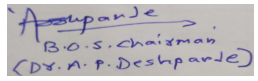
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Seventh Semester Electrical (Electronics & Power) Engineering

Course Category	Course Code	BoS	Course Title	Teaching Scheme				Examination Scheme									
				Hours per week			No. of credits	THEORY						PRACTICAL			
				L	T	P		Duration of paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional MSE	Max. Marks Sessional IE	Total	Min. Passing Marks	Max Marks TW	Max Marks POE	Total	Min. Passing Marks
HSMC-3	FE101	Mechanical	Slot for HS	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PEC-4	FE102	Electrical	Program Elective-4	3	0	0	3	3	80	10	10	100	40	--	--	--	--
OEC-3	FE103	Electronics	OE-3	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC-1	FE104	Electrical	Power system Protection	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC-2	FE105	Electrical	Advanced Power Convertor	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	FE106	Electrical	Power system Protection	0	0	2	1	--	--	--	--	--	--	25	25	50	25
PROJ	FE107	Electrical	Project Stage-I	0	0	6	3	--	--	--	--	--	--	50	50	100	50
		Total		**15**	**0**	**8**	**18**					**500**				**100**	
		Semester Total		**23**			**19**	**650**									

HSMC-3: 1) Operation Research and Management, 2) Human Resource and personal Management
PEC-4: 1) Power System Dynamics and Control, 2) Control System Design, 3) Line Commutated and Active Rectifiers
OEC-3: 1) Embedded Systems, 2) VLSI circuits
PCC-1: Power System Protection
PCC-2: Advanced Power Convertor



Four Year Degree Course in Engineering and Technology

Course and Examination Scheme with Model AICTE Curriculum

Eighth Semester Electrical (Electronics & Power) Engineering

Course Category	Course Code	BoS	Course Title	Teaching Scheme				Examination Scheme									
				Hours per week			No. of credits	THEORY						PRACTICAL			
				L	T	P		Duration of paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional MSE	Max. Marks Sessional IE	Total	Min. Passing Marks	Max Marks TW	Max Marks POE	Total	Min. Passing Marks
PEC-5	FE201	Electrical	Program Elective-5	3	0	0	3	3	80	10	10	100	40	--	--	--	--
OEC-4	FE202	Electrical	OE-4	3	0	0	3	3	80	10	10	100	40	--	--	--	--
OEC-5	FE203	Computer	OE-5	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PROJ	FE204	Electrical	Project Stage-II	0	0	16	8	--	--	--	--	--	--	100	100	200	100
		Total		**09**	**0**	**16**	**17**					**300**				**200**	
		Semester Total		**25**			**17**	**500**									

PEC-5: 1) Power Quality and FACTS, 2) Electrical Drives, 3) Computational Electromagnetic
OEC-4: 1) HVDC Transmission, 2) Electrical Energy Conservation and Auditing
OEC-5: 1) Image Processing, 2) Wavelet Transform, 3) Computer Networks

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HSMC-3	Operations Research Management	3L: 0T :0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit I:- **[08 Hrs]**

Introduction to O.R., Definitions, Characteristics, Limitations, Phases of O.R. and applications. Types of Mathematical Models. Linear programming, Formulation of problem, Graphical Method, Simplex Method., Duality theory and its use in economic interpretation and decision making.

Unit II:- **[08 Hrs]**

Assignment Model: Introduction, Problem on minimization and maximization. Travelling salesman problem by Branch and Bound Method. Transportation Model; Introduction, Methods of finding initial solution, Test of optimality, Transportation problem,

Unit III:- **[08 Hrs]**

Network Models: Introduction to PERT/CPM and its importance in project management. Concept and construction of network diagrams. Probability of completion of project, Cost analysis of project.

Unit IV:- **[08 Hrs]**

Inventory Control Models: Introduction, Meaning of Inventory control, Advantages of Inventory control.

Deterministic Inventory control Models, economic lot size with instantaneous replenishment with and without storage costs, economic lot size with finite replenishment with and without shortage. Selective Inventory Management Technique.

Unit V:- **[08 Hrs]**

Sequencing: Sequencing of n jobs and 2 and 3 machines, 2 jobs and n machines Decision Theory: Pay off and regret tables, Decision rules, Decision under certainty and risk, Decision tree.

Text Books and References:

1. PremKumar Gupta & D.S. Hira, Operations Research, S. Chand, 2007.
2. H.A. Taha, Operations Research, An Introduction, PHI, 2008
3. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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HSMC-3	Human Resource and Personal Management	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

UNIT – I **[8 Hrs.]**

Introduction to Human Resource Management :

Concept of management, concept of human resource management, personnel to human resource management, human resource management model, important environmental influences like government regulations, policies, labour laws and other legislation.

