UNIVERSITY OF MUMBAI

Syllabus Structure (R-2007)

at

B.E.(ELECTRICAL ENGINEERING)

Semester VIII

Sr. No	Subjects	Scheme of Instructions, Periods per week (60 min)			Scheme of Evaluation					
		Lecture	Practical	Tutorial	Paper		Term work	Practical and Oral	Oral	Total
					Hours	Marks				
1	Design, Management and Auditing of Electrical System	4	2	**	3	100	25	**	25	150
2	Drives and Control	4	2	**	3	100	25	25	**	150
3	Power System Planning and Reliability	4	**	2	3	100	25	**	25	150
4	Elective-II	4	**	2	3	100	25	**	25	150
5	Project-II	**	8	**	**	**	50	**	50	100
Total		16	12	4		400	150	25	125	700

Elective - II:

1.Power Quality
2. Electric Traction
3.Flexible AC Transmission Systems
4. Digital Signal Processors Applications in Power Systems

University of Mumbai			
Class:B.E.	**Branch: Electrical Engineering**	**Semester:** VIII	
Subject: Design, Management and Auditing of Electrical System (Abbreviated as DMAES)			
Periods per Week (Each 60 min)	Lecture	**04**	
	Practical	**02**	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory Examination	**03**	**100**
	Practical and Oral	**---**	**---**
	Oral	**---**	**25**
	Term Work	**---**	**25**
	Total	---	**150**
Course Objective:- To get conceptual understanding of design of electrical systems, their management and auditing procedures.			

Module	Contents	Hours
1	**Introduction** Types of electrical Projects, types of electrical systems, review of components of electrical system Different plans/ drawings in electrical system design, single line diagram in detail, Introduction to Energy Conservation Act 2001, Basics of tendering and estimation, Review of Economic and financial analysis techniques: time value of money, Simple payback, IRR.	04
2	**Design of Power Distribution System** Different types of distribution systems and selection criteria, Temporary and permanent power supply, Electrical load: size, LF, DF, future estimates, Substation equipments options, Design considerations in: Transformer selection, sizing and specifications. IS standards applicable in above designs.	08
3	**Design of Switchgear Protection and Auxiliary system** Selection of HT/LT switchgears, Metering, Switchboards and MCC, Protection systems, co-ordination and discrimination; Cables: selection and sizing, cable installation and management systems, bus-bars; Basics of Selection of emergency/backup supplies, UPS, DG set, Batteries; Preliminary design of interior lighting system. IS standards applicable in above designs.	10
4	**Monitoring and Management of Electrical Systems** Energy Monitoring and Targeting: Defining monitoring & targeting, Elements of monitoring& targeting, Energy analysis techniques for	12

	energy optimization. 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, Introduction to Energy Efficient Technologies in Electrical Systems: Maximum Demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, Energy saving potential of each technology. SCADA, Energy Management System (EMS) and Building Management System (BMS) systems	
5	**Energy 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: Audit of installations comprising following with respect to their electrical energy usage: Electric motors, HVAC systems , Fan and blowers systems, Compressed air systems Pumps, DG sets, Lighting installations etc. Evaluation of energy conservation opportunities. Energy conservation in buildings, Economic and non economic aspects of energy conservation in electrical systems	12
6	**Use of Renewable and Green building Concept** Impact of renewable energy sources in electrical system design, Concept of green building and its accreditation	02

Term work:

1: Design based on following case studies with complete design calculation and diagrams/ drawings/ layouts (at least three)

i) Power distribution network: Substation design
ii) Lighting installation
iii) Cable selection
iv) Switchgear and protection system design
v) Emergency / backup system design
vi) Power factor Improvement system

2: Preliminary Audit report on observation and analysis of existing electrical installation (at least two)

3. Three Assignments / case studies based on module 1 and 4

The distribution of the Term Work shall be as follows,

Practical Work : 15 Marks
Tests : 10 Marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Books Recommended:

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, John Wiley and Sons
4. "Handbook on Energy Audits and Management", edited by Amit Kumar Tyagi, Tata Energy Research Institute (TERI).

Reference Book:

1. " Energy Auditing Made Simple", By P.Balasubramanian ,Seperation Engineers (P) Limited
2. "Energy Management Principles", By C.B.Smith, Pergamon Press
3. "Energy Conservation Guidebook", Dale R. Patrick, Stephen Fardo, Ray E. Richardson, Fairmont Press
4. "Handbook of Energy Audits", By Albert Thumann,William J. Younger, Terry Niehus, CRC Press

Websites:

1. ***www.energymanagertraining.com***
2. ***www.bee-india.nic.in***

UNIVERSITY OF MUMBAI			
CLASS B.E	**Branch : Electrical Engineering**	**Sem VIII**	
Subject : Drives and control (abbreviated as DC)			
Periods per week(Each 60 min)	Lecture	**4**	
	Practical	**2**	
	Tutorial	**--**	
		Hours	**Marks**
Evaluation System	Theory	**3**	**100**
	Practical and oral	**---**	**25**
	Oral	**---**	**--**
	Term work	**---**	**25**
	Total	**---**	**150**

Course Objectives: This course is designed to understand fundamentals of electric drives and their control through knowledge of electrical machines and power electronics. The scope of this course covers basics, dynamics, selection, braking, and control of AC DC drives. Students' are expected to learn more by studying application of drives in industry.

