1.3.2 Average percentage of courses that include experiential learning through project work/field work/internship during last five years

PRIYADARSHINI COLLEGE OF ENGG. NAGPUR
CERTIFIED DOCUMENT
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Principal

Lokmanya Tilak Jankalyan Shikshan Sanstha's
PRIYADARSHINI COLLEGE OF ENGINEERING
(Recognised by A.I.C.T.E., New Delhi & Govt. of Maharashtra, Affiliated to R.T.M.Nagpur University)
Near CRPF Campus, Hingna Road, Nagpur-440 019, Maharashtra (India)
Phone : 07104 – 236381, 237307, Fax : 07104 – 237681,
email : principal.pce.ngp@gmail.com, www.pcenagpur.edu.in

1.3.2 Average percentage of courses that include experiential learning through project work/field work/internship during last five years

M.Tech. Industrial Drives and Control

2019-20 and 2020-21

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code
1	Advanced Power Electronics	PGIDC101T
2	DC Drives	PGIDC102T
3	Advanced Control Theory	PGIDC103T
4	Elective I	PGIDC104T
5	Elective II -	PGOPEN105T
6	Elective II -Ultilization of Electrical Energy.	PGOPEN105T
7	Advanced Power Electronics	PGIDC106P
8	DC Drives	PGIDC107P
9	Drives System Design	PGIDC201T
10	AC Drives	PGIDC202T
11	Electrical Transportation	PGIDC203T
12	Elective III	PGIDC204T1
13	Research Methodology	PGFD205T
14	AC Drives	PGIDC206P
15	Computer Aided Design	PGIDC207P
16	Elective IV	PGOPEN301T
17	Foundation Course-II Project Planning and Management	PGFD302T
18	Project Seminar	PGIDC303P
19	Project	PGIDC401P

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2017-18 and 2018-19

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code
1	Advanced Power Electronics	PGIDC101T
2	DC Drives	PGIDC102T
3	Advanced Control Theory	PGIDC103T
4	Elective I	PGIDC104T
5	Elective II -	PGOPEN105T
6	Elective II -Ultilization of Electrical Energy.	PGOPEN105T
7	Advanced Power Electronics	PGIDC106P
8	DC Drives	PGIDC107P
9	Drives System Design	PGIDC201T
10	AC Drives	PGIDC202T
11	Electrical Transportation	PGIDC203T
12	Elective III	PGIDC204T1
13	Foundation Course-II Project Planning and Management	PGFD302T
14	Project Seminar	PGIDC303P
15	Project	PGIDC401P

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2016-17

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code
1	Advanced Power Electronics	PGIDC101T
2	DC Drives	PGIDC102T
3	Advanced Control Theory	PGIDC103T
4	Elective I	PGIDC104T
5	Elective II -	PGOPEN105T
6	Elective II -Ultilization of Electrical Energy.	PGOPEN105T
7	Advanced Power Electronics	PGIDC106P
8	DC Drives	PGIDC107P
9	Drives System Design	PGIDC201T
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11	Electrical Transportation	PGIDC203T
12	Foundation Course-II Project Planning and Management	PGFD302T
13	Project Seminar	PGIDC303P
14	Project	PGIDC401P

COURSE SCHEME
EXAMINATION SCHEME
ABSORPTION SCHEME
&
SYLLABUS

Of

First, Second, Third & Fourth Semester
Choice Base Credit System (CBCS)

Of
Master of Technology (M.Tech)

in
Industrial Drives and Control (IDC)

Of
RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY, NAGPUR

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Scheme of Teaching and Examination
I Semester M. Tech. CBCS Industrial Drives and Control (IDC)

Subject Code	Subject	Teaching Scheme			Examination Scheme				
					Theory/ Practical				
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment		
PGIDC 101T	Advanced Power Electronics	4	-	4	3	70	30	100	50
PGIDC 102T	DC Drives	4	-	4	3	70	30	100	50
PGIDC 103T	Advanced Control Theory	4	-	4	3	70	30	100	50
PGIDC 104T	Elective –I (Core)	4	-	4	3	70	30	100	50
PGOPEN 105T	Elective –II (Open)	4	-	4	3	70	30	100	50
PGIDC 106P	Advanced Power Electronics	-	2	1	-	50	50	100	50
PGIDC 107P	D.C. Drives	-	2	1	-	50	50	100	50
Total		20	4		-	450	250	700	-
Semester Total		24		22	700 Marks				
Elective –I (Core)					1.Analysis of Electrical Machines 2. Application of Microcontroller in Electrical System 3. Micro and Smart Grid				
Elective-II (Open)					List of Open Electives from various discipline is attached				

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Scheme of Teaching and Examination
II Semester M. Tech. CBCS Industrial Drives and Control (IDC)

Subject Code	Subject	Teaching Scheme			Examination Scheme				
					Theory/ Practical				
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment		
PGIDC 201T	Drives System Design	4	-	4	3	70	30	100	50
PGIDC 202T	AC Drives	4	-	4	3	70	30	100	50
PGIDC 203T	Electrical Transportation	4	-	4	3	70	30	100	50
PGIDC 204T	Elective – III (Core)	4	-	4	3	70	30	100	50
PGFD 205T	Research Methodology	4	-	4	3	70	30	100	50
PGIDC 206P	A.C. Drives	-	2	1	-	50	50	100	50
PGIDC 207P	Computer Aided Design	-	2	1	-	50	50	100	50
Total		20	4		-	450	250	700	-
Semester Total		24		22	700 Marks				
Elective –III (Core)					1. Energy Audit and Management 2. Converter for Non Conventional Energy Sources 3. Process control and Instrumentation				

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Scheme of Teaching and Examination
III Semester M. Tech. CBCS Industrial Drives and Control (IDC)

Subject Code	Subject	Teaching Scheme			Examination Scheme				
					Theory/ Practical				
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment		
PGOPEN 301T	Elective –IV (Open)	4	-	4	3	70	30	100	50
PGFD 302T	Project Planning and Management	4	-	4	3	70	30	100	50
PGIDC 303P	Project Seminar	-	8	8	-	--	200	200	100
Total		8	8	16	-	140	260	400	-
Semester Total		16		16	400 Marks				
Elective-IV (Open)					List of Open Electives from various discipline is attached				

Note: For the teaching work load calculation for Project Seminar, work load will be 3 hours per week per project

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Scheme of Teaching and Examination
IV Semester M. Tech. CBCS Industrial Drives and Control (IDC)

Subject Code	Subject	Teaching Scheme			Examination Scheme				
					Theory/ Practical				
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment		
PGIDC 401P	Project	-	16	16	-	400	--	400	200
Semester Total		16		16	400 Marks				

Note: For the teaching work load calculation for project, work load will be 6 hours per week per project

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Absorption Scheme for the students of M.Tech. Industrial Drives and Control (IDC) from Old Semester pattern to New CBCS Semester Pattern
I Semester M. Tech. Industrial Drives and Control (IDC)

Subject Code	Name of the Subject in New CBCS Pattern	Subject Code	Name of the Subject in old Pattern
PGIDC 101T	Advanced Power Electronics	1S-IDC-02	Advanced Power Electronics (Theory)
PGIDC 102T	DC Drives	1S-IDC-05	D.C. Drives (Theory)
PGIDC 103T	Advanced Control Theory	1S-IDC-03	Advanced Control System (Theory)
PGIDC 104T	Elective –I (Core) Analysis of Electrical Machines (Theory)/ Application of Micro Controller in Electrical System	1S-IDC-04/ 1S-IDC-01	Analysis of Electrical Machines (Theory)/ Micro Controller & its Applications (Theory)
PGOPEN 105T	Elective –II (Open) Artificial Intelligence	2S-IDC-02	Artificial Neural Network & Fuzzy Logic (Theory)
PGIDC 106P	Advanced Power Electronics	1S-IDC-02	Advanced Power Electronics (Practical)
PGIDC 107P	D.C. Drives	1S-IDC-05	D.C. Drives (Practical)

The Students who fail to clear any subject(s) of the I Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of I Semester (New Pattern) along with the additional subject marked with (*). The Theory and Practical College and university Assessment Marks of old Pattern will be converted into the same proportion in New Pattern. The College Assessment Marks of the Additional Theory/ Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the theory / Practical subject of old pattern in the same semester.

