PANDIT DEENDAYAL PETROLEUM UNIVERSITY

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B.TECH. ELECTRICAL ENGINEEING

SEMESTER VII			**B.TECH. ELECTRICAL ENGINEEING**											
Sr. No	**Course Code**	**Course Name**	**Teaching Scheme**					**Exam Scheme**						
			L	**T**	**P**	**C**	**Hrs/wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**LW**	**LE/Viva**	**Marks**
1	EE 423T	Electrical Machine Design - I	4	0	0	8	4	30	60	10	--	--	100
2	EE 424T	Power System Operation And Control	3	0	0	6	3	30	60	10	--	--	100
3	EE 425T	Advanced Microcontroller and Embedded System	3	0	0	6	3	30	60	10	--	--	100
4	EE 425P		0	0	2	1	2	--	--	--	25	25	50
5	EE 4xxT	Department Elective I	3	0	0	6	3	30	60	10	--	--	100
6	EE428P	Minor Project	0	0	6	3	6	--	--	--	50	50	100
7	HS 410T	Industrial Economics	3	0	0	6	3	30	60	10	--	--	100
		Total	**16**	**0**	**8**	**36**	**24**	150	300	50	75	75	650

MS = Mid Semester, ES = End Semester; IA = Internal assessment (like quiz, assignments etc)

LW = Laboratory work; LE = Laboratory Exam

EE 423T Electrical Machine Design-I										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
4	**-**	**-**	**8**	**4**	**30**	**60**	**10**	**-**	**-**	**100**

UNIT I **06**

BASIC CONSIDERATIONS IN ELECTRICAL MACHINES DESIGN: Design factors, Limitations in design, Modern trends in design of electric machines, Conducting materials, Magnetic materials, Insulating materials and its classification. Temperature rise, Expression for temperature rise, heating and cooling time constants, examples. Types of duties and ratings, Types of enclosure, Selection of motor capacity, examples. Cooling of machines.

UNIT II **20**

DESIGN OF TRANSFORMER: Specification, Output equation of transformer, Output equation- Volt per turn. Stacking factor, Ratio of iron loss to copper loss, Relation between core area and weight of iron and copper. Optimum designs, variation of output and losses in transformer with linear dimensions, examples. Design of core, Choice of flux density and current density, Choice of window space factor, window dimensions. Design of yoke, Overall dimensions, examples. Design of high voltage and low voltage winding, examples. Estimation of operating characteristics: Primary and Secondary resistance, Leakage reactance of windings, Regulation, examples. Mechanical forces, No load current calculation, Change of parameters with change of frequency. Temperature rise of transformer, Design of tank, examples. Design of Current Transformer: Introduction, construction, design principles, turns compensation.

UNIT III **10**

WINDINGS OF ELECTRICAL MACHINES: Types of transformer windings**.** D.C. Armature Winding: Types of dc winding, terms related to armature winding, comparison between closed and open winding, simplex lap and wave winding, Duplex lap and wave winding, Dummy coils in wave winding, Equalizer connections, examples.

A.C. ARMATURE WINDING: Number of phases and phase spread, classification of ac winding, Concentric winding, Mesh winding, Integral slot winding, Fractional slot winding, examples.

UNIT IV **16**

DESIGN OF DIRECT CURRENT MACHINES: Field form, Carter's Fringe curves Specifications, Main Dimensions, Total Loadings, Specific Loadings, Choice of Specific Magnetic Loading,Choice of Specific Electrical Loading, Interdependance of Bav and ac Output equation, Factors affecting size of machines, Seperation of DandL Selection of number of poles, examples Core length, Armature diameter, Pole proportions, Number of ventilacting ducts, Estimation of Length of air gap, examples. Armature reaction and its effects, Reduction of effects of armature reaction.

ARMATURE DESIGN: Number of armature conductiors, Number of armature coils, Number of armature slots, Cross section area of conductors, Slot dimensions, Armature volatge drop, Depth of armature core, examples. Design of Yoke, Magnetic circuit. Design of field system, Design of shunt

and series winding, examples. Improvement in commutation Design of Interpoles, Desing of Commutator and Brushes, examples.

TOTAL HOURS	**52**

Texts and References:

1 A. K. Sawhney and A. Chakrabarti, "***A course in Electrical machine design***" Dhanpat Rai and Co.

2 M. G. Say, "***The performance and design of alternating current machines***", CBS Publishers and Distributors

3 Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovsova, "***Design of rotating electrical machines***" Wiley publication.

