IPS Academy

INSTITUTE OF ENGINEERING & SCIENCE

(A UGC Autonomous Institute affiliated to RGPV)

Electrical and Electronics Engineering Department

Honors degree certification course in Power Electronics

S. No.	Course Code	Sem	Course Title	Hrs./ week			Credits	Semester
				L	T	P		
1		**V**	Advance Control System	3	1	0	4	V
2		**VI**	Advanced Microprocessor and Microcontroller & its Application	3	1	0	4	VI
3		**VII**	Advance Power Electronics	3	0	0	3	VII
4		**VIII**	Advance Electrical Drives	3	1	0	4	VIII
Total credits				**12**	**3**	**0**	**15**	

	Advanced Control System	**3L: 1T: 0P (4 hrs.)**	**4 Credits**

Course Objective:-
This subject deals with state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems, Nonlinear control, Variable Structure Control

Pre Requisite: - Should have knowledge of mathematics, differential equations and difference equation, Laplace transform, matrices and vectors

Module 1 (11 hrs.): **State Space Analysis**
Review of Linear Control System, introduction to modern control system , State space method of description, State Space Representation using Phase Variable and Canonical Variables, , Solution of State Equation, State Transition Matrix and its Properties, Eigen Values, Eigen Vectors, Canonical Forms –Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form., Diagonalization, Concepts of Controllability Observability & Stability, Discretization of continuous-time State space model

Module 2 (08 hrs.) Pole Placement Design and State Observers:
Introduction, Stability Improvements by State Feedback, Necessary and Sufficient Conditions for Arbitrary Pole Placement,. State Regulator Problem and State Regulator Design, Evaluation of State Feedback Gain Matrix K, Selection of Location of Desired Closed Loop Poles, State Observer Design, Full Order/Reduced Order Observer Design, Observer Based State Feedback Control,

Module 3 (07 hrs)Non-linear systems Analysis:
Introduction, Common Nonlinear System Behaviors, Common Nonlinearities in Control Systems, Fundamentals, Describing Functions of Common Nonlinearities, Stability Analysis by Describing Function Method, Concept of Phase Plane Analysis, , Singular points, Stability of Nonlinear System, Construction of Phase Trajectories, Lyapunov Stability Definitions, Lyapunov Stability Theorems, Lyapunov Functions for Nonlinear Systems.

Module 4 (07 hrs.) Optimal Control:
Introduction to Optimal Control, Parameter Optimization Calculus of variation, Euler-Lagrange equations, Boundary conditions, Transversality condition, Bolza problem, Pontryagin's maximum principle.

Module 5 (07 hrs.). **Variable Structure Control**
Variable Structure Control and its applications. Examples on variable structure control.

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

CO1: Analyze control system by classical control method and advanced control method.

CO2: Analyze Pole placement problem.

CO3: Analyze non-linear control systems by different methods.

CO4:.Analyze optimum control by different methods in terms of performance indices.

CO5. Analyze to Variable Structure Control.

Text Books/ Reference Books

1. B. C. Kuo, "Automatic Control Systems", eight edition, Wiley India 2009.
2. K. Ogata, "Modern Control Engineering", fifth edition, Prentice-Hall 2010.
3. B. C. Kuo, "Digital Control Systems", Oxford University Press 1992.
4. K. Ogata, "Discrete-Time Control Systems", second edition, Pearson Education 2005.
5. Andrew P. Sage, "Optimum System Control", Pearson Education Canada, 1977.
6. M. Gopal Modern Control System Theory New Age International, 1993 –

	Advanced Microprocessor, Microcontroller & its Application	3L: 1T: 0P (4 hrs.)	4 credits

Course Objective: The objective of this course is to familiarize the students with the architecture of and the instruction set of an Intel microprocessor and microcontroller, design of various types of digital and analog interfaces. The course also provides hands on experience on assembly language programming.

Pre Requisite: Digital Electronics Circuits.

