SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)
Department of Electrical Engineering

Semester/Year		VI/III	Program		B.Tech
Subject Category		Subject Code:	EE- 702	Subject Name:	Power system Protection .

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	30	10	10	150	3	0	2	04

Prerequisites:

Power system-I and Power system analysis

Course Objective:

Course Outcomes:

CO1. To understand architecture of protection system, its requirement and basics.
CO2. To analyze the need of different types of relaying, principles and characteristics.
CO3. Knowledge of generator, transformer, bus bar and transmission line protection.
CO4. To study different types of static relays, numerical relays, microprocessor relay.
CO5. To explain the construction and operation of different types of circuit breakers.

UNITs	Descriptions	Hrs.	CO's
I	**UNIT I PROTECTION SCHEMES** Principles and need for protective schemes — nature and causes of faults — types of faults — Methods of Grounding — Zones of protection and essential qualities of protection — Protection scheme	8	CO1
II	**UNIT II ELECTROMAGNETIC RELAYS** Operating principles of relays — the Universal relay — Torque equation — R-X diagram — Electromagnetic Relays — Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.	8	CO2

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-

III	**UNIT III APPARATUS PROTECTION** Current transformers and Potential transformers and their applications in protection schemes — Protection of transformer, generator, motor, bus bars and transmission line.	8	CO3
IV	**UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION** Static relays — Phase, Amplitude Comparators — Synthesis of various relays using Static Comparators — Block diagram of Numerical relays — Over current protection, transformer differential protection, distant protection of transmission lines. Microprocessor based relays.	8	C04
V	**UNIT V CIRCUIT BREAKERS** Physics of arcing phenomenon and arc interruption — DC and AC circuit breaking — re-striking voltage and recovery voltage — rate of rise of recovery voltage — resistance switching — current chopping — interruption of capacitive current — Types of circuit breakers — air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers — comparison of different circuit breakers — Rating and selection of Circuit breakers.	8	CO5
Expert Lecture		02	
Total Hours		40	

Suggestive list of experiments:

To study symmetrical and Unsymmetrical faults.
Study of Over-Current relay—To find time-current characteristics of IDMT relay with different time settings and plug settings.
To perform experiment on under/over voltage protection.
To perform experiment on Distance protection.
Study of Auto-Reclose system.
Study of percentage biased Differential relay.
To perform experiment on differential protection of transformer.
To study Generator Differential Protection.
To perform experiment on reverse phase protection.
To perform experiment on unbalanced Voltage protection.
To perform testing of breakdown strength of transformer oil.
To perform Directional Over Current Relay.
To perform fault statistics on line simulator

Text Book:

1. Power System Protection and Switchgear Badri Ram, D.N. Vishwakarma McGraw Hill 2 nd Edition
2. Power System Protection and Switchgear BhuvaneshOza et al McGraw Hill 1 st Edition, 2010.
3. Switchgear Protection and Power system. Khanna Publishers.

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Reference Books-

1 Y. G. Paithankar and S. R. Bhinde, Fundamentals of Power System Protection, PHI.
2 Power System Switchgear and Protection N. Veerappan S.R. Krishnamurthy S. Chand 1 st Edition, 2009
3 Fundamentals of Power System Protection Y.G.Paithankar S.R. Bhide PHI 1 st Edition, 2009

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)
Practical (30)	Lab work (10)	Quiz (10)	-	Total (50)

List/Links of e-learning resource

NPTEL/Moocs
https://archive.nptel.ac.in/courses/108/107/108107167/
https://archive.nptel.ac.in/courses/108/101/108101039/
https://archive.nptel.ac.in/courses/108/106/108106160/

Recommendation by Board of studies on	20 May 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Prof Shivendra SinghThakur
Subject handled by department	Electrical Engineering

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Department of Electrical Engg.

Semester/Year	V/III	Program	B.Tech

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

Subject Category	Departmental Course	Subject Code:	EE- 702 (A)	Subject Name:	**Advance Electrical Drives & Traction**

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	--	--	--	100	3	0	0	03

Prerequisites:

Electrical Drive, Power Electronics & Electrical Machines

Course Objective:

1. To explain the Construction and working of special machines & and their controller.
2. To classify the need and Requirement of special machines.
3. Explain traction system and various types of controlling of braking techniques. Different types of motors used in Traction with supply system layout schemes in traction.
4. To understand the controller of dc & AC machines
5. Understanding the basic of EV and motor control

Course Outcomes:

At the end of this course, students will demonstrate the ability to :

CO1: Acquire the knowledge of the design procedure of drive system and its characteristics of stepper motor and switched reluctance motor.

