APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

(A State Government University)

B. Tech, 2024

Minor Degree in

Energy Engineering

Offered By: Electrical Engineering

CURRICULUM

Minor (Energy Engineering)											
Sl.No:	Semester	Course Code	Course Title (Course Name)	Credit Structure			SS	Total Marks		Credits	Hrs./ Week
				L	T	P		CIA	ESE		
1	3	MNEET319	Introduction to Power System	3	1	0	5	40	60	4	4/5
2	4	MNEET419	Energy and Storage Systems	3	1	0	5	40	60	4	4/5
3	5	MNEET519	Power Plant Instrumentation and Automation	3	1	0	5	40	60	4	4
4	6	MNEET619	Energy Audit and Management	3	0	0	4.5	40	60	3	3
Total							**20/ 21**			**15**	**15/ 17**

SYLLABUS

SEMESTER 3

SEMESTER 3

INTRODUCTION TO POWER SYSTEM

Course Code	MNEET319	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	60
Credits	4	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	GXEST104/ GZEST204	Course Type	Theory

Course Objectives:

1. To introduce the various conventional energy sources and the economics of power generation.
2. To introduce the design of transmission and distribution systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Power Generation** Generation from renewable and non-renewable sources – Hydro, thermal, nuclear- (block schematic details, environmental and ethical factors, advantages, disadvantages) Solar and wind - (block schematic details, environmental factors, regulations, advantages, disadvantages) Energy storage systems as alternative energy sources – BESS, CESS, thermal SS.	11
2	**Economics of Power Generation** Types of loads, Load curve, terms and factors, peak load and base load Cost of electrical energy – numerical problems Power factor improvement – causes of low power factor, disadvantages - methods of power factor improvement, calculations of power factor correction, economics of power factor improvement. Tariff – different types.	11

3	**Transmission and distribution systems** Power Transmission System - (Electrical Model)- Line parameters – resistance - inductance and capacitance (Derivation of three phase double circuit) Transmission line modelling - classifications (concept only) – transmission line as two port network – derivation and calculation of ABCD parameters Skin Effect & Ferranti Effect Sag – calculations at equal and unequal tower heights – Corona (qualitative study only) – Surge Impedance Loading Insulators – string efficiency - (numerical problems) – grading Introduction to HVDC:-Principle, different types, advantages/disadvantages compared to EHVAC. Underground cables – ratings - classification - Capacitance of cables – grading – 2 types Types of distribution systems – AC distribution systems – connection schemes – radial and ring main systems – single phase only (numerical problems)	**11**
4	**Protection** Need for protection- Types of protection schemes – primary and back-up Protective relays – Basics of typical electromechanical relay – induction type only Static (block diagrams of o/c and instantaneous o/c relays) Microprocessor (block diagram and flow chart of o/c relay) Fundamentals of Numerical relay (block diagram). Circuit breakers – operating principle – arc phenomenon – arc extinction – principle & methods – Important terms in arc extinction – Circuit breaker classification based on medium of arc extinction SF6 & VCB – working principle. Introduction to GIS.	**11**

Mandatory Assignments:

1) *Visit to a nearby substation, identify the components and prepare a technical report.*
2) *Conduct survey and draw the load curve of a particular building. Calculate the various terms associated.*

Course Assessment Method
(CIE: 40 marks,ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate various conventional sources of energy generation.	**K2**
CO2	Analyse the economics of power generation and power factor improvement.	**K3**
CO3	Design mechanical and electrical parameters of a transmission system.	**K3**
CO4	Demonstrate the working of relays and switchgear for protection schemes.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**										**2**
CO2	**3**	**3**										**2**
CO3	**3**	**3**										**2**
CO4	**3**	**3**										**2**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	ElectricalPowerSystems	WadhwaC. L.	NewAgeInternational	8th edition 2023
2	Principles of Power System	V. K. Mehta and Rohit Mehta	S.Chand	4th edition reprint 2020
3	PowerSystemProtectionandSwitchgear	BadriRamandD.N.Viswakarma	Tata McGraw Hill	2nd edition, 2011
4	Non-conventional energy sources	B. H. Khan	Tata McGraw Hill	3rd edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A text book of Power system Engineering	A. Chakrabarti, M. L.Soni, P.V. Gupta, V. S. Bhatnagar	DhanpatRai	2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	
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MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNEET319