Module 1(8 hrs.) Advanced Processors
Introduction to 16-bit and 32-bit microprocessors – 80x 86 families. Assembly language programming for 8086/8088. Register details, operation-addressing modes & instruction set of a typical 16-bit microprocessor

Module 2 (10hrs.) Programmiable Support Chips
Programmable parallel interface chip (e.g. 8255) functional schematic. Pin function operating mode interface with microprocessor chip programming serial communication interface chip (e.g. 8251) functional schematic pin function. Operating mode interface with processor mode and command words for the chip programmable interrupt controller (8259) functional schematic pin function single and cascaded operation interface with microprocessor and I/O devices programmable interval timer (8253) functional schematic pin functions. Modes of operations.

Module 3 (6 hrs.) 32-BIT Intel Microprocessors
The Intel 80286, 80386, 80486, Pentium and RISC based Intel MMX architecture. Real mode of 80386, protected mode of 80386, Virtual 8086 mode.

Module 4 (6hrs.) Microcontroller
Hardware and software integration in microprocessor control system. An overview of 8-bit microcontroller architecture and instruction set.

CASE STUDY
Example of microprocessor application: Data acquisition system open loop close loop controller.

Module 5 (6hrs.) ARM Family of Processors
Overview of ARM architecture, Android-ARM hardware- software interface.

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

CO1: Discuss various advanced microprocessor and their application.
CO2: Discuss and interface with various controllers.
CO3: Explain about 32-Bit Intel Microprocessors.
CO4: Understand basic concept microcontroller.
CO5: Discuss about basic of ARM architecture

Text/ Reference books

1. Advanced Microprocessor A.K. Ray, K.M. Bhurchandi, TMH.
2. Microprocessor Hardware & Programming Douglas V Hall.
3. ARM System Developer's Guide: Designing and Optimizing System Software Morgan Kauffman Publisher.
4. IBM PC Assembly Language & Programming, Peter Abel, PHI.
5. Microprocessor & Interfacing – Dauglas Hall, THM .
6. Ramesh S. Gaonkar, Microprocessor architecture, Programming and applications with 8085, 5/E Prentice Hall, 2002.
7. Advanced 80386 Programming Techniques: James Turley.
8. Advance Microprocessor - Deniel Tabak.
9. The Intel Microprocessors (Eight Editions): Barry B. Brey.
10. The 8086 Microprocessor, Kenneth Ayala, Cengage Learning.
11. The 8088 and 8086 Microprocessors, Triebel & Singh, Pearson Education.
12. ARM System-on-Chip Architecture (2nd Edition): Steve Furber

	Advance Power Electronics	3L: 0T: 0P (3 hrs.)	3 Credits

Course Objective:
The objectives of the study is to acquire knowledge of design and analyze different power converter circuits.

Pre Requisite

Knowledge of Basic Electrical Engineering and Power electronics.

Pre Requisite:-

Module 1(8 hrs.)
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 , Ferroresonant, Linears and the switchers

Module 2 (12 hrs.)
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 magnetics, converter control, averaged model, state-space model.

Module 3 (10 hrs.)
DC to Controlled AC: Controlled inversion, three phase full bridge inverters. 180^0 mode and 120^0 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 (7 hrs.)
AC Choppers: Modeling and analysis of AC choppers, harmonics control using symmetrical and asymmetrical waveform pattern,

Module 5 (8 hrs.)
Soft switching DC to DC converters, zero current switching topologies, zero voltage switching topologies, generalized switching cell, ZCT and ZVT DC converters.

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

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

Text/ Reference books:

1. "Power Electronics Circuits", Issa Batarseh, John Wiley & Sons Inc., 2004.
2. "Power Electronics: ", L.Umanad, Wiley India
3. "Power Electronics: Converters, Applications, and Design", Ned Mohan, John Wiley & Sons Inc., 2001.
4. "Power Electronics: Devices and Circuits", Jagannathan, PHI Learning 2012
5. "Power Electronic Systems Theory and Design", Jai P Agrawal, Pearson Education Asia, 2001.
6. "Switching Power Supply Design", A I Pressman, McGraw Hill Publication, 1991.
7. "Handbook of Power Electronics", M H Rashid

	Advance Electrical Drives	**3L: 1T: 0P (4 hrs.)**	**4 Credits**

Course Objective: advance electrical drives course are give unified treatment of complete electrical drive systems, electrical machines, power converters and control system.