Acquisition of human resources: Human resource planning, Demand for man power, Weaknesses of manpower planning, job analysis, job specification, recruitment sources, recruitment advertising, the selection process, selection devices, equal opportunities: Indian and foreign practices, socializing the new employee

UNIT – II **[8 Hrs.]**

Development of Human Resources Employee Training and Management Development: Training, Training and Learning, Identification of training needs, training methods, Manager Development, Methods for developing managers, evaluating training effectiveness Career Development: Concept of career, value of effective career development, external versus internal dimensions to a career, career stages, linking career dimensions with stages .

UNIT – III **[8 Hrs.]**

Motivation of Human Resources: Definition of motivation, Nature and Characteristics of Motivation, Theories of motivation, Psychological approach. Job Design and Work Scheduling: Design, Scheduling and Expectancy Theory, Job characteristics model, job enrichment, job rotation, work modules, flex-time, new trends in work scheduling.

UNIT – IV **[8 Hrs.]**

Performance Appraisal: Performance appraisal and expectancy theory; appraisal process, appraisal methods, factors that can destroy appraisal. Rewarding the Productive Employee: Rewards and expectancy theory, types of rewards, qualities of effective rewards, criterions for rewards.

UNIT – V **[8 Hrs.]**

Maintenance of Human Resources Compensation Administration: Concept of Compensation Administration, Job evaluation, Pay structures, Incentives compensation plans. Discipline: Concept of Discipline, types of discipline problems, general guidelines, disciplinary action, Safety and Health: safety programs, health programs, stress, turn out.

Collective Bargaining: Objectives, scope, participants of collective bargaining, process of collective bargaining

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REFERENCE S BOOKS:

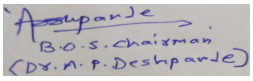
1. David A. DeCenzo, Stephen P. Robbins, "Personnel/Human Resources Management", Prentice Hall of India Pvt. Ltd, 3 rd edition, 2002.

2. Trevor Bolton, "An Introduction to Human Resource Management", Infinity Books, 2001.

3. Ellen E. Kossek, "Human Resource Management– Transforming the Workplace", Infinity Books, 2001.

4. G. S. Batra, R. C. Dangwal, " Human Resource Management New Strategies", Deep and Deep Publications Pvt. Ltd., 2001.

5. D. M. Silvera, " HRD: The Indian Experience", New India Publications, 2 nd edition, 1990.



PEC-4	Power System Dynamics and Control	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

UNIT I: Introduction (6 Hrs)

Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design - distinction between transient and dynamic stability - complexity of stability problem in large system – necessity for reduced models - stability of interconnected systems.

UNIT II: Modelling of Synchronous Machine (10 Hrs)

Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants. Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.

UNIT III: Modelling of Excitation System (6 Hrs)

Excitation System, Excitation System Modelling, Excitation System Standard Block Diagram, System Representation by State Equation, Prime Mover Control System.

UNIT IV: Transient Stability (9 Hrs)

State equation for multi machine system with one axis model and simulation – modelling of multi machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

UNIT V: Dynamic Stability (9 Hrs)

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact - linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals - dynamic performance measure - small signal performance measures.

Text Books:

1. P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2003.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.
3. Power System Dynamics By K R Padiyar, B S Publications.

Reference Books:

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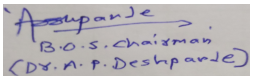
1. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002
2. James A.Momoh, Mohamed. E. EI-Hawary. " Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
3. K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.



PEC-4	Control System Design	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit I: Compensation Techniques (09 Hrs)

Approaches and Preliminary consideration. Need for compensation. Common compensating network. Transfer function of Lag, Lead and Simple Lag-Lead network. Analysis of compensator in time and frequency domain using Bode Plot. Physical realization of compensators using Active and Passive elements.

Unit II: State Space Analysis (09 Hrs)

Review of state space analysis. Concept of diagonalization. Eigen values, Eigen vector, Diagonalization of system matrix with distinct and repeated Eigen values. Vander Monde matrix. Solution of homogenous and non-homogenous state equation. State transition matrix, its properties, various methods to determine State transition matrix.

Unit III: Design of Control System Using State Space Techniques (09 Hrs)

Definition of controllability & observability, controllability & observability matrices, condition for controllability & observability from the system matrices in canonical form, Jordan canonical form, effect of pole zero cancellation on the controllability &observability of the system, duality property. Pole placement design by state feedback, State observer, design of full order observer.

Unit IV: Nonlinear System Analysis (09 Hrs)

Introduction, Types of non-linearity's, Characteristics of non linear control systems, Inherent & intentional non linearity's, Introduction to describing function, Describing function of some common non-linearity's. Stability analysis, Limit cycle & stability oflimit cycles.