CO2: To apply their knowledge to prepare control schemes as per different types of motors used in industries.

CO3: Evaluate systems for traction drives, starting, and braking speed control of traction motors and design of traction system.

CO4: Identify suitable electric motor drive for particular application.

CO5: Understand efficient control strategies, to explain the basic of Electric vehicles and its motor control

UNITs	Descriptions	Hrs.	CO's
I	**TRACTION:** Special features of Traction motors, Different system of electric traction and their Advantages and disadvantages, diesel electric locomotives. Mechanics of train movement: simplified speed time curves for different services, average and schedule speed, tractive effort, specific energy consumption, factors affecting specific energy consumption, acceleration and braking, retardation, adhesive weight and coefficient of adhesion.	8	CO1

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II	TRACTION MOTORS : DC motors, single phase and three phase motors, starting and control of traction motors, braking of traction motors: plugging, rheostatic and regenerative braking, Modern 25 KV A.C. single phase traction systems: advantages, equipment and layout of 25 KV, line and current selection, single phase power frequency A.C. traction	10	CO2
III	**Special Drives**: Switched reluctance & permanent magnet brushless DC Operation, Converters, Characteristics &Control, PLC based drives. Servo drives & stepper motor- AC& DC Servomotor, Stepper motor, Control techniques, Controllers, Micro stepping, Sensor less operation. Applications of these machines.	8	CO3
IV	AC Drive: v/*f* control of induction motor, dynamic model, direct and indirect field orientation, direct torque control, direct self control, space vector direct torque and self control, machine Intelligence controller, sensor less operation of induction motor.	7	CO4
V	Review of electric motors & Solid state converters: Speed control techniques of DC, Induction & synchronous motor. Energy efficient electric motors, Pay back periods, Energy conservation through solid state control.	7	CO5
Expert Lecture			
Total Hours		40	
Suggestive list of experiments:			
NA			

Text Book-

1. G.K. Dubey, "Fundamentals of Electrical Drives",Narosa Publishing House
2. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, New Delhi, 1989
3. Andrzej M. Trzynadlowski, Control of Induction Motors (Engineering), Academic Press, October 2000.

Reference Books-

1. Naser A and BoldeaL,"Linear Electric Motors: Theory Design and Practical Applications", Prentice Hall Inc., New Jersey 1987.
2. K. Venkataratnam,"Special Electrical Machines", Universities Press, India, 2009.
3. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, New Delhi, 1989.
4. Floyd E Saner," Servomotor Applications", Pittman, London, 1993.
5. William H Yeadon, Alan W Yeadon, Handbook of Small Electric Motors, McGraw-Hill, New Delhi, 2001.
6. Energy-Efficient Electric Motors: Selection and Application, Second Edition, John C. Andreas, Marcel Dekker Inc., 1992
7. B.K. Bose, Modern Power Electronics and Ac Drives, Prentice Hall India Learning Private Limited (2005)

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

List/Links of e-learning resource

- NPTEL

Recommendation by Board of studies on	20 May 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Dr. Sudhir Sharma
Subject handled by department	Electrical Engg.

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

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Department of Electrical Engg.

Semester/Year		V/III	Program		B.Tech
Subject Category	Departmental Course	Subject Code:	EE- 702 (B)	Subject Name:	Electric Vehicle

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	--	--	--	100	3	0	0	03

Prerequisites:

Course Objective:

1. Understand Vehicle Fundamentals
2. Explain electric, hybrid electric and plug in hybrid electric vehicle, their architecture and technology
3. Understand electric propulsion unit and its control for application to electric vehicles.
4. Discuss different energy storage technologies and their control, used for hybrid electric vehicles and functions of battery management systems.
5. Demonstrate different configurations of electric vehicle charging techniques.

Course Outcomes:

At the end of this course, students will demonstrate the ability to :
CO1: Understand vehicle Fundamentals
CO2: Understand the architecture and technology of electric, hybrid electric and plug in hybrid electric vehicle.
CO3: Develop the electric propulsion units and its control for application to Electric Vehicle
CO4: Explain the use of different energy storage system used for electric vehicles
CO5: Understand the control and configurations of various EV charging technologies.

