IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme Based on AICTE Flexible Curricula (B. Tech)

Electrical and Electronics Engineering Department

VIII Semester

w.e.f.

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours/ Week			Total Credits
				Theory			Practical			L	T	P	
				End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Term Work / Lab Work & Sessional					
1	**PEC - EEE801**	**PEC**	Professional Elective-IV	70	20	10	-	-	100	**3**	**0**	**0**	**3**
2	**PEC - EEE802**	**PEC**	Professional Elective-V	70	20	10	-	-	100	**3**	**0**	**0**	**3**
3	**OEC - EEE801**	**OEC**	Open Elective-IV	70	20	10	-	-	100	**3**	**0**	**0**	**3**
4	**PROJ - EEE801**	**PROJ**	Seminar & Group Discussion	-	-	-	-	50	50	**0**	**0**	**2**	**1**
5	**PROJ - EEE802**	**PROJ**	Project Phase-II	-	-	-	120	80	200	**0**	**0**	**12**	**6**
			Total	**210**	**60**	**30**	**120**	**130**	**550**	**9**	**0**	**14**	**16**

Professional Elective-IV (PEC-EEE801)	Professional Elective-V (PEC-EEE802)	Open Elective-IV (OEC-EEE801)
(A) EHV AC DC Transmission	(A) Power Electronics Application to Power System	(A) DBMS
(B) Power Quality and Mitigation Techniques	(B) Computer Aided Electrical Machine Design	(B) Robotics
(C) Advance Power Electronics	(C) Electrical Installation & Practice	(C) Data Science

1 Hr. Lecture	1 Hr. Tutorial	2 Hr. Practical
1 Credit	1 Credit	1 Credit

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PEC-EEE801 (A)	Program Elective Course IV (EHV A.C D.C. Transmission)	3L: 0T:0P (hrs.)	3 Credits

Course Objective

Pre Requisite: Power System, Power Electronics

Module 1(8hrs.)

Constitution of EHV a.c. and d.c. links, Kind of d.c. links, Limitations and Advantages of a.c. and d.c. transmission, Principal application of a.c. and d.c. transmission, Trends in EHV a.c. and d.c. transmission, Power handling capacity. Converter analysis garetz circuit, Firing angle control, Overlapping.

Module 2(10hrs.)

FACTS devices, basic types of controller, series controller, static synchronous series compensator (SSSC), thyristor-controlled series capacitor(TCSC), thyristor controlled series reactor(TCSR), shunt controller (STATCOM), static VAR compensator(SVC), seriesseries controller, combined series-shunt controller, unified power flow controller (UPFC), thyristor controlled phase shifting transformer(TCPST).

Module 3 (8 hrs.)

Components of EHV d.c. system, converter circuits, rectifier and inverter valves, Reactive power requirements, harmonics generation, Adverse effects, Classification, Remedial measures to suppress, filters, Ground return. Converter faults & protection harmonics mis-operation, Commutation failure, Multi terminal D.C. lines.

Module 4 (7hrs.)

Control of EHV d.c. system desired features of control, control characteristics, Constant current control, Constant extinction angle control. Ignition Angle control. Parallel operation of HVAC & DC system. Problems & advantages.

Module 5 (8hrs.)

Travelling waves on transmission systems, Their shape, Attenuation and distortion, effect of junction and termination on propagation of traveling waves. Over voltages in transmission system. Lightning, switching and temporary over voltages: Control of lighting and switching over voltages.

Course Outcomes: After successful completion of course students will be able to

CO1: Ability to understand the EHV AC-DC Transmission system.
CO2: Understanding of different types of FACTs Devices.
CO3: Ability to understand various Converters used in EHV D.C. transmission.
CO4: Understanding EHV d.c. Transmission system controls.
CO5: Understanding effects of over voltages and Surges on EHV lines.