Stability of Non Linear System: Introduction to phase plane method, Singular point. Stability from nature of singular point, Construction of trajectory by isoclines & Delta method.

Unit V: Optimal control: (09 Hrs)

Parameter optimization and optimal control problems, quadratic performance index, analysis and design of finite and infinite time Linear Quadratic Regulators, Introduction to Linear Quadratic Gaussian approach.

Text Books

1. I.J. Nagrath, M.Gopal "Control System Engineering", 5th Edition, New Age International Publishers.

Reference Books

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1. Benjamin C. Kuo, “Automatic Control Engineering”, Prentice Hall of India Pvt. Ltd.
2. K. Ogata’ “Modern Control Engineering”, Prentice Hall of India Pvt. Ltd.
3. M. Gopal’ “Digital Control Engineering”, Wiley Eastern, 1988
4. M. N. Bandyopadhyan, “Control Engineering – Theory and Practice”, Prentice Hall of IndiaLtd. Delhi

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PEC-4	Line Commutated and Active Rectifiers	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1: Diode rectifiers with passive filtering (6 Hours)
Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current wave shape, effect of source inductance; commutation overlap.

Unit 2: Thyristor rectifiers with passive filtering (6 Hours)
Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current wave shape.

Unit 3: Multi-Pulse converter (6 Hours) Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

Unit 4: Single-phase ac-dc single-switch boost converter (6 Hours)
Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

Unit 5: Ac-dc bidirectional boost converter (6 Hours)
Review of 1-phase inverter and 3-phase inverter, power circuits of 1 -phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

Unit 6: Isolated single-phase ac-dc fly back converter (10 Hours)
Dc-dc fly back converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc fly back converter, steady state analysis, unity power factor operation, closed loop control structure.

Text/ References:

1. G. De, “Principles of Thyristorised Converters”, Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, “Principles of Power Electronics”, Addison-Wesley, 1991.
3. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
4. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
5. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2001.

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OEC-3	Embedded Systems	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1-Introduction to Embedded Systems: (09 Hrs)

The concept of embedded systems design, design challenges, Architecture, Design Process, Design Metrics ,Classificationand Characteristics of Embedded System, technological aspects of embedded systems, introduction to ARM LPC2138

Unit 2 - Processor and Memory Organization: (09 Hrs)

optimization of various parameters of embedded system, structural unit in a processor, processor selection for an embedded system, memory devices, memory selection for an embedded system, allocation of memory to program segments and blocks and memory map of a system.

Unit 3- Programming Concept and Embedded Programming in C and C++: (09 Hrs)

Software Programming in assembly language and in high level language "C", C program elementsheader ,source files, pre-processor directives, macros, functions, data types, data structures, modifiers, statements, loop, pointers, queues and stacks, lists and ordered lists, Embedded programming in C++.

Unit 4 -RTOS Concepts: (09 Hrs)

Basic model of a real time system, characteristics of real timesystems, architecture of the kernel, task and task scheduler, interrupt service routines, semaphores, mutex, mailboxes, RMA, priority inheritance protocol , highest locked protocol ,priority ceiling protocol. Priority inversion problem.

Unit 5 - µCOS II and case studies of embedded systems: (09 Hrs)

Features of µCOS II. Kernelstructure. Inter-process communication and synchronization of processes, tasks andthreads, exemplary embedded systems.

Text/Reference Books:

1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition, McGraw Hill.
2. Jean J. Labrosse, "Micro C OS II, The Real-Time Kernel", 2nd edition, CMP Books
3. Dr. K. V. K.K. Prasad - Embedded / real time system.
4. Rajib Mall, Real Time Systems, Pearson Education.

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OEC-3	VLSI Circuits	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1 - Introduction to CMOS technology: (9 Hrs)
History of CMOS Technology, MOS transistors, MOS transistor switches, CMOS logic, Inverter, Combinational logic, NAND gate, NOR gate, Compound gates, Multiplexers, Memory-Latches and registers.

Unit 2- MOS transistor theory: (9 Hrs)
NMOS enhancement Transistor, PMOS enhancement Transistor, Threshold Voltage and Body Effect, MOS Device Equations, Second order Effects, MOS Models, Small Signal AC Characteristics, CMOS Inverter DC Characteristics, Bn &Bp ratios, Noise margin, Static Load MOS Inverters, Transmission Gate and BI-CMOS Inverters.

Unit 3- CMOS processing technology: (9 Hrs)
Silicon Semiconductor Technology, Wafer Processing, Oxidation, Epitaxy, Deposition, Ion Implantation, and Diffusion, Silicon Gate Process, Basic CMOS technology ,n-well process, p-well Process, Twin tub Process, SOI technology, Layout Design Rules, Latch up.