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Absorption Scheme for the students of M.Tech. Industrial Drives and Control (IDC) from Old Semester pattern to New CBCS Semester Pattern
II Semester M. Tech. Industrial Drives and Control (IDC)

Subject Code	Name of the Subject in New CBCS Pattern	Subject Code	Name of the Subject in old Pattern
PGIDC 201T	Drives System Design	2S-IDC-05	Elective –I (Theory) Drive System Design and Simulation
	Drives System Design *		Elective –I (Theory) any other Elective other than Drive System Design and Simulation
PGIDC 202T	AC Drives	2S-IDC-03	AC Drives (Theory)
PGIDC 203T	Electrical Transportation*	--	--
PGIDC 204T	Elective –III (Core) Process control and Instrumentation theory)	3S-IDC-02	Elective-II (Theory) Process Control and Instrumentation
	Elective –III (Core) Energy Audit and Management (Theory)		Elective-II (Theory) Management Information System
	Elective –III (Core) *		Elective-II (Theory) Mechatronics
PGFD 205T	Research Methodology*	--	--
PGIDC 206P	A.C. Drives	2S-IDC-03	AC Drives (Practical)
PGIDC 207P	Computer Aided Design	2S-IDC-03	Computer Aided Design of Electrical Drives (Practical)
--	--	2S-IDC-04	Digital Signal Processing (Theory)

The Students who fail to clear any subject(s) of the II Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of II Semester (New Pattern) along with the additional subject marked with (*). The Theory and Practical College and university Assessment Marks of old Pattern will be converted into the same proportion in New Pattern. The College Assessment Marks of the Additional Theory/ Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the theory / Practical subject of old pattern in the same semester.

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Absorption Scheme for the students of M.Tech. Industrial Drives and Control (IDC) from Old Semester pattern to New CBCS Semester Pattern
III Semester M. Tech. Industrial Drives and Control (IDC)

Subject Code	Name of the Subject in New CBCS Pattern	Subject Code	Name of the Subject in old Pattern
PGOPEN 301T	Elective –IV (Open) Digital Control System	2S-IDC-01	Digital Control System (Theory)
PGFD 302T	Project Planning and Management*	--	--
PGIDC 303P	Project Seminar	EIDC 301T	Elective –IV (Open)*

The Students who fail to clear any subject(s) of the III Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of III Semester (New Pattern) along with the additional subject marked with (*). The Theory and Practical College and university Assessment Marks of old Pattern will be converted into the same proportion in New Pattern. The College Assessment Marks of the Additional Theory/ Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the theory / Practical subject of old pattern in the same semester.

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Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Absorption Scheme for the students of M.Tech. Industrial Drives and Control (IDC) from Old Semester pattern to New CBCS Semester Pattern
IV Semester M. Tech. Industrial Drives and Control (IDC)

Subject Code	Name of the Subject in New CBCS Pattern	Subject Code	Name of the Subject in old Pattern
PGIDC 401P	Project	4S-IDC-01	Project Phase –II (Dissertation Viva Voce)

The Students who fail to clear any subject(s) of the IV Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of IV Semester (New Pattern) along with the additional subject marked with (*). The Theory and Practical College and university Assessment Marks of old Pattern will be converted into the same proportion in New Pattern. The College Assessment Marks of the Additional Theory/ Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the theory / Practical subject of old pattern in the same semester.

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PGIDC101T/PG IPS101T/PGPEPS 101T

Advanced Power Electronics

(Common to M.Tech CBCS IDC, M.Tech CBCS PEPS and M.Tech CBCS IPS)

Course Objective:

To understand the characteristics, capabilities, ratings, limitations and protection of various power semiconductor switches used for various Power Electronic applications.

To understand the performance and analysis of low frequency switched and high frequency switched AC to AC, DC to DC and DC to AC power electronic converters for various applications.

To understand various control schemes and soft switching techniques in industrial applications.

Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology.

Study and understand the different types of drives and selection of drive and power converter for particular application.

Study and understand the operation of electric motor drives controlled from a power electronic converter and to introduce the design concepts of controllers for closed loop operation.

Study and understand special motor drives and their control.

Course Outcome:

After the completion of this course, the students shall be able to:

Develop in depth knowledge of advanced power electronics devices.

Study, design and analyze the ac to ac converters.

Study, design and analyze dc to dc converters with their applications.

Understand and analyze various resonant and soft switching techniques for converters.

Study, design and analyze the dc to ac converters.

Understand the operation of modern power converters and multilevel inverters.

Understand the basic principles of power electronics in drives and its control, types of drives and basic requirements placed by mechanical systems on electric drives.

Understand the operation of 1ϕ & 3ϕ converter drives for separately excited & series DC motors.

Learn speed control of induction motor drives in an energy efficient manner using power electronics.

Unit-I: Power Semiconductor Devices

Characteristics, protection and industrial applications of power devices. Various pulse width modulation techniques for different converter topologies.

Unit-II: AC-AC Converters

Introduction, single and three-phase ac–ac voltage controllers, Cyclo-converter, Matrix converters, application of ac-ac converters.

Unit-III: DC-DC Converters

Introduction, step-down converters- Buck, transformer version of buck converters, step up converters, Buck-Boost converters, application of dc to dc converters

Unit IV-: Resonant and soft switching converters

Introduction, classification, resonant switch-ZC Resonant switch, ZV Resonant switch, Quasi resonant converters, multi resonant converters, load resonant converters and their applications.

Unit V-: DC-AC converters

Introduction, classification, single-phase VSI (Half & Full Bridge), Three -phase VSI with SPWM, SVPWM, Selective harmonic elimination, SPWM with zero sequence signal injection with industrial applications.

Text Books:

1. "Power electronics handbook by Muhammad Rashid , Academic Press.

2. "Modern Power Electronics" by P. C. Sen , A. H. Wheeler Publishing Co.

3. "Thyristorized Power Controller " by Dubey , Joshi Doradla Sinha PHI Publication

Reference Books:

1. "Power Electronics" Cyril W Lander ,MHL

2. "Power Electronics", Ned Mohan, Tora M. Udeland, William P. Riobbins, John Wiley & sons

3. Related IEEE Papers / NPTEL Lectures.

PGIDC102T

DC Drives

Course objective:

Specify the appropriate power circuit configuration amongst the phase controlled rectifiers and choppers for the speed control of DC motor drives for four-quadrant operation with current limit
Design the control circuit and the power circuit for DC-DC converters
Critically compare various options available for the drive circuit requirements

Course Outcomes:

After the completion of this course, the students shall be able to:
Improvise the existing control techniques to suit the application
Identify suitable power converter from the available configurations.
Design controllers for closed-loop operation of a separately excited DC motor drive with symmetrical optimization technique

Unit-I Transient Analysis of D.C. Motor:

Performance & analysis of A.C. & D.C. Commutator machines – Compound wound D.C. motor , Steady state analysis of D.C.shunt motor ,D.C. series motor ,Transient analysis ,Stability of Compound wound D.C. motor, Universal Motor , Separately excited D.C. generator.

Unit-II Dynamics of D.C. machine:

Separately excited D.C. motor, Series excited D.C. motor, Ward- Leonard System. The machine matrices, the system equation, Transient analysis.

Unit-III Single Phase SCR Drives:

One quadrant and two quadrant drive – Continuous current & Discontinuous current mode of operation for separately excited DC motors , Transient performance .