Pre Requisite: Fundamentals of electrical engineering, Electrical machines , Electrical Drives

Module 1 (10hrs.)

DC Drives: Rectifier fed DC drive, Phase controlled converter fed DC drives, steady state analysis of three phase converter controlled DC motor Drive, principle of DC motor speed control, Chopper Control DC drives, steady state analysis of chopper controlled DC Drives, Dual-converter control of DC drive, DC motor Drive with field weakening, four quadrant DC motor drives; Close loop control of DC drive, dynamics of D.C. motor drives and analysis of steady state and dynamic operation.

Module 2 (8hrs.)

AC Drives: Closed loop control schemes, dynamic and regenerative braking, Torque slip characteristics, speed control through slip, rotor resistance control, and chopper controlled resistance; Review of dq0 model of 3-Ph IM, Principle of vector control of IM, Direct vector control, Indirect vector control with feedback, Indirect vector control with feed-forward, Indirect vector control in various frames of reference, Decoupling of vector control with feed forward compensation , Direct Torque Control of IM.

Module 3 (8hrs.)

Vector and Sensor Vector Control of Induction Motor: Introduction of vector control, direct vector control, derivation of indirect vector control, implementation-block diagram, estimation of flux, flux weakening operation; Slip and speed estimation at low performance, rotor angle and flux linkage estimation at high performance, rotor speed estimation scheme estimators using rotor slot harmonics, model reference adaptive systems, extended Kalamn filter, injection of auxiliary signal on salient rotor.

Module 4(10hrs.)

Synchronous Motor Drives: Introduction of three phase synchronous machine, analysis of steady state operation and dynamic operation, voltage and torque equations in machine variables and rotor reference frame variables (Park's equations), analysis of dynamic performance for load torque variations; Types of PM Synchronous motors, Torque developed by PMSM, Model of PMSM, Implementation of vector control for PMSM.

Module 5 (10hrs.)

Control of Switched Reluctance Motor Drives: Introduction of Switched Reduction Motor Drives, SRM Structure, Stator Excitation, techniques of sensor less operation, convertor topologies, SRM drive design factors, Torque controlled SRM, instantaneous Torque control using current controllers and flux controllers.

Control of BLDC Motor Drives: Principle of operation of BLDC Machine, Sensing and logic switching scheme, methods of reducing Torque pulsations, Three-phase full wave Brushless dc motor, Sinusoidal type of Brushless dc motor, current controlled Brushless dc motor.

Course Outcomes: Students will be able to

CO1: To understand the basic concepts and closed loop control methods for DC Drives.
CO2: To explain closed loop control methods for AC Drives.
CO3: To explain Vector and Sensor Vector Control of Induction Motor drives.
CO4: To understand the basic concepts and modeling of Synchronous motor drives.
CO5: To explain control methods for special motor drives

Text/ Reference books

1. Mohan N., Underland T.M. and Robbins W.P., “Power Electronics –Converters, Applications and Design”, 3rd Ed., Wiley India. 2008
2. Bose B.K., “Power Electronics and Variable Frequency Drives –Technology and Applications”, IEEE Press, Standard Publisher Distributors. 2001
3. B.K.Bose, Power Electronics & A.C. Drives, Prentice Hall, 1986
4. Rashid M., “Power Electronics- Circuits, Devices and Applications”, 3rd Ed., Pearson Education.
5. Dubey G. K., “Power Semiconductor Controlled Drives”, Prentice Hall International Edition. 1989
6. Murphy J. M. D. and Turnbull F. G., “Power Electronics Control of AC Motors”, Peragmon Press.
7. G. K. Dubey : Fundamentals of Electrical Drives, 2nd Edition, Alpha Science International, 2001.
8. S. B. Dewan, Gordon R. Slemon and A. Straughen: Power Semiconductor Drives, John Wiley Pub.1996.
9. R. Krishnan: Electric Motor drives - Modelling, Analysis and Control, PHI India Ltd., 2002.
10. W. Shepherd, D. T. W. Liang and L.N. Hulley: Power Electronics and Motor Control, 2nd Edition, Cambridge Univ. Press, 1995.