Unit 4- Circuit characterization and performance estimation: (9 Hrs)
Resistance Estimation, Capacitance estimation, Inductance, Switching Characteristics, Analytical delay models, Fall time, Rise time, Delay time, CMOS Gate Transistor sizing, Power dissipation, Charge sharing, Yield.

Unit 3- CMOS circuit and logic design: (9 Hrs)
CMOS Logic Gate Design, Basic Physical Design of Simple logic gates, inverter, NAND, NOR gates, Euler Graphs, CMOS Logic Structures, Clocking Strategies.

Text Books:

1. Principles of CMOSVLSI DESIGN-Neil Weste, Kamran Eshraghian- Pearson Education.

Reference Books:

1. Introduction to VLSI Systems -Carver Mead, Lynn Conway -BS Publications.
2. Modern VLSI Design- Wayne Wolf- Pearson Education.
3. Basic VLSI Design- Douglas Pucknell, Kamran Eshraghian - Prentice Hall Publications.
4. Introduction to VLSI circuits and Systems- John Uyemura- John Wiley and sons.
5. CMOS Digital Integrated Circuits – SungMo Kang, Yusuf Leblebici - Tata McGraw Hill Publications.

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PCC-1	Power System Protection	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1 - Fundamentals of Arc Interruption & Circuit Breaker (12 Hrs)
Fundamentals of Arc Interruption: Current interruption in AC circuit breaker, high & low resistance principles, arc interruption theories, arc voltage, recovery voltage, restricting voltage and RRRV, current chopping, interruption of capacitive and inductive current,
Circuit breakers: C.B. ratings, Different media of arc interruption, Overview of circuit breakers, construction and operation of air blast, SF6 and vacuum breakers.

Unit 2- Fundamentals of Protective Relaying and Over current Protection (10 Hrs)
Fundamentals of Protective Relaying: Need for protective system, nature & causes of fault, types of faults, effects of faults, evolution of protective relaying, zones of protection. Attracted armature and Induction disc type electromagnetic relays.
Operating principles of over current and directional over current relays, Various types of over current relays as per their time-current characteristics, Current and time settings, Over current protective schemes for transmission line and feeder protection.

Unit 3 - High voltage line protection (8 Hrs)
Introduction to distance protection, impedance relay, reactance relay and mho relay, Methods of relay settings Connections of impedance, reactance and mho relays, Effect of arc resistance, Line length and source impedance and power swing on performance of distance relays, Carrier current protection.

Unit 4 - Equipment protection (12 Hrs)
Transformer Protection: Types of faults in transformer. Percentage differential protection in transformers, Inrush phenomenon, percentage differential relay with harmonic restraint. Restricted E/F protection. Buchholz relay, Phenomenon of over fluxing in transformer, protection against over fluxing.
Generator Protection: Various faults, abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover.
Bus bar Protection: Differential protection of bus bars.. High impedance differential relay.
Protection of induction motor: Abnormal operating conditions and causes of failures in induction motor, Protection against overloads, unbalance and single phasing, stator fault protection .

Unit 5 - Introduction to static and Microprocessor based Digital relay (8 Hrs)
Introduction to static relay: Comparison of static and electromechanical relays, two input amplitude and phase comparator and their duality. Generation of various distance and over current relay characteristics using comparators.
Microprocessor based Digital Relaying: Introduction, Digital logic communication, Direct relay to relay digital logic communication, Digital message security, Relay interface with utility, Microprocessor based over current, impedance, reactance and mho relay, Applications of Microprocessor based relays.

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Text Books

1. S. Rao, “Switchgear Protection and Power Systems”, Khanna Publications
2. Y. G. Paithankar, S. R. Bhide, “Fundamentals of Power System Protection”, Prentice Hall of India
3. Badri Ram, D. N. Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill
4. Ravindra P.Singh, “Switchgear and Power System Protection” Prentice Hall of India

Reference Books

1.C.R.Mason, “Art and science of protective relaying”WileyEastern Ltd.
2. C.L.Wadhwa, Electrical Power Systems, New Age international (P) Limited, Publishers
3. B.L.Soni, Gupta, Bhatnagar, Chakrabarthy, A Text book on Power System Engineering, Dhanpat Rai & Co

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PCC-2	Advance Power Convertor	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1 - DC to DC Converters (09 Hrs)

Buck, boost, buck-boost and Cuk converter topologies- continuous and discontinuous modes of operation, Voltage and current commutated choppers, effect of source Inductance, Filter circuits.