Unit-IV Power Factor Improvement:

PF improvement of single phase full converter & Semi converter drive circuits – phase angle control. Semi converter operation of full converter. Asymmetrical firing, extinction angle control, Symmetrical angle control, PWM control, sequence control of series converter.

Unit-V Three Phase SCR Drives:

Principle and operation of semi converter, full converter and Dual converter drives .Comparison of circulating and non-circulating current dual converter Reversible drives – armature & field current reversal scheme using dual converters.

REFERENCE BOOKS :

1) Analysis of thyristor power conditioned Motors : S. K. Pillai , Longman Ltd .

2) Control of Electrical Drives : Werner Leonhard, Electric Energy System & Engg. , Series Springer Verlag Berlin Heidelberg , New York .

3) Electrical Drives : Vedam Subramanian.

4) Electrical Motors Drives (Modeling Analysis and Control) by -R. Krishnan, Practice Hall India.

PGIDC103T/PGPEPS103T

ADVANCE CONTROL THEORY

(Common to M.Tech CBCS IDC and M.Tech CBCS PEPS)

Course Objective:

To understand and analyse electromechanical systems by mathematical modeling.
To Determine Transient and Steady State behavior of systems using standard test signals.
To understand linear and non-linear systems for steady state errors, absolute stability and relative stability
To Identify and design a control system satisfying requirements..

Course Outcomes:

After the completion of this course, the students shall be able to:
Develop mathematical models of physical systems.
Design optimal controllers for physical systems including power electronic and power systems.
Analyze the issues related to the stability of automatic control systems.
Design complex nonlinear systems by linearizing them

Unit-I State Variable Analysis:

Diagonalization of state model, Computation of STM by Laplace transform, Cayley Hamilton Theorem and Canonical transformation method, Solution of state equation. Controllability, Observability and state variable feedback.

Unit-II Digital Control Systems:

Models of Digital control Devices, State description of Digital processors and sampled continuous time plants, discretization of digital continuous time state equations, Solution of state difference equation, Stability By Bilinear Transformation & Jury's Test.

Unit-III

Controllability and observability tests for digital control systems, Stability of discrete time Systems, Pulse transfer function and its realization, Stability improvement by state feedback, Pole-placement design and state observers.

Unit-IV Lyapunov Stability Analysis:

Basic concepts, Limit cycles, Stability definitions, Stability Theorems, Lyapunov functions for linear and non-linear systems.

Unit-V Optimal Control:
Parameter optimization techniques, Lagrange parameter techniques, Calculus of variations, Unconstrained and Constrained minimization of functional, Two point boundary value problems, Pontrygin's minimum principle, Optimal regulator and tracking problems, Optimal digital control systems.

Reference Books:

1. M.Gopal.; Digital Control and State Variable Methods; Tata McGraw Hill, New Delhi, 1997.

2. D.E. Kirk.; Optimal Control Theory; Prentice Hall, 1970.

3. M.Gopal.; Digital Control Engineering; Wiley Eastern, 1988.

4. B.C. Kuo.; Digital Control System Engineering; Saunders College publishing, 1992.

5. Advanced Control System ,First Edition, M. Rihan

PGIDC104T Elective I-(1)

Analysis of Electrical Machines

Course objective:

To provide knowledge about the fundamentals of magnetic circuits, energy, force and torque.
To analyze the steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer.
To provide the knowledge of theory of transformation of three phase variables to two phase variables.
To analyze the steady state and dynamic state operation of three-phase induction machines using transformation theory based mathematical modeling and digital computer simulation.
To analyze the steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling and digital computer simulation.

Course Outcomes:

After the completion of this course, the students shall be able to:
Develop models for linear and nonlinear magnetic circuits
Determine the developed torque in an electrical machine using the concepts of field Energy and co-energy and determine the dynamic model of a DC machine
Determine the dynamic model of an induction machine based on the dq0 Transformation and determine instantaneous torque developed in an induction Machine- which leads to advanced control strategies such as vector control and direct torque control
Determine the torque developed in a salient pole synchronous machine using the Park's transformation and identify contribution of saliency torque- damping torque and excitation torque

Unit-I

Theory of transformation:

Reference frame, electrical network terminology – mesh network – the generalized machine of first kind, impedance matrix, impedance matrix of synchronous machine, the flux linkage and flux density matrix, rotation matrix –electromagnetic torque, performance calculation, elimination of axes, analysis using revolving field theory, transformation from the stationary d-q axes to stationary real axes reference frame.

Unit-II

State Modeling of Electrical Machines:

Spring and plunger system – rotational motion – mutually coupled coils – lagrange's equation-application of Lagranges Equation – solution of electrodynamical Equations.Voltage & Torque equation under acceleration – motional impedance matrix ofGeneralized machines, state model of generalized machine,State model of Induction motor ,Voltage , Flux Linkages & Torque Equation for 3-phase Induction Motor , Dynamics in the machine variables, Mathematical Models of 3-phase Induction Motor in the arbitrary stationary, rotor & synchronous reference frame.

Unit-III

Synchronous Machines: Per unit system and Normalisation, Park's Transformation , Flux linkage equations, Voltage & Current equations, Formulation of State –space equations, Equivalent circuit, Subtransient & Transient inductances and time constants, Simplified models of Synchronous machines.

Unit-IV

Steady state equations and phasor diagram, Single machine, Infinite Bus system, Determination of machine parameters from Manufacturer's data, Analogue and Digital simulation of Synchronous machines.

Unit-V

Linear Model Of Syschronous Machines: Linearisation of 1) Generator state space current model 2) Load equation for the one machine problem & 3) Flux linkage model , Simplified linear model & it's statespace representation

REFERENCE BOOKS:

1) Mukhopadhyay A.K.,Matrix Analysis of Electrical Machines,New Age International,1996.

2) Bimbhra P. S.-,Generalized Theory Of Electrical Machines,Khanna Publishers,1975

3) S.K.Sen-, Electric Machinery, Khanna Publishers,1998

4) Anderson P. M. & Fouad A. A. –"Power system control & stability" Galgotia Publications 1981

PGIDC104T /PGIPS104T/PGPEPS104T Elective I-(2)

Application of Microcontroller in Electrical System

(Common to M.Tech CBCS IDC , M.Tech CBCS PEPS and M.Tech CBCS IPS)

Course Objective:

To understand Microprocessor types and its programming.
To understand various interfacing circuits necessary for various applications.
To understand various interfacing concepts.
To understand basic concepts of Microcontroller.

Course Outcome:

After the completion of this course, the students shall be able to,
Understand the causes, effects and remedies of power quality problems.
To design a system, component or process as per needs and specifications
To Write Assembly language program for 8051 Microcontroller to achieve solution to given task.
To learn functioning of Signal conditioning using specific circuits/ transducers and to measure electrical ornon-electrical quantities using processor.
To apply applications of microcontroller in various engineering fields.

Unit- I: Review of Microprocessor 8085/8086:

Introduction To 16 Bit Microprocessors, 8086/8088 CPU Architecture, Memory Organization, Floating point arithmetic, Bus structure & timings,8086/8088 Instruction Set.

Unit-II: Microcontroller 8031/8051:

Microcontroller: 8051 Architecture/ Pin Diagram,Special Function Register (SFR), Internal RAM/ROM, 8051 Instruction Set,Interrupts, Assembly Language Programming and their application,Interfacing to External Memory,Programming Techniques for looping, indexing,counting & bit manipulation,

Unit-III: Basic I/O Interfacing Concept:

Memory mapped I/O programmable peripherals,I/O mapped I/O programmable peripherals,Introduction to PPI 8254/8255, Architecture,Modes of operation of 8255,Interfacing of peripherals with 8255,Introduction to PIC 8259, Architecture,Modes of operation of 8259,Interfacing of peripherals with 8259,Interfacing of keyboard & display ,ADC/DAC, USART.