Text/ Reference books

1. S. Rao,- "EHV AC & DC Transmission" Khanna pub.
2. Kimbark,-" HVDC Transmission" john willy & sons pub.
3. Arrillaga,- "HVDC Transmission"2nd Edition ,IEE Londan pub.
4. Padiyar, -"HVDC Transmission" 1st Edition , New age international pub.
5. T.K. Nagsarkar, M.S. Sukhiza, -"Power System Analysis", Oxford University
6. Narain.G. Hingorani, l. Gyugyi-"Understanding of FACTS concept and technology", john willy& sons pub.
7. P.Kundur-"H.V.D.C.Transmission"McGrawHill

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PEC-EEE801(B)	**Program Elective Course IV (Power Quality and Mitigation Techniques)**	**3L : 0T : 0P (hrs.)**	**3 Credits**

Course Objective To educate the students regarding the power quality and causes, consequences and cures to harmonics in electrical systems/ industry.

Pre Requisite: Power System, Power Electronics

Followed by:

Module 1(8hrs.)
Introduction, power quality-voltage quality, power quality evaluations procedures term and definition: general classes of power quality problem, causes & effect of power quality disturbances.

Module 2(9hrs.)
Loads that causes power quality problems, State of art on Passive shunt and series compensation, Classification and working of passive shunt and series compensation, Classification, Principle and control of active shunt compensator: DSTATCOM, Active series compensators, working and its control.

Module 3 (6 hrs.)
Introduction to unified power quality compensators, classification, working and operation of UPQC.

Module 4 (11hrs.)
Voltage sags and interruption: sources of sags and interruption, estimating voltages sag performance, fundamental principles of protection, monitoring sags. Transients over voltages: sources of transient over voltages, principles of over voltages protection, utility capacitor switching transients, fundamentals of harmonics and harmonics distortion, harmonics sources from commercial load and from industrial loads.

Module 5 (8hrs.)
Applied harmonics : harmonics distortion evaluations, principles for controlling harmonics, harmonics studies devices for controlling harmonic distortion, Shunt active and passive filters, their operation and control. Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances.

Course Outcomes: After successful completion of course students will be able to

CO1: Describe the Power quality issues in power systems and effect of power quality disturbances.
CO2: Analyze and solve the various power quality issues.
CO3: Discuss the working and operation of unified power quality compensator**.**
CO4: Define voltage sag and interruption problems and suggest preventive techniques.
CO5: Discuss harmonic distortion and various harmonic controlling Techniques.

Text/ Reference books

1. Power Quality- by R.C. Duggan
2. Power System harmonics –by A.J. Arrillga
3. Power electronic converter harmonics –by Derek A. Paice
4. Power quality problems and mitigation techniques: Bhimsingh, Amrish Chandra, Kamal Al-Haddad.

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PEC-EEE801(C)	**Program Elective Course IV (Advance Power Electronics)**	**3L :0T : 0P (3 hrs.)**	**3 Credits**

Course Objective:-

Objective of this course is to introduce the students the analysis& designing of various power electronics supplies& power converters. It aims to familiarize the Soft switching techniques and its applications in various systems for power control.

Pre Requisite:-Should have basic knowledge of Basic Electronics and Power Electronics.

Module 1(07hrs.)

Introduction to various power electronics supplies. Performance parameters for power electronics supplies and their measurement. Device selection, Control circuits. Switch mode power supplies, Square wave switching, Resonant mode operation of Power supplies, Ferro resonant, Linears and the switchers.

Module 2(11hrs.)

DC to DC Converters: Analysis and design of buck, boost, buck-boost and cuk converters, two quadrant and full bridge converters. Isolated converters i.e., flyback, forward and bridge topology. Design of d.c. inductor. Concept of integrated magnetic, converter control, averaged model, state-space model.

Module 3 (08hrs.)

DC to Controlled AC: Controlled inversion, three phase full bridge inverters. 180^{o} mode and 120^{o} mode operation, harmonic analysis, PWM control of VSI, current mode control of PWM VSI, space vector modulation, three phase current sourced PWM CSI.

Module 4 (07hrs.)

AC Choppers: Modeling and analysis of AC choppers, harmonics control using symmetrical and asymmetrical waveform pattern.

Module 5 (07hrs.)

Soft switching DC to DC converters, zero current switching topologies, zero voltage switching topologies, generalized switching cell, ZCT and ZVT DC converters.

Course Outcomes:-

CO1 Ability to explain the basics of various power electronics supplies.
CO2 Ability to analyse & design DC to DC converters.
CO3 Ability to analyse DC to Controlled AC converters.
CO4 Ability to analyse and modeling of AC choppers.
CO5 Ability to analyse Soft switching DC to DC converters.