Unit 2- AC to DC Converters (09 Hrs)

1-phase and 3-phase half controlled and fully controlled bridge converters with RLE loads, freewheeling diodes, Dual Converter, sequence control of converter-inverter operation, Effect of source inductance on commutation, Harmonic analysis of source current.

Unit III: Inverter-Generic Topology: (09 Hrs)

Inverter-Generic Topology: General topology of 1-phase and 3-phase voltage source and Current source inverters, Selection of switching frequency & switching device.

Unit IV: PWM Inverters: (09 Hrs)

1-phase VSI –sine-triangle PWM. 3-phase VSI sine-triangle PWM: under modulation and over modulation, region of operation. Other Inverter Switching schemes: Programmed harmonic elimination, Current regulated modulation (Hysteresis control), Space vector modulation: brief overview.

Unit V: AC-AC Converters (09 Hrs)

1-phase and 3-phase AC controllers, Principle of operation, single phase and three phase cyclo-converters, harmonics, power factor.

Text Books:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Second Edition, New Delhi,.
2. “Power Electronics: Converters, Design and Applications”, Ned Mohan, Undeland, Robbins. John Wileyand Sons, 2004.

Reference Books:

1. Power Electronics by M.D.Singh and Khanchandani.
2. Power Electronics by Vedam Subramanyam, Tata Mc Graw Hill.
3. “Modern Power Electronics and AC drives”, B.K.Bose, Pearson Education Inc., 2002

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PCC-LAB	Power System Protection	0L:0T:2P	1 Credits

Teaching Scheme
Practical : 2 Hours/Week

Examination Scheme
University Assessment: 25 Marks
College Assessment: 25 Marks

LIST OF EXPERIMENTS: (Any Eight Experiments)

1. To Study Over current Relay
2. To Study Solid State Percentage differential Relay
3. To Study Switchgear Testing Kit
4. To Study and Plot characteristics of Impedance Relay.
5. To Perform Transmission Line Protection Demo Panel
6. To perform Differential Protection of Three Phase Transformer (Star-Delta)using differential Relay
7. To Study 3 Phase Alternator Protection
8. To Study Fault Simulation Model for Induction Motor
9. To Study Current Transformer & Potential Transformer Testing Kit
10. To Study Microprocessor Based Numerical Relays.

PROJECT	Project Stage - I	0L:0T:6P	3 Credits

Teaching Scheme
Practical : 2 Hours/Week

Examination Scheme
University Assessment: 50 Marks
College Assessment: 50 Marks

Instructions :

1. **Project should be based on electrical engineering related area.**
2. **Two progress seminars will be conducted in a semester as a continuous evaluation.**

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PEC-5	Power Quality and FACTS	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1 - Terms and definitions & Sources (12 Hrs)

Overloading, under voltage, over voltage - Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance – Voltage fluctuations - Power frequency variations - International standards of power quality – Computer Business Equipment Manufacturers Associations (CBEMA) curve

Unit 2 - VOLTAGE SAG AND SWELL(10 Hrs)

Estimating voltage sag performance – Thevenin's equivalent source - Analysis and calculation of various faulted condition - Estimation of the sag severity - Mitigation of voltage sag, Static transfer switches and fast transfer switches. - Capacitor switching – Lightning - Ferro resonance - Mitigation of voltage swell.

Unit 3 - Introduction to FACTS (8 Hrs)

FACTS Concepts and General System Considerations: Transmission Interconnections, Flow of Power in AC system, Limits of Loading Capability, Power Flow and Dynamic Stability Considerations of a transmission interconnection, Relative Importance of controllable Parameters, Basic Types of FACTS Controllers, Brief Description and Definition of Shunt, Series and combined Controllers. Benefits from FACTS Technology.

Unit 4 -Static Shunt Compensators (12 Hrs)

Objectives of shunt compensation, Methods of controllable VAR generation, Variable impedance type Static Var Generator (TCR, TSR ,TSC, FC-TCR), Switching converter type Var Generators, basic operating principle.

Unit 5 - Static Series Compensators (8 Hrs)

Objectives of series compensation- Variable impedance type series compensation, Switching converter type series compensation (only SSSC).

Books Recommended :

1. Understanding FACTS", N G Hingorani and L Gyugyi, IEEE Press,1999.

2. "Flexible AC Transmission Systems" (FACTS), Yang hue Song, IEEE Press, 1999.

3. "Reactive Power Control in Power Systems", T J E Miller,John Wiley, 1982

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PEC-5	Electrical Drives	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1: Electric Drives (6Hrs)
Introduction to electric drives: Advantages of Electric drives, Choice of Electric Drives and Losses. Latest trends in DC & AC Drives, Dynamics, Equivalent values of drive parameters, Load Torque: component, Natures and classification, steady state stability, Speed-torque characteristics, criteria load equalization.