Unit-IV: Interfacing of Microcontroller 8031/8051

Interfacing with ADC/DAC display, interfacing with Keyboard,Interfacing with LCD Display & Stepper Motor with 8251,Power factor improvements, Introduction to DSP processor & its application to power system, Generation of PWM signals using Timer/Counter. Harmonics analysis, FFT etc.

Unit-V: Microcontroller dsPIC33EP256MC202

Microcontroller: Architecture/ Pin Diagram, General Input/output ports, Control Registers for PPS, Interrupts, Oscillator, Timer, Generation of High Speed PWM. Applications to Motor Speed Control, AC-DC, DC-AC Conversion, Battery Charger, UPS, INVERTER, and Power factor Correction.

Text Books:

1. Hall: Microprocessor & Interfacing,: Programming & Hardware; Mc-Graw Hill Books.
2. Gaonkar: Microprocessor Architecture, programming Application with 8085,penram international publishing(India)
3. Texas Instruments DSPs.
4. Bhupendra Singh Chhabra: 8086/8088 Microprocessor Architecture Programming, Design & Interfacing, Dhanpat Rai & Sons.
5. Ramakant Gaikwad: Op-amps & Linear IC's; Prentice Hall of India
6. Kenneth J. Ayala: The 8051 Microcontroller-Architecture, Programming & Application: penram international publishing(India)
7. Muhammad Ali Mazidi: The 8051 Microcontroller and Embedded Systems Using Assembly & C:Second Edition : Pearson Publication.
8. Data sheets of dspIC33EPMC202.

PGIDC104T /PGIPS104T/PGPEPS104T Elective I-(3)

Micro and Smart grid

(Common to M.Tech CBCS IDC , M.Tech CBCS PEPS and M.Tech CBCS IPS)

Course Objectives:

To understand fundamental concepts of Microgrids, its Power Electronics Interface, protection and islanding issues

To understand various Power quality issues in Microgrid and introduction to smart grid technologies

To understand Renewable Energy and its storage options for smart grid technologies.

To understand smart grid measurement & communication Technology

Course Outcomes:

After the completion of this course, the students shall be able to:

Microgrid concepts, Power Electronics interface in AC & DC microgrids, Communication infrastructure, modes of operation and control, Protection and islanding issues, etc

Power quality issues in microgrids like modeling and stability analysis, regulatory standards and economics and basic smart grid concepts

Load and generation Power flow analysis, economic dispatch and unit commitment problems and various verticals of smart grid

Smart grid communication and measurement technologies like Phasor Measurement Unit(PMU),Smart meters, Wide Area Monitoring system(WAMS) etc

Penetration of Renewable Energy Sources in smart grid and associated issues and their applications in Electric vehicles etc

Unit-I: MICROGRIDS

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques

Unit-II: POWER QUALITY ISSUES IN MICROGRIDS

Power quality issues in microgrids- Modeling and Stability analysis of Microgrid, regulatory standards, Microgrid economics, Introduction to smart microgrids.

Unit-III: INTRODUCTION TO SMART GRID

Basics of Power Systems: Load and Generation Power Flow Analysis, Economic Dispatch and Unit Commitment Problems, Smart Grid: Definition, Applications, Government and Industry, Standardization, Functions of Smart Grid Components-Wholesale energy market in smart grid-smart vehicles in smart grid.

Unit-IV: SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY

Communication and Measurement - Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS)- Advanced metering infrastructure- GIS and Google Mapping Tools, IP-based Systems , Network Architectures

UNIT V - RENEWABLE ENERGY AND STORAGE

Renewable Energy Resources-Sustainable Energy Options for the Smart Grid-Penetration and Variability Issues Associated with Sustainable Energy Technology-Demand Response Issues-Electric Vehicles and Plug-in Hybrids-PHEV Technology-Environmental Implications-Storage Technologies-Grid integration issues of renewable energy sources.

Text books/References:

1. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, IEEE press 2012.

2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & sons inc, 2012.

3. Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012.

4. Clark W.Gellings, "The smart grid: Enabling energy efficiency and demand response", Fairmont Press Inc, 2009.

PGIDC 201T

Drives System Design

Course objective:

Study of instantaneous power in various frames of reference
Study of various DC-DC converter in CCM and DCM and the effect of variation of the controller parameters
Study on the Sine-triangle PWM scheme for a 3-phase VSI
Study on the switching and conduction power losses in generic power electronic converters

Course Outcomes:

After the completion of this course, the students shall be able to:
Understand the back ground processes related to the numerical solution used in generic simulators
Choose the numerical solver to be used for a given type of analysis
Understand the reason for convergence problems occurring during simulation and to avoid them
Simulate the behavior of Power Converters, DC and AC drive

Unit-I

Systems, Models and the Concept of State: Environment and Variables ,The State of a System, Classification of Systems , Mathematical Models of Continuous-time Linear Lumped Parameter Time-invariant Systems ,Discrete-time Systems.

Unit-II

Linear Approximation of Nonlinear Systems, Topological Models of Systems, State Diagrams, A Generalized Approach to Modelling-The Principles of Conservation and Analogy, Mechanical Systems, Electrical and Electromechanical Systems.

Unit-III

Time-domain Analysis- Input-output Approach, Discrete Signal Models, Discrete-time Convolution, Response of Linear Discrete-time Systems, Continuous (Analog) Signal Models ,Continuous-time Convolution, Response of Linear Continuous-time Systems , Convolution/Deconvolution .

Unit-IV

Time-domain Analysis: State Variable Approach, The Solution of State Equations-Discrete-time Systems, Computation of State Transition Matrix by Canonical Transformation, Computation of State Transition Matrix by Technique based on Cayley-Hamilton Theorem, The Solution of State Equations-Continuous-time Systems, Numerical Method for Solution of Continuous-time State.

UNIT-V

Modelling & Analysis Of D.C. Machines: Modeling and Analysis of Permanent-Magnet Direct-Current Generators driven by Permanent-Magnet Direct-Current Motors. Model Development and Analysis of Ward-Leonard Systems with Direct-Current Electric Machines.

Reference Books:

1) System Modelling & Analysis By I .J. Nagrath & M. Gopal :Tata Macgraw Hill.
2) Electromechanical System,Electric Machines,&Applied Mechatronics : Sergey E. Lyshevski.

PGIDC202T

A.C.Drives

Course objective:

Study of torque produced in an induction machine in *'abc'* and *'qd0'* frames of reference with sinusoidal source and with a 3-Ph VSI with V/f control.
Study on the switching and conduction power losses in generic power electronic converters
Study on the design of controllers for a V/f controlled induction motor drive with slip-compensation technique
Study of a vector controlled 3-Ph induction motor drive with three-level inverters
Study of State Space Averaging Technique.

Course Outcomes:

After the completion of this course, the students shall be able to:
Design a V/Hz controller with sine-triangle modulation for a VSI driven 3-Ph induction motor drive
Model existing and modified power converters under small signal and steady state condition
Develop power converters with better performance for challenging applications
Analyze and design power converters and feedback loops

Unit - I

Brief review of DC to AC inverter circuit, single phase and 3 phase current inverter, Load commutated inverter , AC to AC cyclo-converter

Unit – II

Speed control of 3 phase Induction Motors by AC Power controllers : Static Rotor Resistance Control Slip energy recovery schemes – Static Kramer Drive – Static Scherbius drive – closed loop control schemes using the above special control techniques

Unit – III

Speed control of 3 phase Induction motors using Voltage source inverters, Current source Inverters

Unit – IV

Voltage / Frequency Controller: Open loop speed control, closed loop speed control , low frequency performance with Increased Volts/ Hz , optimum efficiency operation

Unit – V

Speed control of 3- phase Induction motor By Vector Control methods – Basic concepts of Direct and Indirect methods of control performance and analysis of Induction motors with non – sinusoidal supply sources.

