E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai

Accredited by NAAC with 'A' Grade | Accredited by NBA (CSE, EEE, MECH)

NAGAPATTINAM – 611 002

M.E. POWER ELECTRONICS AND DRIVES

Full Time Curriculum and Syllabus

Second Year – Third Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1703PE018	**Elective III**- Optimization Techniques	3	0	0	3	40	60	100
1703PE009/ 1703PE001	**Elective IV**- SCADA system and applications management / Recent trends in power conversion Technology	3	0	0	3	40	60	100
1703EV020	**Elective V**-Environmental Engineering and Pollution Control	3	0	0	3	40	60	100
Laboratory Course								
1704PE301	Project Work Phase-I	0	0	12	6	50	50	100
Open Electives								
1703PE018	Optimization Techniques	3	0	0	3	40	60	100
1703PE020	Energy Management and Auditing	3	0	0	3	40	60	100
1703PE021	Computer Aided Design of Power Electronics Circuits	3	0	0	3	40	60	100
1703PE022	Renewable Energy Technology	3	0	0	3	40	60	100
1703PE023	Soft Computing Techniques for Renewable Energy System	3	0	0	3	40	60	100

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1703PE018	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Numerical Methods
2. Operational Research

COURSE OBJECTIVES:

1. To introduce the different optimization problems and techniques
2. To study the fundamentals of the linear and non-linear programming problem.
3. To understand the concept of dynamic programming and genetic algorithm technique

UNIT I INTRODUCTION TO OPTIMIZATION 7 Hours

Statement of Optimization problems - Classical optimization techniques - Single variable and multi variable optimization - Method of direct substitution constraint variation - Lagrange multipliers multivariable optimization with equality constraints - Kuhn Tucker conditions.

UNIT II LINEAR PROGRAMMING 6 Hours

Linear programming definition - Pivotal reduction of general system of equations - Simplex algorithms - Two phases of the simplex method - Revised simplex method - Duality in linear programming.

UNIT III NONLINEAR PROGRAMMING (ONE DIMENSIONAL) 5 Hours

Unimodal function – Elimination methods - Unrestricted and exhaustive search, Dichotomous search, Fibonacci method - Interpolation methods - Direct root method.

UNIT IV NONLINEAR PROGRAMMING 15 Hours

Unconstrained Optimization -Direct search methods - Univariate method, Pattern search methods - Rosenbrock's method – The simplex method - Descent method - Conjucate gradient method - Quasi Newton Methods.

Constrained Optimization - Direct methods - The Complex method - Cutting plane method - Methods of feasible directions and determination of step length - Termination criteria, determination of step length.

UNIT V DYNAMIC PROGRAMMING AND HEURISTIC TECHNIQUES FOR OPTIMIZATION 12 Hours

Multistage decision process - Computational procedure - Final value problem to initial value problem - Continuous dynamic programming - Discrete dynamic programming. Heuristic Techniques For Optimization - Neural Networks - Genetic algorithm – Adaptive genetic algorithm – particle swarm optimization - Ant Colony Optimization - Typical applications.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

Applications of AI techniques in wave form estimation for a Power Electronic Circuit.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1 Explain different classifications of optimization problems and techniques.

CO2 Understand the linear programming concepts.

CO3 Know the application of non- linear programming in optimization techniques.

CO4 Understand the fundamental concepts of dynamic programming.

CO5 Explain about Genetic algorithm and its application to optimization in power system.

REFERENCES:

1. Nash S G and Ariela Sofer, "Linear and Nonlinear Programming", McGraw Hill Book Com Inc, New York, 1996.
2. David E Goldberg, "Genetic Algorithms in Search, Optimization and Machine learning", Addison Wesley Publishing Company, 1999.
3. Rao S S., "Optimization Theory and Applications", Wiley Eastern Limited, New Delhi, 2003.
4. Lawrence Hasdorff," Gradient Optimization and Non-Linear control", John Wiley & sons Inc, New York, 1976.
5. Dorigo M and Stutzle, T., "Ant Colony Optimization", Prentice Hall of India, 2004.

1703PE009	SCADA SYSTEM AND APPLICATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Power System Operation and Control.
2. Power Quality Issues and Solutions.

COURSE OBJECTIVES:

1. To understand the fundamentals of SCADA.
2. To analyze the SCADA Components, Communication, Monitoring and Control.
3. To analyze the application of SCADA in power System

UNIT I INTRODUCTION TO SCADA 9 Hours

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits.

UNIT II SCADA SYSTEM COMPONENTS 9 Hours

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels.

UNIT III SCADA COMMUNICATION 9 Hours

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV SCADA MONITORING AND CONTROL 9 Hours

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

UNIT V SCADA APPLICATIONS IN POWER SYSTEM 9 Hours

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

SCADA Design for 66/11KV and 132/66/11KV or 132/66 KV any utility Substation and IEC 61850 based SCADA Implementation issues in utility Substations

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1 Explain the fundamentals of SCADA.
CO2 Describe the system components of SCADA.
CO3 Elucidate the SCADA communication.
CO4 Explain the monitoring and control of SCADA.
CO5 Describe the applications of SCADA in power system.

REFERENCES:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004.
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006
4. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003
5. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric Power, PennWell 1999.
6. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2001

1703PE001	RECENT TRENDS IN POWER CONVERSION TECHNOLOGY	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Power Electronics.
2. Analysis of Power Converters and inverters.

COURSE OBJECTIVES:

1. To analyze the recent DC – DC converters.
2. To analyze the recent AC – AC converters.
3. To analyze the PWM techniques, Control Techniques, Harmonics Mitigating techniques and applications.