Course Name: INTRODUCTION TO POWER SYSTEM

Max. Marks: 60 | Duration: 2 Hours 30 Minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		What are the factors affecting the choice of selection of site for a hydel power plant?	1	(3)
2		What is the function of control rods in a nuclear power plant? What is it made up of?	1	(3)
3		Define load factor. Explain its significance by illustrating with sample load curve.	2	(3)
4		Justify that low power factor is disadvantageous for power system operation.	2	(3)
5		Discuss the merits and demerits of high voltage being preferred for transmission.	3	(3)
6		Discuss the main features of an interconnected distribution system.	3	(3)
7		Justify the need for protection of a power system. What happens when a fault occurs in a power system?	4	(3)
8		Explain the principle of arc extinction in circuit breakers.	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

		Module 1		
9	a)	Explain various elements of a diesel power plant.	1	5
	b)	Illustrate the working of a solar PV system with block diagram.	1	4
10	a)	Explain the general layout of a nuclear power plant.	1	5
	b)	Write a note on different types of storage systems.	1	4
		Module 2		
11	a)	Explain any one method of power factor improvement.	2	4
	b)	A generating station has a maximum demand of 150000 kW. The annual load factor is 50% and plant capacity factor is 40%. Determine the reserve capacity of the plant.	2	5
12	a)	Estimate the generating cost per kWh delivered from a generating station from the following data :Plant capacity = 50 MW ;Annual load factor = 40% Capital cost = 1·2 crores ; annual cost of wages, taxation etc. = Rs 4 lakhs ; cost of fuel, lubrication, maintenance etc. = 1·0 paise/kWh generated. Interest 5% per annum, depreciation 6% per annum of initial value.	2	5

	b)	With respect to a load curve explain the terms demand factor and diversity factor.	2	4
		Module 3		
13	a)	In a 33 kV overhead line, there are three units in the string of insulators. If the capacitance between each insulator pin and earth is 11% of self-capacitance of each insulator, find (i) the distribution of voltage over 3 insulators and (ii) string efficiency.	3	5
	b)	Compare radial and ring main distribution system with the help of appropriate schematics.	3	4
14	a)	Derive the equation for Sag in transmission lines, when the support is at equaland unequal heights.	3	5
	b)	A single-phase transmission line has two parallel conductors 3 m apart, radius of each conductor being 1 cm. Calculate the capacitance of the line per km.	3	4
		Module 4		
15	a)	With necessary block diagram explain the working of a microprocessor based overcurrent relay.	4	5
	b)	Write a note on the classification of circuit breakersbased on medium of arc extinction.	4	4
16	a)	With neat sketches explain the working of Vacuum Circuit Breaker.	4	5
	b)	Discuss the difference between primary and back up protection.	4	4
		*****		

SEMESTER 4

SEMESTER 4

ENERGY AND STORAGE SYSTEMS

Course Code	MNEET419	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	MNEET319	Course Type	Theory

Course Objectives:

1. To introduce various types of renewable energy sources.
2. To discuss about various means of energy storage.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Energy Scenario**: Indian Energy Scenario, World Energy Scenario, Indian Energy Sector Reforms, Energy and Environment, Energy Security, Energy conservation act Energy Efficient Systems: Reducing pollution and improving efficiency in buildings, Green Building Standards, Types of lamps and their efficiencies	11
2	**Renewable Energy Resources**: Solar Thermal System-Working Principle-Block diagram, Solar Photovoltaic System- Working Principle-Block diagram, Solar cell efficiency calculation, Wind Energy Systems- Working Principle-Block diagram, wind power equation, Energy from Waves and tides- Working Principle-Block diagram, Ocean Thermal Energy System- Working Principle-Block diagram, Energy from Biomass	11
3	**Energy Storage**: Importance of Energy Storage- Means of Storing Energy- Principle of operation and performance comparison.	11