Unit 2: DC Motor Drives (8Hrs)
Starting, Braking, Speed control of DC motors using single phase fully controlled and half-controlled rectifiers. Three phases fully controlled and half-controlled converter fed DC motor drives. Chopper controlled DC drives.

Unit 3: Induction Motor Drives (8Hrs)
Three phase induction motor drives - ac voltage controlled drives –- VSI fed induction motor drive – stator side control – scalar control and vector control – rotor side control - slip power recovery scheme - CSI controlled induction motor drives. Regeneration in drives: dynamic braking, regenerative braking, dc injection, plugging.

Unit 4: Industrial Application (8Hrs)
Drive for rolling mills,(four quadrant operation), Machine tools(constant torque application), Textile mills , sugar mills, paper mill, Cement mill.

Unit 5: Synchronous Motor Drives (6Hrs)
Steady state & dynamic stability limits of synchronous motor drives, True synchronous & self synchronous modes of operation, Variable frequency control of multiple synchronous motors, Self-controlled synchronous motor drive employing load commutated thyristor inverter, Starting of large synchronous machines, Self-controlled synchronous motor drive employing cyclo-converters.

Text Books:
1. “Fundamentals of Electric Drives”, by G K Dubey ,Narosa Publications.
2. “Power Electronic Circuits, Devices and applications”, by M.H.Rashid, Prentice Hall of India.
3. “Modern Power Electronics and AC Drive”, by B.K. Bose ,Pearson Education.
4. “Electric Drives”, N. K. De, P. K. Sen, Prentice Hall of India Eastern Economy Edition.

Reference Books:
1. “Thyristor Control of Electric drives” by Vedam Subramanyam, Tata McGraw Hill Publilcations.
2. “A First course on Electrical Drives”, by S K Pillai, New Age International(P) Ltd. 2
3. “Electric Drives”, by S.K.Pillai, University Press India, 1993.

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PEC-5	Computational Electromagnetic	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1: Introduction (6 hours)
Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetic. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

Unit 2: Analytical Methods (6 hours)
Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

Unit 3: Finite Difference Method (FDM) (7 hours)
Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

Unit 4: Finite Element Method (FEM) (7 hours)
Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

Unit 5: Special Topics (7 hours)
{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.

Unit6: Applications (7 hours)

Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

Text/Reference Books

1. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetic", CRC press, 2001.

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OEC-4	HVDC Transmission	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1: DC Transmission Technology (4 hours)

Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of a HVDC system. Line Commutated Converter and Voltage Source Converter based systems.

Unit 2: Analysis of Line Commutated and Voltage Source Converters (10 hours)

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

Unit 3: Control of HVDC Converters: (10 hours)

Principles of Link Control in a LCC HVDC system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVDC system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Unit 3: Components of HVDC systems: (8 hours)

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. DC line faults in VSC systems. dc breakers. Mono-polar Operation. Ground Electrodes.

Unit 4: Stability Enhancement using HVDC Control (4 hours) Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

Unit 5: MTDC Links (4 hours) Multi-Terminal and Multi-In feed Systems. Series and Parallel MTDC systems using LCCs. MTDC systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

Text / References:

1. K. R. Padiyar, “HVDC Power Transmission Systems”, New Age International Publishers, 2011.
2. J. Arrillaga, “High Voltage Direct Current Transmission”, Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, “Direct Current Transmission”, Vol.1, Wiley-Interscience, 1971.

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OEC-4	Electrical Energy Conservation and Auditing	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1: Energy Scenario (6 Hours)

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit 2: Basics of Energy and its various forms (7 Hours)

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Unit 3: Energy Management & Audit (6 Hours)

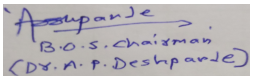
Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Unit 4: Energy Efficiency in Electrical Systems (7 Hours)

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. 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.

Unit 5: Energy Efficiency in Industrial Systems (8 Hours)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.



Unit 6: Energy Efficient Technologies in Electrical Systems (8Hours)

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.

Text/Reference Books

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

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OEC-5	Image Processing	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1- Introduction to Image Processing: (9Hrs)

Scenes And Images, Application Of Image Processing, Image Processing System (Hardware, Software), Elements of Visual Perception, Structure of the Human Visual System, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationship between Pixels, Adjacency, Connectivity, Regions and Boundaries, Logic Operations in Image processing, Image Enhancement in Spatial Domain, Spatial domain Methods, Point processing, Neighbourhood processing, High pass filtering, High-Boost Filtering, Zooming, Image Enhancement based on Histogram Modelling.

