Microbiology, Characteristics of Waste Water, Municipal and Industrial waste water treatment, Unit operation of Pretreatment, Primary Treatment, Unit processes of Secondary treatment, disinfections, Land treatment, Sludge treatment and disposal.	10
2	Solid Waste Management: Waste characteristics, Disposal by Sanitary landfill, thermal conversion; combustion or incineration system, Pyrolysis, Gasification, Pelletization. Waste to Energy, Resource conservation and recovery, Biological processing of Solid wastes.	8
3	Hazardous Wastes Management: Characteristics of Hazardous Waste, Management of Hazardous Waste; Chemical. Oxidation, vitrification, Hazardous wastes landfills, Radioactivewaste; Detection and analysis, classification and disposal of Radioactive Wastes, Fly ash characteristics and disposal, Site remediation techniques	8
4	Effluents from power plants and Impact on environment – pollutants and pollution standards –Methods of Pollution control.	6
5	Industrial safety: Accidents (Causes & Factors, Cost of Accidents, Accident Prevention, Investigation of Accidents, Reporting and Recording Systems for Accidents. First Aid (Basics of First Aid, How injuries are caused in lifting, falls etc.) Fire Fighting: Fundamentals of Fire, Fire Fighting Equipments and Systems, Fire Extinguishing Methods, Demonstration of various Fire	8
6	Industrial Hazards, Protective Clothing and Equipment, Safe Working Practices in Power Plant, Permit to work system, Safety in Movement and storage of Materials, House Keeping, Safety Rules.	8

REFERENCES:

1. Energy Management/Murphy WR, Mc Kay G/Butterworth Heinamn/2009
2. Environmental Engg: A Design Approach / Sincereo & Arcadio P/ PHI

3. Environmental Engineering: Water Supply, Sanitary Engineering and Pollution/ Kamala A Rao/TMH

4. Environmental Engineering/Dean J, Horward S/McGraw Hill/1985

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE 2033	Control System Design	04

Module	Detailed Contents	Hrs.
01	Basics of control system - Types of control – proportional control, Derivative control, Integral control, PID control-Programmable logic controllers.	7
02	Control system performance objectives, Review of design of cascade compensators for continuous time and discrete time control systems, Scalar and multivariable control systems, Feedback compensation	9
03	Industrial PID controllers. state space systems and PID control, Pole placement techniques for design of controllers and observers, design of integral controllers, Kalman filter, Robust control	9
04	Non-linear control system design, Linearization, use of describing function to predict oscillations, compensation and design of non-linear systems, design of non-linear control system using phase plane analysis, selection of best non-linear control system method	9
05	Lyapunov stability, optimal control theory and applications, Adaptive Control -	6
06	Automatic PID controller tuning, Self-tuning control, model reference adaptive control, practical aspects, Control system design examples	8

REFERENCES:

1. Stanley M. Shinnars, Advanced modern control system theory and design, John Wiley & Sons, 1998.
2. Michael A. Johnson, Mohammad M. Moradi, PID Control: New Identification and Design Methods, Springer 2005.
3. Norman S. Nise, Control Systems Engineering (5e), John Wiley & Sons Inc, 2010.
4. Kuo, B.C., Farid Golnaraghi, Automatic Control Systems (8e), Wiley India, 2009.
5. Katsuhiko Ogata, Modern Control Engineering (5e), PHI, 2010.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
EME 2031	Nuclear Power Plants	04

Module	Detailed Contents	Hrs.
01	Nuclear Power Plant: Concept of energy generated from atomic fission. Block diagram of an Atomic power station. Constructional features of nuclear power plants. Site selection for NPP	08
02	Nuclear power production, fission and fusion, nuclear fuels, prospecting, processing of nuclear fuels.	08
03	Reactor Technology: Basic Reactor Systems – BWR, PHWR/CANDU, GCR, fast breeder – comparison. Fuel handling and reprocessing.	07
04	Types of coolants. Control of chain reaction. Radio activity and safety measures. Layout of control rooms.	09
05	Nuclear Waste disposal and environmental management.	08
06	Review of Nuclear Power Programs, Nuclear power in Indian context	08

REFERENCES:

1. Raymond L Murray, Nuclear Energy An Introduction to the Concepts, Systems and Applications of Nuclear Processes, 6th Edition, ELSEVIER
2. Manoj Kumar Gupta, Power Plant Engineering, PHI Learning
3. James Rust, Nuclear Power Plant Engineering, Haralson Publishing Company
4. Nuclear Power Plants, Edited by Soon Heung Chang, InTech Publishers, 2012
5. Geotge Petridis and Dimitrios Nicolau, Nuclear Power Plants, NOVA Publishers, 2011

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE 2042	Steam and Gas Turbine	04