	Concept of power density and energy density, Compressed air storage, Fly wheel Energy Storage, Battery Storage-Battery: Specification, Charging/Discharging rate, Primary and secondary cells-Dry cell, Introduction; Battery Parameters - Cell and battery voltages, Charge (or AH) capacity, Energy stored, Energy density, Specific power, AH (or charge) efficiency, Energy efficiency, Self-discharge rates, Battery geometry, Battery temperature; Heating and cooling needs; Battery life and number of deep cycles. Lead acid batteries: - Construction, Chemistry, charging and discharging rates, Advantages, Disadvantages and Applications. Lithium ion batteries:- Construction, Chemistry, charging and discharging rates, Advantages, Disadvantages and Applications.	
4	**Introduction to fuel cell** - Operation principles of fuel cell – characteristics,Fuel cell efficiency and comparison with combustion engines, Environmental impact and sustainability. Commercially Viable Fuel Cell Technologies**.** **Proton Exchange Membrane Fuel Cells (PEMFC**), Structure, materials, and working principles, Water and thermal management, Applications in transportation. **Solid Oxide Fuel Cells (SOFC):-**High-temperature operation and materials, Fuel flexibility (H_2, CH_4, ammonia), Applications in stationary power and Combined Heat and Power (CHP) Systems **Hydrogen Production and storage:-**Electrolysis (alkaline, PEM, solid oxide), Solar and wind-based electrolysis Storage Techniques**:-**Compressed gas, Liquid hydrogen, Solid-state storage (metal hydrides, LOHCs) Fuel cell – battery based hybrid energy storage system – control strategies.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate Indian and global energy scenario	K1
CO2	Elaborate different conventional and non-conventional energy generation schemes and the economics of generation	K2
CO3	**Explain the operating principles**lead acid and lithium ion batteries for commercial applications	K2
CO4	**Explain the operating principles**of various fuel cell for commercial applications	K2

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**										**2**
CO2	**3**	**3**										**2**
CO3	**3**	**3**										**2**
CO4	**3**	**3**										**2**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Renewable Energy Sources and EmergingTechnology-	K.C. Kothari, D.P.Ranjan, Rakeshsingal	PHI	2nd Revised edition, 2011
2	Energy Storage for Power Systems,	A.G.Ter-Gazarian,	IET	2011
3	Advances in Battery Technologies for Electric Vehicles	Bruno Scrosati, Jürgen Garcheand Werner Tillmetz	WP/ELSEVIER	ISBN 978-1-78242-398-0
4	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles	MehrdadEhsani, YiminGao, Sebastien E. Gay, Ali Emadi,	CRC PRESS	ISBN 0-8493-3154-4

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1				
2				
3				
4				

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
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MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNEET419

Course Name: ENERGY AND STORAGE SYSTEMS

Max. Marks: 60		Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		Enumerate the important features of Energy Conservation act.	1	(3)
2		Illustrate the concept of green buildings.	1	(3)
3		Find the maximum power and efficiency of a 100 x 100 mm sq. solar cell having an open circuit voltage is 0.611 V, Short circuit current of 3.5 A, Fill factor of 0.7 when input power is 10 W.	2	(3)
4		Draw and explain the block diagram of the ocean thermal energy system.	2	(3)
5		Give the relative advantages and disadvantages of battery storage.	3	(3)
6		Discuss about the concept of energy density and power density in energy storage systems	3	(3)
7		What is the working principle of a fuel cell?	4	(3)
8		What is Combined Heat and Power (CHP) and how do fuel cells support it?	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