4 K.G.Upadhyay, "***Design of electrical machines***", New age international publishers.

5 V. N. Mittal and A. Mittal, "***Design of electrical machines***", Standard Publishers distributors.

6 A. E. Fitzerald, Charles Kingsley, Stephen. D. Umans, "***Electric Machinery***" 6th Edition, Tata Mcgraw Hill.

7 J. G. Jamnani, "***Elements of electrical design'*** 2nd Edition, Mahajan publishing house.

EE 424T Power System Operation and Control										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**-**	**-**	**6**	**3**	**30**	**60**	**10**	**-**	**-**	**100**

UNIT I **12**

ECONOMIC OPERATION OF POWER SYSTEM-I: Introduction, Characteristics of Thermal Units, Objective Function and Constrains for the Economic Dispatch Problem, Lagrange Multiplier Method – An Overview, Economic Dispatch Problem- Neglecting Transmission Line Losses

ECONOMIC OPERATION OF POWER SYSTEM-II: Introduction, Economic Scheduling Problem Considering Losses, Derivation of the Transmission Loss Formula, Solution of the Economic Scheduling Problem – Considering Transmission Line Losses, Economic Dispatch Considering Losses- The Classical Method

HYDRO THERMAL SCHEDULING: Introduction, Long Range Hydro Thermal Scheduling.

UNIT II **08**

MODELING OF TURBINE, GENERATORS AND AUTOMATIC CONTROLLERS: Introduction, Modelling of Turbine Speed-Governor Controller, Modelling of Steam Turbine, Generator Load Model, Representation of Loads, Turbine Model, Synchronous Machines, The Swing Equation, Excitation, Excitation Controller Modeling.

UNIT III **12**

SINGLE AREA LOAD FREQUENCY CONTROL: Introduction, Control Area Concept, Isolated Block Diagram Representation of Single Area Frequency Control, Steady State Response, State Space Model for Single Area, Matrix Representation of all State Equations.

TWO-AREA LOAD FREQUENCY CONTROL: Load frequency Control of Two-Area System, Two-Area State Space Model Representation, Steady State Analysis.

LOAD FREQUENCY CONTROLLERS: Introduction, Proportional Plus Integral Controller, Load Frequency control and Economic Dispatch Control.

UNIT IV **07**

REACTIVE POWER CONTROL: Introduction, Power Factor, Reactive Power, Causes of Low Power Factor, Reactive Power flow in an Uncompensated Transmission Line, Necessity for Reactive Power Compensation in Transmission Line, Methods to Improve Power Factor, Power Factor Correction (Load Compensation).

TOTAL HOURS	**39**

Texts and References:

1 N. V. Ramana, "***Power System Operation and Control***", Pearson Education

2 S. Sivanagaraju, "***Power System Operation and Control***", Pearson Education

3 I.J.Nagrath and D.P.Kothari, "***Modern Power System Analysis***", Mcgraw Hill Publications

4 J.B.Gupta, "***A course in Power systems***", S.K.Kataria and Sons

EE 425T Advanced Microcontroller and Embedded System										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**0**	**--**	**6**	**3**	**30**	**60**	**10**	**--**	**--**	**100**

UNIT I **05**

INTRODUCTION: Introduction to Embedded Systems, Typical Embedded System, Characteristics and Quality Attributes of Embedded Systems.

UNIT II **15**

8-BIT PIC MICROCONTROLLER: Architecture of 8 bit PIC Microcontroller, Addressing Modes, Instruction Set, Assembly /C Programming of 8 Bit PIC Microcontroller.

UNIT III **09**

SENSORS AND ACTUATORS: Use of Sensors (Angle Sense, Resistive Sensors, Shaft Encoder, Polaroid Ultrasonic Sensor, LM75 etc.), Actuators (Stepper Motor, DC Motor, Permanent Magnet DC Motor, Induction Motor etc.), Communication Interfaces (I2C BUS, CAN BUS, SPI BUS, UART, 1-Wire etc) in Embedded Systems.

UNIT IV **10**

REAL TIME OPERATING SYSTEM: Real-Time Operating System based Embedded System Design. Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task synchronization.