Module	Detailed Contents	Hrs.
01	Classification of steam turbines, combination of turbines, overview of turbines, Flow of steam through impulse turbine blades / impulse and reaction turbine blades, Energy losses in steam turbines, governing and performance of steam turbines	10
02	Steam turbine auxiliary systems: turbine protective devices, tripping devices, unloading gears, lubricating systems, glands and sealing systems	09
03	Construction, Operation and Maintenance of Steam Turbines	05
04	Gas Turbine-shaft power cycles, velocity diagram and work done by gas turbine, turbine blade cooling, blade materials, blade manufacture, matching of turbine components,	09
05	Combustion chambers, requirements, types, factor affecting performance of CC, performance of turbines	06
06	GT auxiliary systems, operation and maintenance, starting and ignition systems, lubrication systems, Fuel system and controls, operation, maintenance and trouble shooting	09

REFERENCES:

1. R Yadav, Steam and Gas Turbines and Power Plant Engineering, Central Publishing House, Allahabad, 2004
2. Ganesan, V., Gas Turbines, Tata McGraw-Hill Pub.Co.Ltd., New Delhi, 1999.
3. Lee J F, Theory and Design of Steam and Gas Turbines, McGraw-Hill, New York
4. Meherwan P Boyce, Gas Turbine Engineering Handbook, Gulf Publishing Company.
5. Cohen, H., Rogers, G.E.C., and Saravanamuttoo, H.I.H., Gas Turbine Theory, Longman Group Ltd, 1989
6. Gordon C, Dates, Aero-thermodynamics of Gas Turbine and Rocket Propulsion AIAA Education Series, NY, 1984.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPE2043	Power Plant Maintenance	04

Module	Contents	Hours
1	<p>Boiler and its accessories, Boiler structure steel work – Importance, Inspection and maintenance aspects, Problems in structure works & hanging arrangements.</p> <p>Boiler pressure parts Economizer: Tube size, material, spacing and their alignment; Causes and effects of erosion & corrosion on tubes; Causes for failure of economizer tubes; Inspection for damage of tubes and their repair / replacement methods.</p> <p>Boiler Drum & Drum internals: Different connections to boiler drum & their Maintenance, Instrumentation tapings, Safety valves and air vents Problems, Causes and Remedies</p>	6
2	<p>Water Wall Tube Arrangement: Tube materials, spacing and connections, Expansion & Sealing of boiler bottom and prevention of dust accumulation in seal chamber, Effect of water, erosion & corrosion on water wall tubes, Inspections of water valve tubes, Causes of tube failures, Repair/Replacement Procedures of punctured / damaged tubes, Procedure for alkali boil out & acid cleaning, preservation & flushing, Hydraulic statics test.</p> <p>Superheaters - Causes of tube failures, Pattern of tube punctures and their repair / welding / replacement procedures, Different types of welding utilized. Re-heaters -Inspections of tubes for erosion and corrosion & failures.</p> <p>Boiler draught system Draught Fans – ID Fan, FD Fan, PA Fan and their ducts, Causes of erosion and corrosion, Remedial action, Vibration analysis, Bearing/ coupling Maintenance and Shaft Alignment.</p> <p>Air Pre-Heater - Seal arrangement settings & replacement, Cold end corrosion in Air heaters, Causes & remedies, Driving Unit and its maintenance. SCAPH - Inspection of tubes for erosion and corrosion.</p>	10

3	<p>Soot Blower Maintenance, Pulverisers & Raw Coal Feeders: Pulverisers -Setting of spring assembly, Fitting of bearings and rollers on journals shaft, Mounting worm gear and shaft, Lubrication system of mills, Setting of classifier vanes, Repair of discharge dampers, Major problems encountered in coal mills & their causes and remedies, Constructional details working and maintenance aspect of driving units and PIV gearbox, Maintenance of coal flow indicators & inlet gate of coal, Maintenance of coal carrying system, i.e. drag link chain /conveyers / rotating blades.</p> <p>Coal handling plant & ash handling plants maintenance - Coal handling machines –their working and maintenance aspects, Bunker & Chutes- Effect of erosion and corrosion due to coal and their rectification, Coal crusher- Maintenance problems and repairs.</p>	10
4	<p>Turbine Maintenance: Pre-checks & dismantling sequence of Turbine Measurement of clearances, Checking the conditions of babbit metal for score pitting, chipping of or lack of bondage between the babbit and the shell, Checking of turbo supervisory instrument for total expansion & differential expansion, Checking of turbine cylinders for cracks/ deformation, Turbine support arrangements, Cleaning inspection and NDT, Centering of shafts, Alignment of rotors of HP, IP & LP rotors w.r.t. generator, Turbine generating system & control valves and governors, Inspection of barring gears, Vibration analysis, Turbine insulation inspection.</p>	8
5	<p>Turbine auxiliaries maintenance: Boiler feed pump, C.W. pump, Feed Heaters- LP & HP Heater, Condensers- Inspection cleaning & repair of tubes, Chemical dozing pumps reciprocating pumps, Condensate extraction pump, Construction & function of each part and maintenance problems of all equipments, Removal of complete cartridge of boiler feed pump, Inspection of shaft, bearings, seals, glands, balancing arrangements and ever rings, Dismantling & mounting of bearings, Maintenance of Hydraulic coupling, Alignment of pumps, Trouble shooting of pumps.</p>	8
6	<p>Generator Maintenance: Stator & Rotor maintenance, Vibration monitoring, Hydrogen leakage, Rotor earth fault detection, Excitation system maintenance. Electrical plant & auxiliary equipment maintenance –Switchgears, Isolators, Motors, Transformers, Batteries, Cable & earthing Actuators. Major Maintenance aspects of Hydroelectric/ Gas Power Stations.</p>	8