		Module 1		
9	a)	Compare Energy Scenario of India and the world.	1	5
	b)	The luminous efficiency of a lamp is 8.8 Lumens/Watt and its luminous intensity is 700 Cd. What is the power of the lamp?	1	4
10	a)	Compare any four types of lamps. Give their approximate efficiencies as well.	1	5
	b)	Discuss the energy system reforms in India and illustrate their effect.	1	4
		Module 2		
11	a)	Explain how energy can be extracted from the heat and light of sun.	2	5
	b)	Determine the power in the wind if the wind speed is 20 m/s and blade length is 50 m and air density = 1.23 kg/m^3.	2	4
12	a)	Compare the schemes for extraction of energy from waves and tides.	2	5

	b)	Explain with the help of a schematic, extraction of energy from biomass.	2	4
		Module 3		
13	a)	List any four methods of storing energy.	3	5
	b)	Differentiate between primary and secondary batteries.	3	4
14	a)	Describe the basic construction of a lead-acid battery.	3	5
	b)	Mention two advantages of lithium-ion batteries over lead-acid batteries.	3	4
		Module 4		
15	a)	Discuss the main characteristics of fuel cells that make them suitable for clean energy applications.	4	5
	b)	Describe the structure, working principle, and key components of a PEM fuel cell.	4	4
16	a)	Describe how renewable energy sources such as solar and wind can be used for hydrogen production.	4	5
	b)	Discuss various control strategies used in fuel cell–battery hybrid systems for effective energy management.	4	4
		*****		

SEMESTER 5

SEMESTER 5

POWER PLANT INSTRUMENTATION AND AUTOMATION

Course Code	MNEET519	CIE Marks	40
Teaching Hours/Week (L: T:P)	3:1:0	ESE Marks	60
Credits	4	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	MNEET419	Course Type	Theory

Course Objectives:

1. To understand the fundamental principles and components of instrumentation systems used in power plants.
2. To familiarize students with automation of power plants and Supervisory control and data acquisition.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Measurements in power plants: Electrical measurements – current, voltage, power, frequency, power factor etc. – non-electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor.	11
2	Measurement in boiler and turbine: Metal temperature measurement in boilers, piping. System for pressure measuring devices - smoke and dust monitor - flame monitoring. Introduction to turbine supervising system - pedestal vibration - shaft vibration - eccentricity measurement. Installation of non-contracting transducers for speed measurement.	11
3	Controls in boilers: Boiler drum level measurement methods - feed water control - soot blowing operation - steam temperature control - Coordinated control - boiler following mode operation - turbine following mode operation	11

	- selection between boiler and turbine following modes. Distributed control system in power plants interlocks in boiler operation - Cooling system - Automatic turbine runs up systems.	
4	Introduction to SCADA systems: - Elements of a SCADA system - benefits of SCADA system - SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system SCADA System Components: - Remote Terminal Unit-(RTU), Intelligent Electronic Devices (IED) - PLC: Block diagram, Ladder diagram, Functional block diagram, Applications, Interfacing of PLC with SCADA.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse different instruments used for measuring parameters in a power plant.	K2
CO2	Identify the ability to select appropriate sensors and transducers for monitoring parameters like pressure, temperature, flow, and level in a power generation system.	K2
CO3	Identify different components of SCADA for applications in power plants.	K2, K3
CO4	Explain various control systems in power plants.	K2, K3

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**										**1**
CO2	**3**	**3**										**1**
CO3	**3**	**3**										**1**
CO4	**3**	**3**										**1**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Power Plant Engineering	P. K. Nag	Tata McGraw-Hill Education	2nd Edition, 2002.
2	Mechanical and Industrial Measurements	R.K.Jain	Khanna Publishers, New Delhi	10th Edition, 1995
3	The Control of Boilers	Sam. G. Dukelow	ISA Press, New York	2nd Edition, 1991
4	SCADA-Supervisory Control and Data Acquisition	Stuart A. Boyer	Instrument Society of America Publications,USA	2004