UNITs	Descriptions	Hrs.	CO's

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

I	Module 1: Vehicle Fundamentals Vehicle Basics, Roadway Fundamentals, Laws of motion, vehicle kinetics, Dynamies of Vehicle Motion, Propulsion Power, Velocity & Acceleration, EV Power train Component Sizing.	8	CO1
II	Module 2: Basics of EV Technology Economic and environment impact of electrical vehicle. Basics of the EV, HEV configurations - Series hybrid, parallel hybrid, series parallel hybrid, complex hybrid systems. Power Flow control in HEV configurations. Basics of Plug-In Hybrid Electric Vehicle (PHEV) and its architecture	10	CO2
III	Module 3: Electric Propulsion Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives and Synchronous reluctance motor drives, drive system efficiency	8	CO3
IV	Module 4: Energy Storage in EVs Batteries - and their types, Fuel Cells - and their types, basics of Fuel Cell Vehicles (FCEVs,) Ultra Capacitors and Ultra high speed Flywheels, their features and design. Hybridization of Energy Sources. Battery Management Systems-block diagram and functions.	7	CO4
V	Module 5: EV Charging Technologies EV Charging Technologies: Classification of different charging technology for EV charging station, introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) or Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations, bi-directional EV charging systems, energy management strategies used in hybrid and electric vehicle, Wireless power transfer (WPT) technique for EV charging. ISO standards for EV charging	7	CO5
Expert Lecture			
Total Hours		40	
Suggestive list of experiments:			
NA			

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Text Book-

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Vehicles: Fundamentals, Theory and Design, CRC Press , 2004
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, Third Edition, CRC Press 2021

Reference Books-

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd. , 2011

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

List/Links of e-learning resource

- NPTEL

Recommendation by Board of studies on	20 May 25
Approval by Academic council on	11/6/25
Compiled and designed by	Dr. Monika Jain
Subject handled by department	Electrical Engg.

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Department of Electrical and Electronics Engineering

Semester/Year		Program		B.Tech
Subject Category	Subject Code:	EE-702 (C)	Subject Name:	Advanced Power Electronic Circuits

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				Practical			Total Marks				
End Sem	Mid-Sem	Quiz	Ass	End Sem	Lab-Work	Ass		L	T	P	
60	20	10	10	--	--	--	100	3	-	-	3

Prerequisites: Power Electronics , Machine

- Basics of Power Electronics
- Understanding of switching devices and converter operation

Course Objective:

i. To provide in-depth knowledge of advanced inverter topologies and current source inverters.
ii. To introduce and analyze the operation and control of switched-mode rectifiers.
iii. To familiarize students with various switched-mode power supply (SMPS) topologies, including isolated and non-isolated converters.
iv. To impart knowledge of voltage mode and current mode control strategies for SMPS.
v. To explore resonant converter topologies and matrix converters, with emphasis on their operation and control.

Course Outcomes:

CO1: Analyse and design Current source and series inverters
CO2: Analyse Switched Mode Converter circuits
CO3: Design isolated and non-isolated Switched Mode DC converters
CO4: Analyse and design of SMPS
CO5: Analyse and design resonant converters

Units	Descriptions	Hrs.	CO's
I	Special Inverter Topologies - Current Source Inverter. Ideal Single Phase CSI operation, analysis and waveforms - Analysis of Single Phase Capacitor Commutated CSI. Series Inverters. Analysis of Series Inverters. Modified Series Inverter.	9	CO1
II	Switched Mode Rectifier - Operation of Single/Three Phase bilateral Bridges in Rectifier Mode .Control Principles. Control of the DC Side Voltage. Voltage Control Loop. The inner Current Control Loop. Single phase and three phase boost type APFC and control, three phase utility inter phases and control	9	CO2
III	Buck, Boost, Buck-Boost - SMPS Topologies. Basic Operation-Waveforms - modes of operation - Push-Pull and Forward Converter Topologies - Basic Operation. Waveforms - Half and Full Bridge	9	CO3