UNIT I SWITCHING TECHNIQUES 8 Hours

Gating signals – PWM techniques – Types – SPWM, SVPWM and SVM – choice of carrier frequency in SPWM – switch realization – switching losses – efficiency Vs switching frequency – applications – EMI and EMC considerations.

UNIT II DC – DC CONVERTERS 10 Hours

Basic of DC – DC converter – hard and soft switching concepts – digital switching techniques - Luo converter - principle of operation – voltage lift techniques - MPPT algorithms – sliding mode control – applications of DC – DC converters in photovoltaic systems and in hybrid vehicles.

UNIT III ADVANCES IN INVERTERS 11 Hours

Multilevel concept – Diode clamped – Flying capacitor – Cascade type multilevel inverters – Hybrid multi level inverter- FFT analysis- Comparison of multilevel inverters - applications of multilevel inverter in welding - Principle of operation of impedance source inverter- applications – UPS – Induction heating. Concept of Multi stage power conversion in adjustable speed drives - renewable energy systems

UNIT IV MATRIX CONVERTER 8 Hours

Single phase and three phase – direct indirect – sparse and very sparse – multilevel matrix converter – Z source matrix converter – applications – wind mills – Adjustable speed drives industrial applications - Hybrid vehicles.

UNIT V HARMONIC MITIGATIONS 8 Hours

Effects of harmonics – harmonics eliminations – selective harmonic elimination – selective sine PWM carrier elimination – Power Factor controlling – active power factor controlling – hysteresis control – voltage feedback control - current feedback control.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

Applications of Matrix converter in Special Machine.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1 Explain the SVPWM and SVM techniques.
CO2 Describe the operation of Dc – Dc converter and its applications in photovoltaic systems.
CO3 Elucidate the Multi level and hybrid multi level concepts and its application.
CO4 Describe the various recent matrix converters and its applications.
CO5 Understand the harmonics mitigating techniques.

REFERENCES:

1. Ned Mohan, Undeland and Robbin, Power Electronics: Converters, Application and Design, NewYork, John Wiley and Sons Inc., 2002.
2. Kolar, J.W. Schafmeister, F. Round, S.D. Ertl, H. ETH Zurich and Zurich, Novel Three-Phase AC–AC Sparse Matrix Converters, Vol.22, No.5, IEEE Transaction on Power Electronics, Sept. 2007, pp 1649 – 1661.
3. R. Krishnan, Electric Motor Drives – Modeling, Analysis and Control, New Delhi, Prentice Hall of India, 2003.
4. D.M. Bellur, M.K. Kazimierczuk and O.H. Dayton, DC-DC Converters for Electric Vehicle Applications, Conference on Electrical Insulation and Electrical Manufacturing Expo, 22-24, Oct. 2007, Nashville, USA, pp 286 – 293.
5. S. Masoud Barakati, Applications of Matrix Converters for Wind Turbine Systems, Germany, VDM Verlag Publishers, 2008.

1703EV020	ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL	L	T	P	C
		3	0	0	3

PREREQUISITE :

Environmental Studies

COURSE OBJECTIVES:

1. To impart knowledge on the atmosphere and its present condition, global warming and eco-legislations.
2. To detail on the sources of air, water and noise pollution and possible solutions for mitigating their degradation.
3. To elaborate on the technologies available for generating energy from waste.

UNIT I INTRODUCTION **9 Hours**

Global atmospheric change – green house effect – Ozone depletion - natural cycles - mass and energy transfer – material balance – environmental chemistry and biology – impacts – environmental legislations.

UNIT II AIR POLLUTION **9 Hours**

Pollutants - sources and effect – air pollution meteorology – atmospheric dispersion – indoor air quality - control methods and equipments - issues in air pollution control – air sampling and measurement.

UNIT III WATER POLLUTION **9 Hours**

Water resources - water pollutants - characteristics – quality - water treatment systems – waste water treatment - treatment, utilization and disposal of sludge - monitoring compliance with standards.

UNIT IV WASTE MANAGEMENT **9 Hours**

Sources and Classification – Solid waste – Hazardous waste - Characteristics – Collection and Transportation - Disposal – Processing and Energy Recovery – Waste minimization.

UNIT V OTHER TYPES OF POLLUTION FROM INDUSTRIES **9 Hours**

Noise pollution and its impact - Oil pollution - pesticides - instrumentation for pollution control - water pollution from tanneries and other industries and their control – environment impact assessment for various projects – case studies. Radiation pollution: types, sources, effects, control of radiation pollution.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

Case study on environmental pollution near Marg Port – Karaikal due to coal handling process

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1 Explain the causes of atmospheric changes.
CO2 Describe the effects of air pollution and its control measures.
CO3 Understand the sources of water pollution and process involved in waste water management.
CO4 Explain the process of power generation from different wastes.
CO5 Describe the sources and effects of pollution from industries and its impacts on environment

REFERENCES:

1. Arcadio P Sincero and G.A. Sincero, Environmental Engineering – A Design Apporach, Prentice Hall of India Pvt Ltd, New Delhi, 2002.
2. Bishop P., Pollution Prevention: Fundamentals and Practice, McGraw-Hill International Edition, McGraw-Hill book Co, Singapore, 2000.
3. G.Masters, Introduction to Environmental Engineering and Science Prentice Hall of India Pvt Ltd, New Delhi, 2003.
4. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall, 1998.
5. H.Ludwig, W.Evans, Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands N.J. (1991).
6. H.S.Peavy, D.R.Rowe and G.Tchobanoglous, Environmental Engineering McGraw- Hill Book Company, NewYork, (1985).
7. Rao C.S., Environmental Pollution Control Engineering, 2nd Edition, New Age International.