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Boiler Control Systems	David Lindsley	McGraw Hill, New York	1991
2	Power station instrumentation	Jervis M. J	Butterworth Heinemann,Oxford	1993

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	
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MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNEET519

Course Name: INSTRUMENTATION AND AUTOMATION OF POWER PLANTS

Max. Marks: 60 | Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		Explain briefly the working principle of an induction type wattmeter.	1	(3)
2		Discuss the role of dust monitor in power plants.	1	(3)
3		Write notes on temperature measurement techniques used in boilers.	2	(3)
4		Discuss how pedestal vibration is measured in boilers.	2	(3)
5		Explain what you mean by co-ordinated control in boilers.	3	(3)
6		Discuss the role of distributed control system in a power plant.	3	(3)
7		List out the differences between RTUs and IEDs.	4	(3)

8		State the advantages and disadvantages of PLC.	4	(3)
PART B				
Answer any one full question from each module. Each question carries 9 marks				
		Module 1		
9	a)	With the help of a neat diagram, explain the working of a digital frequency meter.	1	9
	b)	Explain how the flow of feed water is measured in power plants.	1	9
10	a)	With the help of a neat sketch, explain the working of a power factor meter.	1	9
	b)	Explain the working of a radiation detector.	1	9
		Module 2		
11	a)	Explain how flame monitoring is done in boilers.	2	9
	b)	Discuss the pressure measuring devices in boilers.	2	9
12	a)	Describe with a neat schematic, how shaft vibration can be detected.	2	9
	b)	Explain the working of a non-contact type speed measuring device.	2	9
		Module 3		
13	a)	Explain the control of boiler drum level in power plant operation.	3	9
	b)	Explain how steam temperature can be controlled in boilers.	3	9
14	a)	Compare the performance of boiler following mode and turbine following mode of operation in power plants.	3	9
	b)	Explain interlocks in boiler operation.	3	9
		Module 4		
15	a)	Describe the basic components of a SCADA system and the components of an IED.	4	9
	b)	Explain the ladder logic approach of programming in a PLC.	4	9
16	a)	Explain the objectives of SCADA	4	9
	b)	Discuss about the various SCADA architectures. Compare them.	4	9
*****				

SEMESTER 6

SEMESTER 6

ENERGY AUDIT AND MANAGEMENT

Course Code	MNEET619	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	ESE Marks	60
Credits	3	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	MNEET519	Course Type	Theory

Course Objectives:

1. To introduce the basic concepts of energy management and audit.
2. To introduce energy conservation aspects of various machines and devices used in industry.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Energy Management - General Principles and Planning: General principles of energy management and energy management planning Energy Audit: Definition, need, types and methodologies. Instruments for energy audit, Energy audit report - Power quality audit, Energy conservation in buildings: ECBC code (basic aspects), Building Management System (BMS). Energy Standards – International Energy Standards-ISO50001, Bureau of Energy Efficiency, star rating	9
2	Electricity transmission and distribution system,cascade efficiency. Lighting: Modern energy efficient light sources, life and efficacy comparison with older light sources, energy conservation in lighting, use of sensors and lighting automation. Motors: Development of energy efficient motors and the present status, techniques for improving energy efficiency, necessity for load matching and selection of motors for constant and variable loads. Transformers: Present maximum efficiency standards for power and distribution transformers, design measures for increasing efficiency in electrical system components.	9

3	Demand side Management: Introduction to DSM, benefits of DSM, different techniques of DSM –time of day pricing, multi-utility power exchange model, time of day models for planning. Load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. Power factor improvement, numerical examples. DSM and Environment. Ancillary services: Introduction of ancillary services – Types of Ancillary services	**9**
4	Boilers: working principle - blow down, energy conservation opportunities in boiler. Steam: properties of steam, distribution losses, steam trapping. Identifying opportunities for energy savings in steam distribution. Heat recovery system - Energy saving opportunities. Cogeneration: Types and schemes, optimal operation of cogeneration plants, combined cycle electricity generation. Economic analysis: methods, cash flow model, time value of money, evaluation of proposals, pay-back period, average rate of return method, internal rate of return method, present value method, life cycle costing approach. Computer aided Energy Management Systems (EMS).	**9**