	Converters. Basic Operation and Waveforms- Fly back Converter .discontinuous mode operation .waveforms- Continuous Mode Operation Waveforms.		
IV	Voltage Mode Control of SMPS. Loop Gain and Stability Considerations. Shaping the Error Amp frequency Response. Error Amp Transfer Function. Current Mode Control of SMPS. Current Mode Control Advantages. Current Mode Vs Voltage Mode.	8	CO3
V	Introduction to Resonant Converters. Classification of Resonant Converters. Basic Resonant Circuit Concepts. Load Resonant Converter. Resonant Switch Converter. Resonant DC Link Inverters with Zero Voltage Switching. Matrix converter. Introduction to digital Controllers -DSP- Texsa-28379D, dSPACE, OPAL- RT, STM – 32 .	10	CO4
Guest Lectures (if any)		1	
Total Hours		45	

Suggestive list of experiments:

1. NA

Text Book-

- Ned Mohan et.al "Power electronics: converters, applications, and design" John Wiley and Sons, 3rd edition, 2007.
- Rashid "Power Electronics circuits, devices and applications" Pearson, 4th edition, 2017.
- P.C Sen, "Power Electronics", Mc Graw Hill, 2017

Reference Books-

- G.K.Dubey et.al "Thyristorised Power Controllers" New age publishers, 2nd edition, 2010.
- IETE Press Book Power Electronics Tata McGraw Hill, 2003
- Cyril W Lander "Power Electronics" McGraw Hill., 2005.
- B. K Bose "Modern Power Electronics and AC Drives" Pearson Education (Asia)., 2007

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

List/Links of e-learning resource

- https://archive.nptel.ac.in/courses/108/107/108107128/

Recommendation by Board of studies on	20 May 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Dr. Jitendra Kumar Tandekar
Subject handled by department	Electrical Engg.

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

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Department of Electrical Engg.

Semester/Year		V/III	Program		B.Tech
Subject Category	Departmental Course	Subject Code:	EE- 703 (A)	Subject Name:	Soft Computing Techniques

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	--	--	--	100	3	0	0	03

Prerequisites:

Power system

Course Objective:

To introduce the concepts in Soft Computing such as Artificial Neural Networks,Fuzzy logic-based systems, genetic algorithm-based systems and their hybrids.

Course Outcomes:

At the end of this course, students will demonstrate the ability to :
CO1. Learn soft computing techniques and their applications.
CO2. Define the fuzzy systems and its applications.
CO3. Analyze various neural network architectures.
CO4. Analyze various neural network architectures.
CO5. Explore hybrid of GA, ANN & neural network..

UNITs	Descriptions	Hrs.	CO's
I	**Introduction to soft computing** Concept of computing systems, "Soft"computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques.	8	CO1

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II	**Fuzzy logic** Introduction to Fuzzy logic, Fuzzy sets and membership functions,Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.	10	CO2
III	**Artificial Neural Networks** Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Some applications of ANN.	8	CO3
IV	**Genetic Algorithms** Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures.GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs.	7	CO4
V	**Hybrid techniques** Introduction, Hybrid of GA & ANN, Hybrid of GA & Fuzzy, Hybrid of ANN & Fuzzy, some applications of Hybrid techniques.	7	CO5
Expert Lecture			
Total Hours		40	
Suggestive list of experiments:			
NA			

Text Book-
1. Neural Networks, Fuzzy Logic and Genetic Algorithms : Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
2. S. N. Sivanandam and S. N.Deepa, Principles of soft computing – John Wiley & Sons,2007.
3. Timothy, J. Ross, Fuzzy Logic with engineering applications , John Wiley & Sons, 2016.

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

Reference Books-
1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory &Applications-Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice HallInternational, Inc.1998
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation,Morgan Kaufman/Elsevier, 2007.
4. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control-Narosa Pub., 2001.
5. Bart Kosko, Neural Network and Fuzzy Systems- Prentice Hall, Inc., Englewood Cliffs,1992
6. Goldberg D.E., Genetic Algorithms in Search, Optimization, and Machine Learning-Addison Wesley, 1989.

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

List/Links of e-learning resource

- NPTEL

https://cse.iitkgp.ac.in/~dsamanta/courses/sca/resources/slides/01%20Intro.pdf
https://cse.iitkgp.ac.in/~dsamanta/courses/sca/resources/slides/10%20EC%20Introduction%20to%20GAs.pdf
https://cse.iitkgp.ac.in/~dsamanta/courses/sca/resources/slides/06%20ANN%20Introduction.pdf
https://ggu.ac.in/gguold/download/Class-Note14/Soft%20Computing-%20Dr.%20H.s.%20Hota%2028.08.14.pdf

Recommendation by Board of studies on	20 May 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Dr. Shilpi Tomar
Subject handled by department	Electrical Engineering

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

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Department of Electrical Engineering

Semester/Year		VII	Program		B.Tech
Subject Category	DE-5	Subject Code:	EE- 703 (B)	Subject Name:	Optimization techniques & their applications

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	--	--	--	100	3	0	0	03

Prerequisites:

Course Objective:

- To understand the concepts of advanced techniques and their applications.