REFERENCE BOOKS:

1.S. B. Devan , G. R. Slemon , A .Straughen : Power semicondutor Drives, Wiley Interscience, 1984

2.V. Subramanian : Thyristor control of Electric Drives, Tata Mc Graw Hill, 1988

3.B. K. Bose : Power Electronics And AC Drives, Prentice Hall,1986

4.Thyristor Control of AC Motors By J .M. D. Murphy, Pargamm Press , New York

5.Control Of Electrical Drives : W. Leonhard Springer-Verlag.

7.Electrical Motors Drives (Modeling Analysis and Control) by -R. Krishnan, Practice Hall

PGIDC203T

Electrical Transportation

Course objective:

To make students understand the importance and various modes of electric transportation systems such as electric traction, hybrid vehicle and elevators etc.

To differentiate various source of energy used in transportation and their performance characteristics.

To impart knowledge about different power and energy converters.

To classify the different controls used in electric vehicles.

To demonstrate the knowledge about electric cars and elevators.

Course Outcomes:

After the completion of this course, the students shall be able to:
Select between alternative modes for electric transportation system.

Explain various types of energy storage devices and their impact on electrified transportation.

Explain various power and energy converters in transportation system.

Analyze different control systems used in electric vehicles.

Describe different characteristics of electric car and elevators

Unit 01: General Review of Transportation :

Need and importance of mobility, various modes of transportation, evolution of transportation system, Horse carriages to steam engines to internal combustion engines to electric vehicles, advantages and disadvantages of electric mobility, various application of electric mobility such as electrical traction, hybrid electric and electric vehicles, elevators, personal mobility and special applications such as wheel chairs, future concepts.

Unit 02: EV- Basic Building Blocks:

Various sources of energy used in transportation and their characteristics, Conventional vehicle power transmission systems. Energy conversions module integrations and their operation. Different types of Batteries & their operation. Types of batteries, their characteristics, charging and discharging of batteries, round trip efficiency, ability to deliver instantaneous power, load cycle and its effect on battery performance, environmental impact of batteries, power quality issues related to charging of batteries. Different load characteristics (Specifically road characteristics)

Unit 03: Power module & Energy converters):
Need for power converters, basic power electronic blocks, AC/DC, DC/DC, DC/AC modules. Types of mechanical drives, conversion of electrical energy into mechanical energy, characteristics of various types of drives, BLDC machines, AC machines, DC machines, mechanical drive / power train

Unit 04: Control system and instrumentation:
Function of instrumentation and control system, speed control, acceleration characteristics, mechanical steering versus electric steering, motion control, driverless vehicles, road safety and traffic control and monitoring, emerging trends

Unit 05: Electric cars:
Emerging trend, typical power train architecture, hybrid cars, acceleration and speed characteristics, **Traction** Introduction to Modern AC traction for high speed rail application, their control and performance under different operating conditions. Comparison of AC/DC traction. **Elevators** Load characteristics of elevator systems, Introduction to control schemes in elevators with new power-electronics controlled drives, considerations for energy efficient systems. Special vehicles, basic concepts and emerging trend .

Text Books:

1. James Larminie and John Lowry, "Electrical Vehicle" John Wiley & Sons, 2012.

2. Mark Warner, "The Electric Vehicle Conversion handbook" –HP Books, 2011.

3. Iqbal Husain, "Electric & Hybrid Vehicles-Design Fundamentals", Second edition, CRC press

4. D. A. J. Rand, R. Woods R. M. Dell, "Batteries for Electric Vehicles", New York, John Wiley and Sons.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao and Ali Emadi, "Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and Design", CRC Press, 2009.

2. Burch Edward P., "Electric Traction for Railway Trains" McGraw Hill, 1911.

3. H.Partab, "Modern Electric Traction"–Dhanpat Rai & Sons, 1973.

4. Barney, George C., "Elevators Technology" international Association of Elevator Engineers by Ellis Harwood, 1986.

PGIDC204T/ PGIPS204 T /PGPEPS 204T Elective III-(1)

Energy Audit and Management

(Common to M.Tech CBCS IDC , M.Tech CBCS PEPS and M.Tech CBCS IPS)

Course Objective:

To understand the present scenario of energy utilization, management and corresponding ACT of regulatory commission

To understand the process billing and power factor improvements to achieve energy efficient systems.

To understand role and responsibilities as energy auditors and energy manager in industrial applications.

Course Outcome:

After the completion of this course, the students shall be able to,

An ability to develop in depth knowledge for energy balance and understand the various acts for the same

To carry out energy audits for optimal use of energy.

An ability to understand billing process for various industrial applications and selection of the factors for better utilization of energy.

Understand energy conservation in thermal power station.

Carry out performance analysisof electrical appliances and related case studies for improvement.

Unit-I- Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance

Unit II- Energy Management & Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit Instruments energy management, Roles and responsibilities of energy Manager and Accountability, Financial analysis techniques, Financing options, Energy performance contracts and role of ESCOs. Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques energy consumption, Production, Cumulative sum of differences.

Unit III-Energy Efficiency in Electrical system: Electricity billing, Electrical load management and maximum demand Control, Maximum demand controllers; Power factor improvement, Automatic power factor controllers, efficient operation of transformers, Energy efficient transformers; Induction motors efficiency, motor retrofitting, energy efficient motors, Soft starters, Variable speed drives; Performance evaluation of fans and pumps, Flow control strategies and energy conservation opportunities in fans and pumps, Energy efficiency measures in lighting system, Electronic ballast, Occupancy sensors, and Energy efficient lighting controls.

Factors affecting selection of DG system, Energy performance assessment of diesel conservation avenues

Unit IV:-Energy Conservation in Thermal Systems -Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler, Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery. Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria.Introduction, Mechanism of fluidized bed combustion, Advantages, Types of FBC boilers, Operational features, Retrofitting FBC system to conventional boilers, saving potential. HVAC system: Coefficient of performance, Capacity, Factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Classification and Advantages of Waste Heat Recovery system, analysis of Waste heat recovery for Energy saving opportunities

Unit V: Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, Fans and pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method. Financial Analysis: simple payback period, NPV, IRR,

Text Books:

1. Handbook of Electrical Installation Practice. , By Geofry Stokes, Blackwell Science

2. Designing with light: Lighting Handbook., By Anil Valia, Lighting System

3. Energy Management Handbook., By W.C. Turner, JohnWiley and Sons

4. Handbook on Energy Audits and Management.Edited by Amit Kumar Tyagi, Tata Energy Research Institute (TERI).

5. Energy Management Principles., By C.B.Smith, Pergamon Press

6. Energy Conservation Guidebook., Dale R. Patrick, Stephen Fardo, Ray E.Richardson,Fairmont Press 7. Handbook of Energy Audits., By Albert Thumann,William J. Younger, Terry Niehus, CRC Press

PGIDC204T/ PGIPS204 T /PGPEPS 204T Elective III-(2)

Converters for Non Conventional Energy Sources

(Common to M.Tech CBCS IDC , M.Tech CBCS PEPS and M.Tech CBCS IPS)

Course Objective:

To introduce to students the importance of Advanced Power for conversion of power in various forms

To understand basic operation and control of pulse-width modulated inverters (PWM).

Course Outcome:

After the completion of this course, the students shall be able to,

An ability to develop in depth knowledge for WEC and PV based system.

An ability to develop in depth knowledge for analysis of grid connected WEC and PV system.

Able to understand the various power electronic converter topologies.

Able to use the basics of various converter topologies in the photovoltaic system operation.

Able to use the basics of various converter topologies in the wind energy conversion system.

UNIT- 1: Introduction

Wind Energy Conversion (WEC) system, Photovoltaic (PV) based Power conversion system. Introduction to converter in WEC and PV system.Modes of Operation of Converters; Grid Connection Mode, Stand-Alone Mode,Battery Charging Mode.

