IPS Academy, Institute of Engineering & Science

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

Scheme Based on AICTE Flexible Curricula (B. Tech) (WP)

Electrical and Electronics Engineering Department

(For Batches admitted in 2025-26)

VIII Semester

w.e.f. July 2023

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.	Lab Work & Sessional					
1	PEC-EE03	PEC	Departmental Elective-III	60	25	15	-	-	100	3	-	-	3
2	IOC-EC01	IOC	Interdisciplinary Open Course-II	60	25	15	-	-	100	3	-	-	3
3	PEC-EE04	PEC	Departmental Elective-IV	60	25	15	-	-	100	3	-	-	3
4	PROJ-EE04	PROJ	Project Phase -II	-	-	-	60	40	100	-	-	16	8
Total				**180**	**75**	**45**	**60**	**40**	**400**				**17**

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

- **Departmental Elective-III, PEC-EE03* (Any One Course)**
  a) EHV AC DC
  b) Power Quality and Mitigation Technique
  c) Advance Power Electronics

- **Departmental Elective-IV, PEC-EE04* (Any One Course)**
  a) Power Electronics Convertors for Renewable Energy
  b) Solar and Wind
  c) Embedded System

- **Interdisciplinary Open Course-II, IOC (Any One Course)**
  a) Robotics
  b) Data Science
  c) Business Communication

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Subject Code	Name of the Subject	L:T:P	Credits	Maximum Marks	
				Theory	
PEC-EE-03	Power Quality and Mitigation Technique	3:0:0	3	CIE	ESE
				40	60

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

Power quality problems and mitigation techniques: Bhimsingh, Amrish Chandra, Kamal Al- Haddad.

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Subject Code	Name of the Subject	L:T:P	Credits	Maximum Marks	
				Theory	
PEC-EE-04	Power Electronics Convertors for Renewable Energy	3:0:0	3	CIE	ESE
				40	60

Course objective: To familiarize the students with the

Prerequisite: Power System, Electrical machines, Instrumentation

Module 1(8 hrs.)

Introduction to renewable sources: world energy scenario, Wind, solar, hydro, geothermal,availability and power extraction. Introduction to solar energy: Photovoltaic effect, basics ofpower generation, P-V & I-V characteristics, effect of insolation, temperature, shading; Modules,connections, ratings; Power extraction (MPP), tracking and MPPT schemes; standalone systems,grid interface, storage, AC-DC loads.

Module 2(10 hrs.)

Power converters for solar: Micro converter, DC-DC buck/boost/buck-boost /flyback/forward/cuk, bidirectional converters; Inverters: 1ph, 3ph inverters Multilevel Neutral pointclamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar

Module 3(10 hrs.)

Single phase and three-phase back Controllers. Triggering techniques for power factor andharmonic controls. Design and analysis of phase control circuits. Solid state transfer switches.Concept of three-phase to single phase and single phase to three-phase cyclo-converter. Effect ofsource inductance. Concept of PWM techniques single and multiple pulse form. Working ofSTATCON, SVC, UPS, SMPS

Module 4(8 hrs.)

Intro to wind energy: P-V, I-V characteristic, wind power system: turbine-generator-inverter,mechanical control, ratings; Power extraction (MPP) and MPPT schemes. PLL andsynchronization, power balancing / bypass, Parallel power processing; Grid connection issues:leakage current, Islanding mode, harmonics, Mitigation of harmonics, filters, passive filters,Active filters, active/reactive power feeding, unbalance

Module 5(8 hrs.)

Generators for wind: DC generator with DC to AC converters; Induction generator with & w/oconverter; Synchronous generator with back to back controlled/ uncontrolled converter; Doublyfed induction

generator with rotor side converter topologies; permanent magnet based generators.Battery: Types, charging discharging.

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

CO1. Understanding renewable energy sources and optimization of Solar Energy tapping in PV systems
CO2. Understanding of different power converter for Solar (PV Systems)
CO3. Application of single phase and three phase controller with different controlling techniques.
CO4. Understanding of wind energy generators and their synchronization with grid network.
CO5. Understanding of different topology of wind generators.

References:

1. Sudipta Chakraborty, Marcelo G. Sim303265es, and William E. Kramer. PowerElectronics for Renewable and Distributed Energy Systems: A Sourcebook of ChetanSingh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications,Prentice Hall of India, 2011.
2. N. Mohan, T.M. Undeland& W.P. Robbins, Power Electronics: Converter, Applications& Design, John Wiley & Sons, 1989
3. Muhammad H. Rashid, Power Electronics: Circuits, Devices, and Applications, PearsonEducation India, 2004.
4. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaicand Wind Power Systems, John Wiley and Sons, Ltd., 2011

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Subject Code	Name of the Subject	L:T:P	Credits	Maximum Marks	
				Theory	
IOC-EC01	Robotics	2:1:0	3	CIE	ESE
				40	60

Prerequisite: NA

Course Objective: To understand the basic concepts associated with the design and Functioning and applications of Robots. To study about the drives and sensors used in Robots.

Course Contents: (40 hrs.)

Module 1: (06 hrs.)

Fundamentals of Robot: Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications

Module 2: (12 hrs.)

Robot Drive Systems and End Effectors : Pneumatic Drives , Hydraulic Drives, Mechanical Drives, Electrical Drives, D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

Module 3: (14 hrs.)

Sensors and Machine Vision: Requirements of a sensor, Principles and Applications of the following types of sensors– Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors),Touch Sensors, (Binary Sensors, Analogue Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis –Data Reduction: Edge detection, Feature Extraction and Object Recognition -Algorithms. Applications– Inspection, Identification, Visual Serving and Navigation.

Module 4: (04 hrs.)

Robot Kinematics and Robot Programming: Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs

Module 5: (04 hrs.)

Implementation and Robot Economics: RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

Course Outcome:

1. Learn about knowledge for the design of robotics.
2 Learn about force and torque sensing
3. Understand different sensors and vision of machine
4. Understand robot kinematics and robot programming
5. Apply basics on an application of Robots

List of Text / Reference Books:

1. M. P. Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw- Hill, 2001.
2. Saha S. , Introduction to Robotics , TMH.
3. Ghoshal Ashitava, Robotics, Fundamental Concepts and Analysis, Oxford.
4. Yu Kozyhev, Industrial Robots Handbook, MIR Publications.