Unit 2- Discrete Image Transform: (9Hrs)

Linear Transformations: Representation of a Discrete Function, Sampling, One dimensional Discrete Transformations, Two dimensional Discrete Linear Transformations , FFT, DCT, DST, Walsh-Hadamard Transform, Walsh transform, Haar transform, Fast algorithm for computing Hadamard transform, Slant transform, K-L Transform, Wavelet Transform and Sub band Coding.

Unit 3- Image Enhancement in Frequency Domain: (9Hrs)

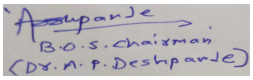
Fourier Transform, One dimensional Fourier Transform, Two dimensional Fourier Transform, Properties of DFT, Low Pass Frequency Domain Filters: Ideal Low Pass Filters, Butterworth Low Pass Filters, Gaussian Low Pass Filters, High Pass Frequency Domain Filters: Ideal High Pass Filters, Butterworth High Pass Filters, Gaussian High Pass Filters, High Boost Filtering, Clipping and Thresholding, Homo-morphic Filtering, Relationship between Filtering in the spatial and frequency domain

Unit 4-Segmentation : Point, Line and Ege Detection, Computing the Gradient, Finding Gradients using Masks: (9Hrs)

Roberts Mask, Prewitt and Sobel Operators, Compass Operators, Canny Edge Detector, Edge Linking, Connectivity, Region-based Segmentation, Thresholding, Region Extraction, Image Compression: Fidelity Criteria, Image compression Standards, Huffman Coding, LZW Coding, Run-Length Coding, Predictive Coding, Interpolative coding

Unit 5- Morphological Image processing: (9Hrs)

Arithmetic and Logical Operation, Erosion and Dilation, Structuring Elements, Opening and Closing, Hit-or-Miss Transform, Boundary Extraction, Hole(Region) Filling, Thinning, Thickening, Pruning, Morphological reconstruction, Representation and Description: Chain Codes, Polygonal Approximations, Signatures, Medical Axis transform, Moments, Fourier Descriptors, Topological Descriptors, Texture



Text Book/s:

1. B. Chanda, D. Datta Mujumdar, "Digital Image Processing And Analysis", PHI , 5th Reprint ISBN-81-203- 1618-5
2. R.C. Gonzalez, R.R. Woods, "Digital Image Processing Person Education ", ISBN - 81-7808-629-

Reference Book/s:

1. William Pratt, "Digital Image Processing", John Willey & Sons Inc. ISBN-9-814-12620-9
2. Anil K. Jain, "Fundamentals Of Digital Image Processing", PHI, ISBN-81-203-0929-4

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OEC-5	Wavelet Transform	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1- Fundamentals of Linear Algebra (8Hrs)

Vector spaces, Orthogonality, Ortho-normality, Projection, Functions and function spaces. Orthogonal basis functions. Fourier series orthogonality of complex exponential bases, mathematical preliminaries for continuous and discrete Fourier transformer. Limitations of Fourier domain signal processing, towards wavelet signal processing, signal representation with continuous and discrete Short Time Fourier Transform

Unit 2- Introduction to Wavelet (8Hrs)

Concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's uncertainty principle and time frequency tiling, why wavelet transform? The origin of wavelets, Properties of Wavelet Transform, Wavelet and other wavelet like transformer, different communities and family of wavelets, different families of wavelets within wavelet communities, Continuous and discrete wavelet transform

Unit 3-Discrete Wavelet Transform (9Hrs)

Haar scaling function and function spaces, translation and scaling of $\varphi(t)$, function spaces V0 Finer Haar Scaling Functions, concept of nested vector spaces, Haar wavelet function, scaled and translated Haar wavelet functions, orthogonality of $\varphi(t)$ and $\gamma(t)$. Normalization of Haar bases at different scales, Daubechies wavelets, plotting of Daubechies wavelets. 1-D and 2-D decomposition (analysis) of signals using Wavelet

Unit 4-Multi-resolution Analysis (10Hrs)

Signal decomposition and its relation with filter banks, frequencies response, signal reconstruction course to fine scale, up sampling and filtering, QMF conditions, concepts of multi-Resolution analysis and multi-rate signal processing, Perfect matching filters, Vanishing moments of wavelet function and filter properties, introduction to wavelet lifting.

Unit 5-Wavelet Transform in Data Compression (10Hrs)

Transform coding, image compression using DWT, Embedded tree image coding, comparison of JPEG and JPEG 2000, Audio masking, MPEG Coding for audio, Wavelet based audio coding, video coding using Multi-resolution technique (introduction). Applications of Wavelet Transform Wavelet de-noising, speckle removal, Edge detection and object isolation Image fusion, wavelet watermark, image enhancement. Communication application scaling functions as signalling pulses, Discrete Wavelet Multi one modulation.