UNIT- 2: Analysis of Wind and PV Systems:

Standalone operation of fixed and variable speed wind energy conversion systems and solar PV system. Gridconnection Issues,operation of Grid integrated PMSG, SCIG and DFIG Based WECS.Grid Integrated solar PV system.

UNIT- 3: Converter Topologies

Topologiesfor two-Level Converter and three level converters.Modulation Strategies-Pulse WidthModulation, Carrier-Based Strategies, Space Vector Strategies.

UNIT- 4: Photovoltaic Inverter Structures

Inverter Structures Derived from H-Bridge Topology; Basic Full-Bridge Inverter, H5 Inverter (SMA), HERIC Inverter (Sunways), REFU Inverter Summary of H-Bridge Derived Topologies. Inverter Structures Derived from NPC Topology Neutral Point Clamped (NPC) Half-Bridge Inverter;NPC Inverter, Summary of NPC-Derived Inverter Topologies, Three-Phase PV Inverters, Control Structures, Conclusions and Future Trends.

UNIT-5: Converter Structures for Wind Turbine Systems

Introduction, WTS Power Configurations, Grid Power Converter Topologies; Single-Cell Voltage source converters, Multicell (Interleaved or Cascaded) converters and back to back converters, WTS Control; Generator-Side Control Grid side Control, Future trends in wind conversion system converters.

Text Books:

1. Modern Power Electronics by P.C. Sen AH Wheeler Publication
2. Power Electronics hand book By Rashid M.H. Academic Press
3. Non Conventional Energy Sources by G.D.Rai Khanna Publishers.
4. Grid Converter for Photovoltaic and Wind Power Systems by Remus Teodorescu,Marco Liserre, Pedro Rodr´ ıguez IEEE Press John Viley and Sons
5. Power Electronics Converter for Microgrids by Suleiman M. Sharkh, Mohammad A. Abusara, Georgios I. Orfanoudakis IEEE Press John Wiley and Sons
6. Power Electronics by Ned Mohan, Tora M. Udeland,William P. Robbins John Wiley and Sons
7. Non Conventional Energy Sources by B.H.Khan Mc Graw Hill

PGIDC204T Elective III-(3)

Process Control & Digital Instrumentation

Course objective:

To learn about measurements and its relation with instrumentation system

To familiarize with the concepts of design and measurement of electronic instrumentation.

To give the students a comprehension of Process Control Instrumentation Design.

To give the students a comprehension of the relation between Instrumentation and controller design in industrial applications.

To make the students able to analyze the control loops and to achieve the control actions with different Controllers

Course Outcomes:

After the completion of this course, the students shall be able to:

Illustrate the concepts of signal integrity design issues, limitations of various measurement equipments.

Analyze various measuring techniques for various digital and analog signals.

Compare different types of Measurement protocols.

Illustrate the concepts of design and measurements of microwave, virtual and digital instrumentation

Unit I Introduction:

Process control- Design aspects, hardware & development of a mathematical model. Control strategies. Classical control approach-Transfer functions and input/output models. Modern control approach- State space model. Basic components of process control systems- Sensors, Transmitters, Control valves-Types, Control valve action, Sizing, selection of design pressure drop, Control valve gain, Flow characteristics. Feedback controllers- (P, PI, PID, PD). Digital controllers & Reset Windup.

Unit II Dynamic behavior of Process Control:

First order dynamic systems- Thermal process, Gas process, Level process, Chemical reactor & Dead time. Second order dynamic systems- Interacting & Non interacting multi-capacity stirred tank heater system. Higher order dynamic systems- Tanks in Series- Non-interacting/ Interacting system & Thermal process. Response of process control systems to different types of forcing functions.

Unit III Analysis and design of Feedback Control Systems:

Introduction to feedback control loop for Temperature control of Heat exchanger-Steady state closed loop response. Stability analysis of Feedback systems. Effect of dead time. Tuning of Feedback controllers. Design of Feedback control systems using frequency response techniques-Ziegler-Nichols tuning technique.

Unit IV Analysis and design of Advanced Control Systems:
Introduction to Computing Relays. Ratio Control- Blending Liquid Flow Process Control System. Cascade Control-Heat Exchanger Temperature Control System. Feed-forward Control-Drum Boiler, Distillation Column & CSTR.
Override and Selective Control-Temperature Control of Plug-Flow Reactor & Hot Oil System. Multivariable Process Control- Hot Oil System, Blending System, Chemical reactor, Evaporator, Paper Machine & Distillation Column. Adaptive and Inferential Control systems.

Unit V Analog and Digital Signal Conditioning:
Principles of Analog signal conditioning-Conversions, Filtering & Impedance matching, Concept of loading. Operational Amplifier circuits in Instrumentation. Principles of Digital signal conditioning- Converters (Comparators, DAC's, ADC's, Frequency-Based Converters). Data-Acquisition Systems-DAS Hardware/Software. Thermal Sensors- Metal resistance versus Temperature devices, Thermostats, Thermocouples, Bimetal Strips, Thermometers & Solid State Temperature Sensors. Mechanical Sensors- Position Sensors, Strain Sensors, Motion Sensors, Pressure Sensors & Flow Sensors. Optical Sensors-Photo detectors, Pyrometers & Optical Sources. Non-Contact type of Sensors. Final Control Operations- Analog /Digital Electrical/Pneumatic Signals, Electrical/Pneumatic/Hydraulic Actuators, Fluid valves/Mechanical/Electrical Final Control Elements.

REFERENCE BOOKS:

1. Chemical Process Control- An Introduction to Theory & Practice by- George Stephanopoulos, Prentice-Hall of India Private Limited New Delhi-2001.

2. Process Control Systems- Application, Design and Tuning- by F. G. Shinskey, Third Edition, Tata Mcgraw-Hill International Edition Singapore-1988.

3. Process Control by-Peter Harriott, Tata McGraw-Hill Publishing Co. Ltd. New Delhi-1997.

4. Principles of Process Control by D. Patranabis, Second Edition, Tata Mcgraw-Hill Publishing Co. Ltd. New Delhi-1998.

5. Process Control Instrumentation Technology by- Curtis D. Johnson, Seventh Edition, Prentice-Hall of India Private Limited New Delhi-2002.

PGOPEN 105T Open Elective II

Artificial Intelligence

(Open Elective II from Electrical Engineering Board)

Course Objectives:

To learn various types of algorithms useful in Artificial Intelligence (AI).
To convey the ideas in AI research and programming language related to emerging technology.
To understand the concepts of machine learning, probabilistic reasoning, robotics, computer vision, and natural language processing.
To understand the numerous applications and huge possibilities in the field of AI that go beyond the normal human imagination.

Course Outcomes:

After the completion of this course, the students shall be able to:
Design and implement key components of intelligent agents and expert systems.
To apply knowledge representation techniques and problem solving strategies to common AI applications.
Apply and integrate various artificial intelligence techniques in intelligent system
Development as well as understand the importance of maintaining intelligent systems.
Build rule-based and other knowledge-intensive problem solvers.

Unit 01: Introduction to Artificial Neural Network:

Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Historical Developments. Essentials of Artificial Neural Networks: Artificial Neuron Model, operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures

Unit 02: Classification Taxonomy of ANN:

Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules. Perceptron Models: Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem. Multilayer feed forward Neural Networks

Unit 03: Memory:

Associative Memory, Bi-directional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART).

Unit 04: Introduction to Fuzzy Logic system:
Fuzzy versus crisp, fuzzy sets: membership function, Basic fuzzy set operations, properties of fuzzy sets, fuzzy relations. Fuzzy Control**,** Predicate logic (Interpretation of predicate logic formula, Inference in predicate logic), fuzzy logic (Fuzzy quantifiers, fuzzy Inference), fuzzy rule based system, defuzzification methods

Unit 05: Introduction to other intelligent tools:
Introduction to Genetic Algorithm: biological background, GA operators, selection, encoding, crossover, mutation, chromosome. Expert System: software architecture, rule base system.