Course Outcomes:

CO1. Introduction of intelligent techniques.
CO2. To focus on multi-objective optimization with NSGA.
CO3. To Apply advanced AI techniques of swarm intelligence, particle swarm optimization, ant-colony optimization.
CO4. To focus on hybrid AI techniques and case studies.

UNITs	Descriptions	Hrs.	CO's
I	**Introduction**: Statement of an optimization problem – Classification of optimization problems – Optimal problem formulation, Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms.	10	CO1

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II	**Non-linear programming:** One dimensional minimization methods – Unconstrained optimization techniques – Constrained optimization techniques – Transformation methods – Interior and exterior penalty function method – Convergence and divergence of optimization algorithms – Complexity of algorithms.	10	CO2
III	**Modern Methods in Optimization:** Genetic Algorithm – Simulated Annealing – Particle Swarm Optimization – Neural Network based Optimization , Optimization of Fuzzy systems.	10	CO3
IV	**Multi-Objective Optimization:** Data Analytics and Solving multiobjective problems using GA, PSO, ANN.		
V	**Implementing optimization Algorithms:** Implementation of Optimization techniques in power system, control system application in MATLAB software.	10	C04
Expert Lecture		01	
Total Hours		40	

Text Book:

1. S.S. Rao, Engineering optimization: Theory and Practice, New age international, 3rd edition, 2013.

2. K. Deb., Optimization for Engineering Design: Algorithms and Examples, PHI, 2nd Edition, 2012.

3. J. S. Arora, Introduction to Optimum Design, Academic press, 4th Edition, 2017.

Reference Books-

1.Multiobjective Optimization: Interactive and Evolutionary Approaches:Jürgen Branke, Kalyanmoy Deb , Kaisa Miettinen , Roman Slowiński, Springer, 2008.

2. Swarm Intelligence Optimization: Algorithms and Applications Abhishek Kumar, Pramod Singh Rathore, Vicente Garcia Diaz, Rashmi Agrawal, John Wiley & Sons, 2022.

3. D.E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Longman Publishing, 1989.

4. Chandra, S., Jayadeva, Mehra, A., Numerical Optimization and Applications, Narosa Publishing House, (2013).

5. Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004)

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

List/Links of e-learning resource
1. https://www.sciencedirect.com/topics/engineering/swarm-intelligence 2. https://link.springer.com/chapter/10.1007/978-1-4302-5990-9_10 3. https://www.geeksforgeeks.org/hybrid-sorting-algorithms/
NPTEL/Moocs 1. https://archive.nptel.ac.in/courses/112/103/112103301/ 2. https://nptel.ac.in/courses/112105235 3. https://nptel.ac.in/courses/111105614

Recommendation by Board of studies on	20 May 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Dr. Shilpi Tomar
Subject handled by department	Electrical Engineering

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)
Department of Electrical Engineering

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Semester/Year		VI/III	Program		B.Tech
Subject Category	DE-5	Subject Code:	EE- 703 (C)	Subject Name:	Nature inspired Techniques

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	--	--	--	100	3	0	0	03

Prerequisites:

Course Objective:

To understand the fundamentals of nature inspired techniques which influence computing, studythe Swarm Intelligence and immuno computing techniques and familiarize the DNA Computing

Course Outcomes:

CO6. The basics Natural systems.
CO7. The concepts of Natural systems and its applications.
CO8. Familarize with ACO, swarm robotics.
CO9. Focusing on immunocomputing.
CO10. Understanding DNA computing

UNITs	Descriptions	Hrs.	CO's
I	**Introduction** :Overview, Individuals, Entities and agents - Parallelism and Distributivity, Interactivity ,Adaptation-Feedback-Self-Organization-Complexity, Emergence and ,Bottom-up Vs Top-Down- Determination.	8	CO1
II	**Computing Inspired by Nature :** Evolutionary Computing, Hill Climbing and Simulated Annealing, Darwin's Dangerous Idea, Genetics Principles, Standard Evolutionary Algorithm -Genetic Algorithms , Reproduction-Crossover, Mutation, Evolutionary Programming.	8	CO2
III	**Swarm Intelligence**: Introduction - Ant Colonies, Ant Foraging Behavior, AntColony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), SwarmRobotics, Foraging for food, Social Adaptation of Knowledge , Particle Swarm Optimization (PSO)	8	CO3