Mandatory assignments:

1) *Conduct energy audit of a building.*
2) *Conduct economic analysis of a case study project.*

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the significance of energy management and auditing.	K3
CO2	Discuss the energy efficiency and management of electrical loads.	K3
CO3	Apply demand side management techniques.	K3
CO4	Compute the economic feasibility of the energy conservation measures.	K4

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**		**1**	**1**		**1**	**1**		**1**			
CO2	**2**		**1**	**1**		**1**	**1**					
CO3	**2**		**1**	**1**		**1**	**1**					
CO4	**2**		**1**	**1**		**1**	**1**				**2**	

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Handbook of Energy Audit	A. Thumman, W. J. Younger	CRC Press	2003
2	Energy Management and Conservation Handbook	D. Yogi Goswami, Frank Kreith,	CRC Press	2007
3	Operation of restructured power system	Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen	Kluwer Academic	2001
4	Energy management Hand Book	Wayne C. Turner	The Fairmount Press	1997

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Energy Conservation Act 2001			
2	Publications of Bureau of Energy Efficiency			
3	IEEE recommended practice for energy management in industrial and commercial facilities			
4	Industrial Energy Conservation	Charles M. Gottschalk	John Wiley and Sons	1996

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	
2	
3	
4	

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNEET619

Course Name: ENERGY AUDIT AND MANAGEMENT

Max. Marks: 60		Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		What is meant by power quality audit?	1	(3)
2		Write a short note on building management systems.	1	(3)
3		Compare the efficacy of different light sources.	2	(3)
4		Give the design measures for increasing efficiency in transformers.	2	(3)
5		Explain the benefits of demand side management.	3	(3)
6		Explain the benefits of power factor improvement.	3	(3)
7		Explain how the life cycle costing approach can be used for the selection of energy projects.	4	(3)
8		Comment on the merits and demerits of simple payback period method.	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

		Module 1		
9	a)	Explain the different steps involved in a detailed energy audit.	1	5
	b)	What are the different phases of energy management planning?	1	4
10	a)	With the help of case studies, explain any two energy management principles.	1	5
	b)	Explain the different instruments used for energy audit.	1	4
		Module 2		
11	a)	Elaborate upon the methods used to reduce energy consumption in lighting.	2	5
	b)	Justify the necessity of load matching for selection of motors.	2	4
12	a)	How does energy efficient motors reduce energy consumption?	2	5
	b)	Illustrate how cascade efficiency of an electrical system can be obtained.	2	4

		Module 3		
13	a)	Discuss the different techniques of demand side management.	3	5
	b)	What are ancillary services? What are the different types? Explain any one type in detail.	3	4
14	a)	Justify the need for peak demand control. Discuss the different methods used for peak demand control.	3	4
	b)	The load on an installation is 900 kW, 0·8 lagging p.f. which works for3000 hours per annum.Thetariff is Rs 100/- per kVA plus 20 paise per kWh. If the power factor is improved to 0·9 lagging by means of loss-free capacitors costing Rs 60/- per kVAR, calculate the annual saving effected. Allow 10% per annum for interest and depreciation on capacitors.	3	5
		Module 4		
15	a)	Calculate the energy saving and payback period which can be achieved by replacing a 11kW,existing moto rwith an EEM.The capital investment required for EE Mis Rs.5 0,000/-.Cost of energy/kWhisRs.5.Theloadingis 70% of therated value for both motors. Efficiency of the existing motor is81% and that of EEM is 84.7%.	4	5
	b)	Explain the working of different types of cogeneration systems.	4	4
16	a)	Compare the internal rate of return method with present value method for the selection of energy projects.	4	4
	b)	Comment on Computer Aided Energy Management Systems.	4	5
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