Text Books:

1. Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2nd Edition, Pearson Education

2. S. Rajsekaram, G. A. Vijayalaxmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms Synthesis & Applications", Practice Hall India

3. James A. Anderson, "An Introduction to Neural Networks", Practice Hall India Publication

4. Mohamed H. Hassoun, "Fundamentals of Artificial Neural Network", Practice Hall India

Reference books:

1. Kelvin Waruicke, Arthur Ekwlle, Raj Agarwal, "AI Techniques in Power System", IEE London U.K.

2. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Network Using MATLAB 6.0", Tata McGraw Hill

3. Jacek Zurada, "Introduction to Artificial Neural Network", Jaico Publishing House India

PGOPEN 105T Open Elective II

Utilization of Electrical Energy

(Open Elective II from Electrical Engineering Board)

Course Objective:

To understand the Illumination -Design of lighting scheme-sources of light
To understand the Drives-Suitability for different applications
To understand Electric Heating and Welding - Different methods.

Course Outcome:

To select their electric drive system based on application and availability of power source.
Apply power electronics technology in efficient utilization of electrical heating
Apply power electronics technology in efficient utilization of electrical welding
Create lighting system using illumination fundamentals and various illumination Technologies.
Analyze effective utilization of Power Electronic technologies in Electrical Traction.

UNIT-I ELECTRIC DRIVES:

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, Particular applications of electric drives, Types of industrial loads, continuous, Intermittent and variable loads, load Equalization.

UNIT-II ELECTRIC HEATING:

Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating.

UNIT-III ELECTRIC WELDING:

Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT-IV ILLUMINATION FUNDAMENTALS & VARIOUS ILLUMINATION METHODS:

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood ighting.

UNIT-V ELECTRIC TRACTION:

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostatic braking and regenerative braking, Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

TEXT BOOKS:

1. J.B. Gupta, "Utilization of Electric Power and Electric Traction", Kataria & Sons publishers, Delhi, IX Edtion, 2004.

2. C.L. Wadhwa, "Generation, Distribution and Utilization of electrical Energy", New Age International (P) Limited Publishers, 3rd Edition, 2010.

REFERENCES:

1. N.V. Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric traction", New Age International (P) Limited Publishers, 1st Edition,1994.

2. E. Open Shaw Taylor, "Utilization of Electric Energy", Orient Longman,1st Edition,1937.

PGOPEN 301T Open Elective IV

PLC & SCADA

(Open Elective IV from Electrical Engineering Board)

Course Objective:

To understand the present scenario of energy utilization, management and corresponding ACT of regulatory commission

Students should understand the role of automation to make the distribution system more smart, reliableand efficient. They should correlate this aspect with required modern technology of PLC basedcomponents and SCADA.

Students should deal with the all inclusive role of SCADA and PLC in real time application.

Course Outcome:

Students will take part in all sorts of PLC system.

Students will be in condition to deal with the problems of PLC programming.

They will find out the real time schedule of operation of advanced PLC function.

Students will be in condition to deal with various PLC application.

They will handle the problems related with automation and SCADA

.

Unit 01: Introduction to PLC

Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition, types, selection criterion, Overall PLC system, PLC Input and output modules (along with Interfaces), CPU, programmers and monitors, power supplies, Solid state memory , advantages and disadvantages

Unit 02: Programming of PLC

Programming equipment, Various techniques of programming, Ladder diagram fundamentals, proper construction of ladder diagram, basic components and their symbols in ladder diagram, MCR (master control relay) and control zones, Boolean logic and relay logic Timer and counter-types along with timing diagrams, shift registers, sequencer function, latch instruction Arithmetic and logical instruction with various examples

Unit 03: Advance PLC function

Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices, programming ON/OFF Inputs to produce ON/OFF outputs. Analog PLC operation, PID control of continuous processes, simple closed loop systems, problems with simple closed loop systems, closed loop system using Proportional, Integral & Derivative (PID), PLC interface, and Industrial process example.

Unit 04: Applications of PLC

PLC interface to various circuits : Encoders, transducer and advanced sensors (Thermal, Optical, Magnetic, Electromechanical, Flow, Level sensors) Measurement of temperature, flow, pressure, force, displacement, speed, level Developing a ladder logic for Sequencing of motors, Tank level control, ON OFF temperature control, elevator, bottle filling plant, car parking Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

Unit 05: SCADA Systems:

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution), Petroleum Refining Process, Water Purification System, Chemical Plant. Interfacing of SCADA with PLC.

Text Books:

1. Gary Dunning, “Introduction to Programmable Logic Controllers”, Thomson, 2nd Edition

2. John R. Hackworth, Frederick D., Hackworth Jr., “Programmable Logic Controllers Programming Methods and Applications”, PHI Publishers

3. John W. Webb, Ronald A. Reis, “Programmable Logic Controllers: Principles and Application”, PHI Learning, New Delhi, 5th Edition

4. Ronald L. Krutz, “Securing SCADA System”, Wiley Publications.

5. Stuart A Boyer, “SCADA supervisory control and data acquisition”, ISA, 4th Revised edition

6. Sunil S. Rao, “Switchgear and Protections”, Khanna Publications.

7. L.A. Bryan, E. A. Bryan, “Programmable Controllers Theory and Implementation” Industrial Text Company Publication, Second Edition

Reference books:

1. Batten G. L., “Programmable Controllers”, McGraw Hill Inc., Second Edition
2. Bennett Stuart, “Real Time Computer Control”, Prentice Hall, 1988
3. Doebelin E. O., “Measurement Systems”, McGraw-Hill International Editions, Fourth Edition, 1990
4. 4. Gordan Clark, Deem Reynders, “Practical Modern SCADA Protocols”, ELSEVIER
5. Krishna Kant, “Computer Based Industrial Control”, PHI
6. M. Chidambaram, “Computer Control of Process”, Narosha Publishing
7. P. K. Srivstava, “Programmable Logic Controllers with Applications”, BPB Publications
8. Poppovik, Bhatkar, “Distributed Computer Control for Industrial Automation”, Dekkar Publications
9. S. K. Singh, “Computer Aided Process Control”, PHI
10. Webb J. W, “Programmable Controllers”, Merrill Publishing Company, 1988

PGOPEN 301T Open Elective IV

Digital Control System

(Open Elective IV from Electrical Engineering Board)

Course Objective:

The course will develop the capability of analyzing the stability of a system and of designing simplecontrollers to regulate system behavior.

The course will introduce different optimization techniques to achieve desired performance.

The course will give an idea about digital controller and technique for stability analysis of Digital Control System.

Course Outcome:

Students will be able to analyze discrete time control system and signals

Students will be able to derive and design various stability techniques for improving performance of the system

Students will be able to analyze continuous time system using state space technique.

students will be able to derive and describe pole placement by state variable technique and condition for controllability and observability of the system

Students will be in condition to deal with various Digital control system applications.

Unit 01: Discrete systems and Signals

Standard discrete test signals, Basic operations on signals. Classification of discrete systems. Detail analysis of frequency aliasing & quantization, Brief review of Sampling theorem, Ideal low pass filter. Transfer function of ZOH, Frequency domain characteristics of ZOH, First order hold, frequency domain characteristics of first order hold.

Unit 02: Stability Analysis

Brief review of pulse transfer function, mapping between S-plane and Z-plane, constant frequency loci and constant damping ratio loci. Stability analysis of closed loop system in the Z-Plane. Jury's stability test, Stability analysis by use of Bilinear transformation & Routh Stability Criterion. Digital compensator design using frequency response (Bode plot).

Unit 03: State - Space analysis

Conversion of Pulse transfer functions to State space model and vice a versa. Solution of LTI Discrete –time state equation; State Transition Matrix (STM) and properties of STM; Computation of STM by Z-transform method, by power series expansion method, by Cayley Hamilton theorem, by Similarity transformation method, Discretization of continuous time state space equation.