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IV	**Immuno computing**: Introduction- Immune System, Physiology and main components, Pattern Recognition and Binding , Immune Network Theory- Danger Theory, Evaluation Interaction-Immune Algorithms , Introduction – Genetic algorithms , Bone Marrow Models , Forest's Algorithm.	8	C04
V	**Computing with new natural materials**: DNA Computing: Motivation, DNA Molecule , Adleman's experiment , Test tube programming language, Universal DNA Computers , PAMModel , Splicing Systems , Lipton's Solution to SAT Problem , Scope of DNA Computing , From Classicalto DNA Computing	8	CO5
Expert Lecture		02	
Total Hours		40	

Text Book:
1.Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007

Reference Books-
1. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies ",MIT Press, Cambridge, MA, 2008.
2. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006. Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

List/Links of e-learning resource
https://www.sciencedirect.com/science/article/abs/pii/S0925231220319172
https://www.sciencedirect.com/topics/computer-science/immune-algorithm
https://www.pluralsight.com/resources/blog/cloud/what-is-dna-computing-technology

NPTEL/Moocs

Recommendation by Board of studies on	20 May 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Dr. Shilpi Tomar
Subject handled by department	Electrical Engineering

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Semester/Year		V/III	Program		B.Tech
Subject Category	DE	Subject Code:	EE- 704 (A)	Subject Name:	**Non Conventional Sources of Energy**

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	--	--	--	100	3	0	0	03

Prerequisites: Power System and Generation, Electrical Machines

Power system –I, machine

Course Objective:

1. Analyze solar energy technologies.
2. Classify the wind energy and hybrid energy systems.
3. Analyze concepts of hydro, ocean and geothermal energy systems.
4. Familiarize the operations of direct energy conversion systems.

Course Outcomes:

At the end of this course, students will demonstrate the ability to :

CO 1: Describe Renewable Energy Sources: Understand the importance of solar, wind, biomass, ocean, and tidal energy.

CO 2: Compare Renewable Energy Sources: Analyze and compare various renewable energy sources.

CO 3: Identify Applications: Recognize the applications of different renewable energy sources.

CO 4: Demonstrate Renewable Energy Systems: Illustrate the schematics of renewable energy systems.

CO 5: Analyze Implications: Evaluate the implications of renewable energy and solve numerical problems related to solar radiation.

UNITs	Descriptions	Hrs.	CO's
I	NEW & RENEWABLE ENERGY SOURCES Solar, biomass, wind, tidal, geothermal, microhydel, etc. – their availability & potential. Conversion of solar energy into various forms of energy (heat, electricity, mechanical etc.)	8	CO1

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II	GEOTHERMAL & TIDAL ENERGY Basic principles, systems used in practice and applications, resource assessment criteria, status in India. SOLAR THERMAL ENERGY Solar thermal devices: Radiation geometry, various types of solar collectors, flat plate & concentrating collectors, their construction working & application, hot water & hot air systems, industrial hot water systems, low pressure steam generation, solar dryers, solar pond, space heating & space conditioning, design criteria and methodologies for solar thermal applications. Solar concentrator and their applications, solar thermal power generation. use of solar thermal systems with existing systems, economic analysis of solar thermal systems, example of hybrid systems.	10	CO2
III	SOLAR PHOTOVOLTAIC Solar photovoltaic conversion: Basic principle of SPV conversion, types of solar cells, fabrication of SPV cells, Units.SPV systems: Different configurations, SPV system components and their characteristics, applications, hybrid SPV system. Block diagram of general SPV system, Balance of system(BOS) components, MPP Tracker, Inverter, Battery, Cables, Wiring.	8	CO3
IV	WIND ENERGY Wind energy conversion technologies, aerodynamics of wind turbine rotor, site selection. Wind resource assessment, various models to predict wind pattern and their analysis, concept of wind farms, various aspects of wind turbine design, hybrid wind energy systems (Wind + diesel power, wind + conventional grid, wind + photovoltaic system etc.).	7	CO4
V	HYDROGEN & FUEL CELL Hydrogen as a renewable energy source, source of hydrogen, fuel for vehicles. Hydrogen production: Direct electrolysis of water, direct thermal decomposition of water, biological and biochemical methods of hydrogen production. Storage of hydrogen: Gaseous, cryogenic and metal hydride. Utilization of hydrogen fuel cell – Principle of working, construction and applications.	7	CO5
Expert Lecture			
Total Hours		40	