Text/ Reference books:

1. M.E. Van Valkenburg, Network Analysis, Pearson
2. Samarajit Ghosh, Network Theory Analysis and Synthesis
3. U.A. Patel, Circuit and Networks, Mahajan Publishing House.
4. William H Hayt. & Jack E. Kemmerly, Steven M Durbin; Engineering Circuit Analysis; McGrawHill
5. Richard C Dorf, James A Svoboda, Introduction to Electric Circuits, Wiley India,2015
6. Charles K. Alexander & Matthew N.O. Sadiku: Electrical Circuits; McGraw Hill
7. J David Irwin, Robert M Nelms, Engineering Circuit Analysis, WileyIndia,2015
8. Robert L Boylestad, introductory circuit analysis,Pearson,2016
9. M S Sukhija, T K Nagsarkar; Circuits and Networks, Oxford University Press, 2015

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PEC-EEE802 (A)	**Program Elective Course V (Power Electronics Application to Power System)**	**3L : 0T : 0P**	**3Credits.**

Course Objective: Student should study and understand the ac power flow and its control.

Module -1: (10 Hours)

Steady state and dynamic problems in AC systems: Flexible AC transmission systems (FACTS), Principles of series and shunt compensation, Description of static var compensators (SVC), Thyristor Controlled series compensators (TCSC), Static phase shifters (SPS), Static condenser (STATCON), Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC).

Module -2: (10 Hours)

Modelling and Analysis of FACTS controllers: Control strategies to improve system stability, Power Quality problems in distribution systems.

Module -3: (10 Hours)

Harmonics: Harmonics creating loads, modelling, harmonic propagation, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, filters, passive filters, Active filters, shunt, series hybrid filters, voltage sags & swells, voltage flicker, Mitigation of power quality problems using power electronic conditioners, IEEE standards, HVDC Converters and their characteristics, Control of the converters (CC and CEA), Parallel and series operation of converters.

Module -4: (8 Hours)

Active Power Controllers: Dynamic static synchronous controllers, D – STATCOM, Dynamic static synchronous series controllers, dynamic voltage restorer, AC/AC voltage regulators.

Module -5: (7 Hours)

Energy Storage Systems: Introduction, structure of power storage devices, pumped – storage hydroelectricity, compressed air energy storage system, flywheels, battery storage, hydrogen storage, super conducting magnet energy storage, super capacitors, applications of energy storage devices.

Course Outcomes: After successful completion of course students will be able to

CO1: To understand and explain operating principles and control methods of power converters for electric power systems.
CO2: To understand how to model power converters, and able to model power converters for electric power systems.
CO3: To understand different power quality issues and mitigation of power quality problems using power electronic conditioners.
CO4: To understand working of different Active power controllers.
CO5: To understand different types Energy Storage Systems and its structure.

Textbooks/References:

1. N.G. Hingorani& Laszlo Gyugyi , Understanding FACTS , IEEE Press, 2000.
2. E. F. Fuchs & Mohammad A.S. Masoum, Power Quality in Power Systems and Electrical Machines, Elsevier Academic Press 2008.
3. K.R. Padiyar, FACTS controllers in power transmission and distribution, New Age International publishers, New Delhi, 2007.
4. K.R. Padiyar, HVDC Power Transmission Systems, New Age International publishers, New Delhi,

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PEC – EEE 802 (B)	**Program Elective Course V (Computer-Aided Electrical Machines Design)**	**3L : 0T :0 P (3hrs.)**	**3 Credits**

Course Objective: The objectives are to study

1. To understand the design of Electrical Machines.

Pre Requisite: Knowledge of Basic Electrical Engineering, Electrical Machines.

Unit I: **[8Hrs]**

Introduction - Design problem-Mathematical programming methods, computer aided design-Mathematical formulation of the problem. Programming techniques (LP & NLP only), Methods of solution, Unconstrained optimization problems, constrained optimization problems.

Unit II: [10Hrs]

Optimal design of DC machine-Design of armature, Windings and field systems, Selection of variables for optimal design, Formulation of design equations, Objective function, Constraint functions, Algorithms for optimal design.

Unit III: [8Hrs]

Optimal design of power transformer-Design of magnetic circuit, Design of windings, Selection of variables for optimal design, Formulation of design equations, Objective function, Constraint functions, Algorithms for optimal design.