Unit 04: Design using state space

Controllability and observability of linear time invariant discrete-data system, Tests for Controllability and obervability; Principal of Duality; Effect of pole- zero cancellation; Relationship between controllability, observability and stability. Pole placement design using linear state-feedback. State estimation and full order observer design. Ackermann's formula.

Unit 05: Digital control system applications

Hybrid system simulation, Computer program structure for simulation of discrete time control of continuous time plant. Digital temperature control, position control, Stepper motor control, Block diagram presentation and control algorithms.

Text Books:

1. K. Ogata, "Discrete Time Control System", 2nd Edition, PHI Learning Pvt. Ltd. 2009

2. B. C. Kuo, "Digital Control Systems", 2nd Edition, Oxford University Press

3. M. Gopal, "Digital Control Engineering", New Age International Publishers

4. M. Gopal, "Digital Control and State Variable Methods", 3rd Edition The McGraw Hill Co.

Reference books:

1. Load D. Landau, Gianluca Zito, 'Digital Control Systems: design, Identification and Implementation' Springer.

2. Mohammed Santina, Allen Stubberud, Gene Hostetter 'Digital control System Design', Sanders College publishing.

3. K.J. Astrom, B Wittenmark 'Computer Controlled Systems: Theory and Design' Prentice-Hall Inc New Jersey , 2011 Dover .

PGFD205T Foundation Course -I

Research Methodology

Course objective:

1. Introduction to philosophy of research.
2. Understand process to formulate research questions / idea
3. Understand process of planning of research time, resource
4. Understand different statistical analysis methods
5. Develop thesis and report writing.

Course outcome:

1. Knowledge on various kinds of research questions and research designs
2. Formulate research problems (task) and develop a sufficiently coherent research design
3. Assess the appropriateness of different kinds of research designs
4. Knowledge on qualitative, quantitative and mixed methods of research, as well as relevant ethical and philosophical considerations
5. Develop independent thinking for critically analyzing research reports

Unit 1 Research Foundation

What is Research,Objectives of Research,Types of Research,Scientific Research,Research and Theory,Conceptual and theoretical Models,Importance of research methodology in scientific research

Unit 2 Review of Literature

Need for Reviewing Literature, What to Review and for what purpose, Literature Search Procedure, Sources of Literature, Planning of Review work, Note Taking, Library and documentation

Unit 3 Planning of Research

The planning process ,Selection of a Problem for Research,Formulation of the Selected Problems, Hypothesis formation,Measurement, Research Design/Plan

Unit 4 Processing of Data and Statistical Analysis of Data

Introduction to Statistical Software, MINITAB, SPSS, Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, MATLAB and Neural Network based optimization,Optimization of fuzzy systems, Error Analysis, Results and their discussions

Unit 5 Report and Thesis writing

Types of Reports, Planning of Report Writing, Research Report Format, Principles of Writing, Data and Data Analysis Reporting in a Thesis, Use of Endnote, Bibliography, API , appendix, table, Observations arrangement, Preparation of type script and lay-out of thesis, Use of LATEX Indexing of Journals, Impact factor and social Media for Researchers.

Reference Book:

1. Research Methodology: Methods and Techniques by C. R. Kothari, New Age International Publishers, ISBN:81-224-1522-9

2. Statistical Methods for Research Workers by Fisher R. A., Cosmo Publications, New Delhi ISBN:81-307-0128-6

3. Design and Analysis of Experiments by Montogomery D.C. (2001), John Wiley, ISBN: 0471260088

4. MINITAB online manual

5. Methodology of Research in Social Sciences by O. R. Krishnaswamy and M. Rangnatham Himalaya publication House, 2005, ISBN: 8184880936

6. SPSS online manual

PGFD302T Foundation Course -II

Project Planning and Management

Project Management (PM) will provide students with the opportunity to gain a systematic and comprehensive understanding of key concepts and skills essential to project management in international affairs. By examining the project cycle using potential projects, students will learn techniques and tools used in formulating and managing projects and programs for desired impact.

By course end, students will be familiar with aid and development of project works, language and terminology used, different project structures, implementation practices, and strategies to address potential conflicts and obstacles. More importantly, students will have developed skills - strategic design, needs assessment, implementation, proposal and report writing, budgeting, monitoring and evaluation, advocacy, and others - that practitioners need to be effective in a range of professional contexts.

Course Philosophy: This is a course that will utilize learning techniques to provide students with opportunities to practice and process what they learn. This course attempts to cover skills that are relevant and current in international program work.

Learning Objectives: By course end students will be able to, within the above-stated limitations:

1. Conduct a basic needs assessment for a proposed project
2. Develop a project proposal
3. Develop a logical framework
4. Develop measureable indicators
5. Have ability to insert Monitoring and Evaluation into a project
6. Develop a grant proposal
7. Develop a project budget

As part of comprehensive preparation for the subject, by end of semester students will prepare an analytical and operational concept note that demonstrates:

1. Comprehensive understanding of the *context* in which they will work, including socio-political, economic, and cultural aspects.
2. Understanding of the *issue* they will work on, the causes, and its variations across contexts.
3. Strategies that have been used to tackle the problem(s) - the usual ones, and innovative ones. Students can introduce also other possible solutions worth exploring.

Benefits

- Establish measures of success
- Quantify value commensurate with cost
- Optimize use of organizational resources
- Incorporate quality principles
- Put strategic plans into practice

- Ensure fast time-to-market Project Manager
- Reduced cost to deliver solutions
- Lower risk of slipping schedule
- Repeatable successes on projects
- Crisis prevention
- Early problem identification and risk mitigation
- Structured approach to Project Management
- More predictable results
- Improved resource productivity and satisfaction
- Project success that builds business success

Course Contents

Unit 1 : ***Basics of Project Management:***

Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

Unit 2 : Project Identification and Selection:

Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point ***Project Planning:*** Introduction, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS) ***Organisational Structure and Organisational Issues:*** Introduction, Concept of Organisational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team

Unit 3: Resources Considerations in Projects:

Introduction, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts ***Project Risk Management:*** Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks

Unit 4 : ***Project Quality Management and Value Engineering:***

Introduction, Quality, Quality Concepts, Value Engineering ***Project Management Information System:*** Introduction, Project Management Information System (PMIS), Planning of PMIS, Design of PMIS ***Purchasing and Contracting for Projects:*** Introduction, Purchase Cycle, Contract Management, Procurement Process

Unit 5 : ***Project Performance Measurement and Evaluation:***

Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects ***Project Execution and Control:*** Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control ***Project Close-out, Termination and Follow-up:*** Introduction, Project Close-out, Steps for Closing the Project, Project Termination, Project Follow-up ***Project Management Software:*** Introduction, Advantages of Using Project Management Software, Common Features Available In Most of the Project Management Software, Project 2000.

Reference Books:

1. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, by John W. Creswell, 2nd Edition , Sage Publication, 2003

2. Qualitative Inquiry and Research Design: Choosing among Five Approaches, by John W. Creswell, 3rd Edition , Sage publication, 2013.

3. Evaluation: A Systematic Approach, Peter H. Rossi, Mark W. Lipsey, and Howard E. Freeman, 7th edition , Sage publications, 2007.

4. Handbook of Practical Program Evaluation, Joseph S. Wholey, Harry P. Hatry, Kathryn E. Newcomer. 4th edition, Wiley, 2015

5. Program Evaluation and Performance Measurement: An Introduction to Practice, James C. McDavid and Laura R. L. Hawthorn, Sage Publication, 2013.

6. Evaluation, Carol H. Weiss, 2nd Edition, ABE books, 1997.

7. Case Study Research: Design and Methods, Robert K. Yin, 3rd Edition, Sage Publications, 2011

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