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Suggestive list of experiments:
NA
Text Book- 1. K. Sukhatme, Suhas P. Sukhatme, “Solar Energy – Principles of thermal collection and storage” Tata McGraw Hill Education. 2. J. Twidell and T. Weir, “Renewable Energy resources”, E & F N spon Ltd., London
Reference Books- 1. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies And Applications" PHI Learning; 3 edition (9 May 2015) 2. Joshua Earnest, "Wind Power Technology", Prentice-Hall of India Pvt.Ltd; 1 edition 2014 3. N.S. Rathore and N. L. Panwar, “Renewable Energy Sources for Sustainable Development”, New India Publishing Agency, New Delhi, 2007. 4. G.N. Tiwari, M. K. Ghosal, “Fundamentals of Renewable Energy Sources”, Narosa Publication 2007. 5. Godfrey Boyle (editor), “Renewable Energy”.
Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

List/Links of e-learning resource
● NPTEL

Recommendation by Board of studies on	20 May 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Dr. Jitendra Tandekar
Subject handled by department	Electrical Engg

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Department of Electrical Engg.

Semester/Year		VI/III	Program		B.Tech
Subject Category	DE	Subject Code:	EE- 704 (B)	Subject Name:	**Energy audit & management**

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	--	--	--	100	3	0	0	03

Prerequisites:

Pre-requisites: Non conventional energy source, thermodynamics and laws, energy utilization, Electric Machines.

Course Objective:

Course Objective -

1. To discuss energy problem and scope for conservation, energy audit and its types.
2. To motivate the students of energy auditing instruments.
3. To realize the importance of thermal insulation, waste heat, recovery techniques and co-generation.
4. DSM and its program, payback period and cost benefit analysis.
5. To explain the of energy efficient motors.

Course Outcomes:

After successful completion of this course students will able to:

1. Able to calculate energy loss and understand energy patterns.
2. Able to examine energy audit technique and instruments.
3. Will be aware of thermodynamics laws, types of maintenance and energy conservation economic evaluations.
4. Can understand energy efficient motors and drives
5. Will understand cogeneration and energy conservation aspects in industries.

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UNITs	Descriptions	Hrs.	CO's

Abbreviations: ES-EndSemester, MS-MidSemester, LW LaboratoryWork, Assignment (L:Lectre,T:Tutorial,P:Practical), BFC-Basic Science Course, ESC-Engineering Science Course, HSMC-Humanities Science & Management Course, MAC-Mandatory Audit Course, HEC-Holistic Education Course, ILC-Institute Level Course, DC Department Course, DE-Department Elective, OE-Open Elective, DLC-Departmental Laboratory Course

I	**UNIT-I** General energy problem: Energy use patterns and scope for conservation. Energy audit: Energy monitoring, Energy accounting and analysis, Auditing and targeting. Energy conservation policy, Energy management & audit, Energy audit, Types of energy audit, energy management (audit), qualities and function of energy managers, language of an energy manager, Questionnaire, Check list for top management, Loss of energy in material flow, energy performance, Maximizing system efficiency, Optimizing, input energy requirements, Energy auditing instruments, Material load energy balance diagram.	8	CO1
II	**Unit-II** Thermodynamics of Energy Conservation. Basic principle. Irreversibility and second law efficiency analysis of systems. Primary energy sources, optimum use of prime movers, energy efficient house keeping, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation. Thermal energy audit in heating, ventilation and air conditioning. Maintenance and Predictive and preventive maintenance, lubrication and tribo-logical innovations.	10	CO2
III	**Unit-III** Load curve analysis & load management DSM, 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, Pay back period.	8	CO3
IV	**UNIT-IV** 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. Open source software	7	CO4

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V	**Unit-V** Energy conservation task before industry, Energy conservation equipments, Co-Generation, Energy conservation process, Industry Sugar, Textiles, Cement Industry etc Electrical Energy Conservation in building, heating and lighting. domestic gadgets	7	CO5
Expert Lecture			
Total Hours		40	