TOTAL HOURS	**39**

Texts and References:

1 Milan Verle, MikroElektronika; "***PIC Microcontrollers***", 1st Edition, 2008

2 Milan Verle, MikroElektronika; "***PIC Microcontrollers - Programming in C***", 1st Edition, 2009

3 Shibu K. V., "***Introduction to Embedded Systems***", Tata McGraw hill.

4 Raj Kamal, "***Embedded System: Architecture, Programming and Design***", Tata McGraw Hill

Internet References

5 **http://www.mikroe.com/products/view/11/book-pic-microcontrollers/**
http://www.mikroe.com/products/view/285/book-pic-microcontrollers-programming-in-c/

EE 425P Advanced Microcontroller and Embedded System										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
--	**--**	**2**	**1**	**2**	**--**	**--**	**--**	**25**	**25**	**50**

List of Experiments:

1 Introduction of C programming for Embedded Systems.
2 Program for LED Blinking.
3 Program for Seven Segment Display.
4 Program for Button.
5 Program for ADC on LEDs.
6 Program for Stepper Motor Interfacing.
7 Program for ADC-DAC.
8 Program for LCD.
9 Program for UART.
10 Program for One Wire.
11 Shaft Encoder / Power Bidirectional Signal Handling

Department Elective I

EE 426T Energy Management in Electrical Systems										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**0**	**--**	**6**	**3**	**30**	**60**	**10**	**--**	**--**	**100**

UNIT I **10**

ENERGY MANAGEMENT and 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.

ELECTRICAL SYSTEM: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses.

UNIT II **10**

ENERGY MANAGEMENT IN ELECTRIC MOTORS: Types, Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, Energy saving opportunities with energy efficient motors.

ENERGY MANAGEMENT IN LIGHTING SYSTEM: Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues.

UNIT III **09**

ENERGY EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS: Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, Energy saving potential of each technology.

UNIT IV **10**

DIESEL GENERATING SYSTEM: Factors affecting selection, Energy performance assessment of diesel conservation avenues.

ENERGY MANAGEMENT IN FANS AND BLOWERS: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities.

ENERGY MANAGEMENT IN PUMPS AND PUMPING SYSTEM: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities.

TOTAL HOURS	**39**

Texts and References:

1 Rajiv Shankar, "***Energy Auditing in Electrical Utilities***", Viva Book

Internet References

http://www.beeindia.in/content.php?page=about_bee/career.php

EE 427T Power Quality										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**0**	**--**	**6**	**3**	**30**	**60**	**10**	**--**	**--**	**100**

UNIT I **07**

INTRODUCTION TO POWER QUALITY: Terms and definitions of transients, Long Duration Voltage Variations: under Voltage, Under Voltage and Sustained Interruptions**;** Short Duration Voltage Variations: interruption, Sag, Swell; Voltage Imbalance; Notching D C offset,; waveform distortion; voltage fluctuation; power frequency variations**.**

UNIT II **10**

VOLTAGE SAG: Sources of voltage sag, motor starting, arc furnace, fault clearing etc; estimating voltage sag performance and principle of its protection; solutions at end user level- Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, Active Series Compensator.

ELECTRICAL TRANSIENTS: Sources of Transient Over voltages- Atmospheric and switching transients- motor starting transients, PF correction capacitor switching transients, ups switching transients, neutral voltage swing etc; devices for over voltage protection.

UNIT III **09**

HARMONICS: Causes of harmonics, current and voltage harmonics: measurement of harmonics; effects of harmonics on – Transformers, AC Motors, Capacitor Banks, Cables, and Protection Devices, Energy Metering, Communication Lines etc. harmonic mitigation techniques.

UNIT IV **13**

MEASUREMENT AND SOLVING OF POWER QUALITY PROBLEMS: Power quality measurement devices- Harmonic Analyzer, Transient Disturbance Analyzer, wiring and grounding tester, Flicker Meter, Oscilloscope, Multimeter etc.

INTRODUCTION TO CUSTOM POWER DEVICES: Network Reconfiguration devices; Load compensation and voltage regulation using DSTATCOM; protecting sensitive loads using DVR; Unified power Quality Conditioner. (UPQC)

TOTAL HOURS	**39**

Text and References:

1. Roger C Dugan, McGrahan, Santoso and Beaty, "***Electrical Power System Quality***", McGraw Hill
2. Arinthom Ghosh and Gerard Ledwich, Kluwer, "***Power Quality Enhancement Using Custom Power Devices***", Academic Publishers
3. C. Sankaran, "***Power Quality***", CRC Press.
4. Arilaga (Books on Harmonics)