REFERENCES:

1. Modern Power Station Practice/C.E.G.B./ Vol-III.
2. Operator’s hand book/CEGB
3. NPTI Manual on Power Plant Maintenance.
4. BHEL Operation & Maintenance Manual

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
PPL 201	Laboratory III	01

Experiments and Case Studies on

- 1 Calculation of heating and cooling load
- 2 Preparation of energy audit plan and analysis energy audit data
- 3 Preparation of heat balance for a thermal machine
- 4 Determination energy efficiency of different machines
- 5 Preparation process flow diagram and energy utility diagram

Note:

The experiments will focus on the following:

1. Ability to select and install the measuring instruments
2. Take accurate readings
3. Analyse the data
4. Interpret the results

Industrial Training:

- The training on Energy Audit, shall be arranged for 2-4 weeks after completion of Sem-II exams and before commencement of Sem-III.
- To implement energy audit procedures for any utility, system or process in the industry.
- The student will submit a report on the training which will be assessed by the concerned faculty.

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
PPL202	Laboratory IV	01

RENEWABLE ENERGY

1. Performance testing of Solar Water Collector
2. Testing of Gasifier
3. Properties of Fuels

ENERGY CONSERVATION

1. Boiler efficiency testing
2. Heat Exchangers
3. Refrigeration and Air conditioning systems

ADVANCED ENERGY SYSTEMS

1. Fuel Cell
2. Thermal Storage Systems

SIMULATION BASED ON:

1. Solar control and monitoring
2. Nuclear power plant simulator
3. Wind turbine condition monitoring
4. Thermal energy monitoring

Perform minimum six experiments/Simulations based on syllabus contents.

EQUIPMENTS REQUIRED

1. Solar water heater – 100 LPD
2. Bomb calorimeter
3. Junker’s gas calorimeter
4. Hydrometer
5. Flash and fire point apparatus
6. Proximate analyzer (Muffle furnace and micro weigh balance)
7. Solar Radiation Meters
8. Non-IBR boiler
9. Heat Exchangers (plate, pipe-in-pipe, shell and tube)
10. Vapour Compression Refrigeration Test Rig
11. Fuel cell – Educational Kit
12. PCM based energy storage system

Seminar

Subject Code	Subject Name	Credits
PPS301	Seminar	03

Guidelines for Seminar

- Seminar should be based on thrust areas in Power Plant Engineering/Energy management
- Students should do literature survey and identify the topic of seminar and finalize in consultation with Guide/Supervisor. Students should use multiple literature and understand the topic and compile the report in standard format and present in front of Panel of Examiners appointed by the Head of the Department/Institute of respective Programme.
- Seminar should be assessed based on following points
 - Quality of Literature survey and Novelty in the topic
 - Relevance to the specialization
 - Understanding of the topic
 - Quality of Written and Oral Presentation

Dissertation (I and II)

Subject Code	Subject Name	Credits
PPD 301 / PPD 401	Dissertation (I and II)	12 + 15

Guidelines for Dissertation

- Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation I

- Dissertation I should be assessed based on following points
 - Quality of Literature survey and Novelty in the problem
 - Clarity of Problem definition and Feasibility of problem solution
 - Relevance to the specialization
 - Clarity of objective and scope
- Dissertation I should be assessed through a presentation by a panel of internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

- Dissertation II should be assessed based on following points
 - Quality of Literature survey and Novelty in the problem
 - Clarity of Problem definition and Feasibility of problem solution
 - Relevance to the specialization or current Research / Industrial trends
 - Clarity of objective and scope
 - Quality of work attempted
 - Validation of results
 - Quality of Written and Oral Presentation
- Dissertation II should be assessed through a presentation jointly by Internal and External Examiners appointed by the University of Mumbai

Students should publish at least one paper based on the work in reputed International / National Conference (desirably in Refereed Journal)