Suggestive list of experiments:

NA

Text Book-

1. Energy Management Head Book- W.C. Turner, John Wiley
2. Energy conservation and management-Surah Kumar Soni, Manoj Nair, Edition 4, Satya Prakash

1. Energy Management – W.R. Murphy & G. Mckey Butler worths.
2. Energy Management Principles- Craig B. Smith, Pergamon Press
3. Energy Conservation- Paul O Callagan- Pergamon Press
4. Design & Management of energy conservation. Callaghan
5. Elect, Energy Utilization & Conservation. Dr. Tripathi S.C

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

List/Links of e-learning resource

- NPTEL

Recommendation by Board of studies on	20 may 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Prof. Sudhir Sharma
Subject handled by department	Electrical Engg.

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Semester/Year		V/III	Program		B.Tech
Subject Category	DE	Subject Code:	EE- 704 (C)	Subject Name:	FACTS devices & HVDC system

Maximum Marks Allotted								Contact Hours			Total Credits
Theory				**Practical**			Total Marks				
ES	MS	Quiz	Assig	ES	LW	Quiz		L	T	P	
60	20	10	10	-	-	-	100	3	0	0	3

Prerequisites:

Power system I, Power system II

Course Objective:

The subject deals with basic FACTS concepts, static shunt and series compensation and combined compensation techniques and also the importance of HVDC transmission, analysis of HVDC Converters, Harmonics and Filters, Reactive power control and Power factor improvements of the system.

Course Outcomes:

At the end of this course, students will demonstrate the ability to :
CO1 : Explain the basic concepts, its classification and benefits from FACTS technology.
CO2: Enumerate the shunt compensators with their applications in power system.
CO3: Describe series controllers TCSC, SSSC & UPSC for control of the transmission line current.
CO4: Describe layout, its component functioning and the converter control characteristics of HVDC systems.
CO5: Explain converter control for HVDC systems, commutation failure, control functions.

UNITs	Descriptions	Hrs.	CO's
I	**Introduction to FACTS Concept and General System considerations**: Flow of Power in an AC System, Stability Considerations of Transmission Interconnection, Basic Types of FACTS Controllers, Brief Description and Definitions of FACTS Controllers, Checklist of Possible Benefits from FACTS Technology, In Perspective: HVDC or FACTS.	8	CO1

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II	**Static Shunt Compensators :** Objectives of shunt compensation, methods of controllable VAR generation, Static VAR Compensators, SVC and STATCOM, comparison between SVC and STATCOM, V–I and V–Q Characteristics, Transient stability, Response Time,V –I and V–Q Characteristics, Transient stability, Response Time.	10	CO2
III	**Static Series Compensators:** Objectives of Series Compensation, Concept of Series Capacitive Compensation, Impact on Voltage Stability, Improvement of Transient Stability, TCSC, SSSC, Transmitted Power Versus Transmission Angle Characteristic, UPSC.	8	CO3
IV	**Development of HVDC Technology:** Introduction Advantages of HVDC Systems, HVDC System Costs, Overview, Layout and Organization of HVDC Systems,Power Conversion: 3-Phase Converter, 3-Phase Full Bridge Converter, 12-Pulse Converter.	7	CO4
V	**Control of HVDC Converter and System:** Principles of DC Link control, converter control characteristics, system, control hierarchy, firing angle control, current and excitation angle control, generation of harmonics, AC and DC filters, Commutation Failure, HVDC Control and Design, HVDC Control Functions, Reactive Power and Voltage Stability.	7	CO5
Expert Lecture			
Total Hours		40	

Suggestive list of experiments: Nil

Text Book:

1. Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems Narain G Hingorani, Laszlo Gyugyi Wiley 1st Edition, 2000

Reference Books-

1. Thyristor Based FACTS Controllers for Electrical Transmission Systems R. Mohan Mathur, Rajiv K. Varma Wiley 1 st Edition, 2002
2. HVDC and FACTS Controllers applications of static converters in power systems, Vijay K. sood, Kluwer Academic Publishers.

Modes of Evaluation and Rubric

Theory (60)	Midsem (20)	Assg (10)	Quiz (10)	Total (100)

List/Links of e-learning resource

- NPTEL

Recommendation by Board of studies on	20 May 2025
Approval by Academic council on	11/6/25
Compiled and designed by	Dr. Shilpi Tomar
Subject handled by department	Electrical Engg.

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