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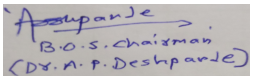
Text Books:

1. K.P Soman, K I Ramchandran, N G Resmi, ―Insights into Wavelets from theory to Practice‖, Third edition, PHI publication.

2. Raghuveer M Rao, Ajit S. Bopardikar, ―Wavelet Transforms, Introduction to Theory and Applications‖, Seventh Indian Reprint 2005, Pearson Education.

Reference Books:

1. Jaideva C. Goswami, Andrew K. Chan, ―Fundamentals of Wavelets‖, Wiley Student Edition 2. V. M. Gadre, A. S. Abhyankar, ―Multiresolution and Multirate Signal Processing, Introduction, Principles and Applications‖, MGH Publication



OEC-5	Computer Network	3L:0T:0P	3 Credits

Teaching Scheme
Lectures: 3 Hours/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

SYLLABUS:

Unit 1- Introduction to Computer Networks: (9Hrs)

Uses of Computer Networks, Types of Networks, Network Hardware, Network software, network design issues, network design tools. ISO's OSI Reference Model & TCP/IP Reference model, Example Networks: Internet, X.25, Frame Relay, ATM, Ethernet, Wireless LANs, Network standardization, Switching, Buffering and Multicasting, MODEM, cable media. Data Link Layer: Design issues, Services, framing, error and flow control, elementary data link protocols: Simplex stop & wait protocol, simplex protocol for noisy channel. Sliding window protocols: Using GO back-N ARQ, using selective repeat ARQ, HDLC. Protocol performance, protocol specification & verification. The Data Link Layer in the Internet & ATM.

Unit 2-Point-to-Point-Access (PPP): (9Hrs)

Frame format, Transition states, PPP Stack: LCP, NCP Network Hardware Components: Connectors, Transceivers and Media Converters, Repeaters, NICs, Bridges and Switches. The Medium Access Control Sublayer: Static and dynamic channel allocation, multiple access protocols: ALOHA, CSMA/CD, Collision-free protocols. Limited-contention Protocols, WDMA, wireless LAN protocols. Ethernet: Cabling, encoding, MAC sub-layer protocol, Switched, fast and Gigabit Ethernet, Logical link control, Wireless LANs and Digital Cellular Radio, Broadband Wireless, Virtual LANs, Bluetooth, Virtual Circuit. Switching: Frame Relay and ATM, IEEE 802.3, 802.4, 802.5 standards, FDDI, fast Ethernet & satellite networks.

Unit 3 - Network Layer: (9Hrs)

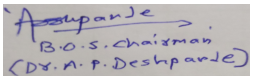
Design Issues, Packet switching, Connectionless and Connection-oriented Services, Virtual Circuits and Datagram Subnets, Router, Configuring Router Routing Algorithms, Internetworking, Firewalls

Unit 4 - Transport Layer: (9Hrs)

The transport services, elements of transport protocols: Addressing establishing & releasing a connection, flow control and buffering, multiplexing and crash recovery, simple transport protocol, the Internet transport protocol TCP & UDP. Performance issues. Concept of socket and socket programming (TCP/IP, SPX/PX, WINSOCK).

Unit 5 - Application Layer: (9Hrs)

Domain Name Systems (DNS), and DNS server, Electronic Mail Architecture and services, Message Formats, MIME, message transfer, SMTP, Mail Gateways, Relays, Configuration 50Mail Servers, DHCP, NetBIOS, File Transfer Protocol, General Model commands, TFTP. World Wide Web: Introduction, Architecture overview, static and dynamic web pages, WWW pages and browsing HTTP, LDAP, Browser Architecture, Caching in Web Browser remote login, Wireless web



Text/Reference Books:

1. Tanenbaum A, "Computer Networks", 4 Edition, PHI
2. Fourauzan B., "Data Communications and Networking", 3 edition, Tata Mc-Graw Hill
3. Keshav S., "An Engineering Approach to Computer Networking", Pearson Education, ISBN 981-235-9869
4. Comer D., "Computer Networks and Internet", 2140 Edition, Pearson Education, ISBN 81 -7808-086-9
5. Gallo M., Hancock W., "Computer Communications and networking Technologies", Thomson Brooks/Cole

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PROJECT	Project Stage - II	0L:0T:16P	8 Credits

Teaching Scheme
Practical : 16 Hours/Week

Examination Scheme
University Assessment: 100 Marks
College Assessment: 100 Marks

Instructions :

1. **Two progress seminar will be conducted in a semester as a continuous evaluation.**
2. **Final Examination will be conducted by guide and external examiner.**
3. **One Research paper must be published in a reputed Journal.**