Unit IV: [7 Hrs]

Optimal design for 3-phase alternator-Design of stator, windings, Design of Field systems for salient pole and non-salient pole machines, Selection of variables for optimal design, Formulation of design equations, Objective function, Constraint functions, Algorithms for optimal design.

Unit V: [7Hrs]

Optimal design of 3-phase induction motor -Design of stator, Windings Design of squirrel cage rotor, Design of slip ring rotor, Selection of variables for optimal design, Formulation of design equations, Objective functions Constraint functions, Algorithms for optimal design.

Course Outcomes: After successful completion of course students will be able to

CO1: Formulate the mathematical programming for electrical machines
CO2: Formulate Design calculations for DC machine
CO3: Formulate Design calculations for 3 Phase & 1 Phase Transformer
CO4: Formulate Design calculations for Three Phase alternator
CO5: Formulate Design calculations for Three Phase Induction machine

Text Books:

1. Electrical Machine Design- by A.K. Sawhney, Dhanpat Rai & Sons.
2. Principles of Electrical Machine Design with Computer Programmes by- S.K. Sen, Oxford & IBH

Reference Books:

1. Design and Testing of Electrical Machines, MV Deshpandey PHI Learning.
2. Computer- Aided Design of Electrical Equipment- by Dr. M. Ramamoorthy-Affiliated East-West press Pvt. Ltd. New Delhi.
3. Performance and Design of A.C. Machines-M.G. Say, Affiliated East West Press Pvt. Ltd., New Delhi.

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PEC - EEE802(C)	Program Elective Course V (Electrical Installation Practice)	3L : 0T : 0P	3 Credits

Course Objective: To teach students basic principle of operation, construction and application of Electrical Installation Practices

Pre Requisite: Fundamentals of electrical workshop.

Module 1 (08 hrs.)

Electrical lay out and distribution systems, Introduction to general electric distribution systems, residential buildings, IT sector industry, Various components and their functions, General specification and ratings, top class brands, drawing of electric circuits, standard symbols, MCC and DCC, design issues for MCC and DCC.

Module 2 (08 hrs.)

Differential components in electric systems Types of wirings, cables, Insulators, Switches, thermal relays, wires, conductors, Types of Energy meters, MCB's and MCCB's, single phase preventer and basic protection equipment, HRC fuses, capacitors for PF correction, earthing of electrical installations.

Module 3 (10 hrs.)

Installation of electrical devices; Various types of electric motors, selection of motors for various applications such as fans, pumps, compressors, extruders, lifts, servo drives, heating and cooling of motors, simple industrial control such as multi-speed, star/delta, forward reverse, control circuits.

Module 4 (08 hrs.)

Typical installations: Installation of A. C.'s, UPS, inverters, D.G. sets, estimating the requirements, sizing the device, electrical system requirements, typical diagrams, AMF panel, types of UPS- on line and off line

Module 5 (06 hrs.)

Principle of contracting Purchasing techniques, spot quotations, floating enquiry, typical example of quotation form, preparation of comparative statement, analysis of comparative statement, tender types(Single tender, Open tender), Earnest money, Security deposit, various steps involved in complete purchase, typical order formats, various criteria for selecting the supply, general considerations in order for procedures to be allowed for submitting the tenders and quotations.

Course Outcomes: After successful completion of course students will be able to

CO1: knowledge of fundamentals of Electrical lay out and distribution systems
CO2: knowledge of differential components in electric systems
CO3: knowledge of installation of electrical devices & various types of electric motors
CO4: knowledge of typical installations: Installation of A. C.'s, UPS, inverters
CO5: knowledge about principle of contracting Purchasing techniques &quotations.

Text/ Reference books

1. Uppal S.L., Garg S.C., "Electrical wiring, estimation and costing", Khanna publishers, New Delhi, Sixth edition 2009.
2. Surjit Singh, "Electrical Estimating and Costing", Dhanpatrai and sons Reprint 2008
3. Raina K. B., Bhattacharya S. K., "Electrical Design Estimating and Costing", New age International Publishers Reprint 2009.
4. Stokes G , "Handbook Of Electrical Installation Practice", Wiley India 2014