Module	Contents	Hours
1	**Electrical Drives** Introduction, Advantages of Electrical Drives, Parts of Electrical Drives, Choice of Electrical Drives, Status of DC and AC Drives	3
2	**Dynamics of Electrical Drives** Fundamental torque equations, Speed torque conventions and multi quadrant operation, Equivalent values of drive parameter, Measurement of moment of inertia, Components of load torques, Nature and classification of load torques, Calculation of Time and Energy-Loss in transient operations, Steady state stability, Load equalization	7
3	**Selection of Motor Power Rating** Thermal Model of motor for heating and cooling, Classes of motor rating, Determination of motor ratting	5
4	**Control of Electrical Drives** Modes of operation, Speed control drive classification, Closed loop control of drives	4
5	**DC Drives** Speed torque relations for shunt, Series and separately excited motors, Starting, Braking – Regenerative, Dynamic, Plugging, Speed control- Armature voltage, Field flux, Armature resistance, Methods of voltage Control – Ward Leonard scheme, Controlled rectifiers, Controlled rectifier fed DC drives(separately excited only)- Single phase fully-controlled rectifier, Single phase half controlled rectifier, three phase fully-controlled rectifier, three phase half-controlled rectifier, dual converter control, Chopper Control – Motoring and braking of separately excited and series motor.	12
6	**AC Drives** Induction Motor drives, Review of speed-torque relations, Review of Starting methods Braking- Regenerative, Plugging, Ac dynamic	12

	braking, Speed Control- stator voltage control, variable frequency control form voltage source, Vector Control (Elementary treatment only), Introduction to Synchronous Motor variable speed drives.	
7	**Special Motor drives** Stepper Motor drives- Types, Torque Vs Stepping rate characteristics, Drive circuits, Introduction to Brushless DC drives, Introduction to Switched reluctance drives	5

Term work:
Term work will consist of at least 6 experiments /assignments performed, properly recorded and graded, which will carry weightage of 15 marks and the test will carry weightage of 10 marks.

List of Practicals.

1. Simulation of electrical drive.
2. Simulation of Starting of D. C. Motor (soft start)
3. Dynamic Braking of D. C. motor.
4. Plugging of D. C. Motor / Plugging while lowering the load.
5. Regenerative braking of D. C. motor. (by making V< Eb for high inertia load.)
6. DC or AC dynamic braking of 3 phase induction motor.
7. Plugging of Induction Motor.
8. Single Phase full wave controlled D. C. motor drive
9. Chopper drive.
10. V/F control of Induction Motor using PWM inverter.
11. Measurement of moment of inertia by retardation test.
12. Study of Stepper Motor Drive.

Books Recommended:

Text books:

1. Dubey G.K, fundamentals of electrical drives, Narosa .
2...Subrahmanyam .V. Electrical Drives: concepts and applications TMH
3. Krishnan R , Electric motor drives: modeling, analysis and control PHI
4. Pillai s.k A first course on electrical drives, willey eastern ph

Reference books:

1. Bose B.K Modern Power electronics and AC Drives, Pearson Education Asia
2. Rashid M.H, Power electronics: circuits, Devices and Applications, PHI

University of Mumbai			
Class: B.E.	**Branch: Electrical Engineering**	**Semester:** VIII	
Subject: Power System Planning and Reliability (Abbreviated as PSPR)			
Periods per Week (Each 60 min)	Lecture	04	
	Practical	--	
	Tutorial	02	
		Hours	**Marks**
Evaluation System	Theory Examination	03	100
	Practical and Oral	---	---
	Oral	---	25
	Term Work	---	25
	Total	---	150
Course Objective:- To understand the different power system planning/forecasting techniques and reliability evaluation in terms of basic reliability indices.			

Module	Contents	Hours
1	**Load Forecasting:** Introduction, Classification of Load, Load Growth Characteristics, Peak Load Forecasting, Extrapolation and Co-Relation methods of load Forecasting, Energy Forecasting, Reactive Load Forecasting, and Impact of weather and Factors affecting load Forecasting, Annual, Monthly and Total Forecasting.	8
2	**System Planning:** Introduction to system planning, Its Objectives & Factors affecting to System Planning, Short, Medium and Long Term Planning, Reactive Power Planning.	8
3	**Generation and Transmission planning:** Objectives of generation planning, Factors affecting Generation Planning, Sources of Generation. Objectives of transmission planning Network Reconfiguration,	6
4	**Fundamentals of Power system Reliability** Concepts, Terms and Definitions, **o**utage, failure rate, and outage rate availability, unavailability, Reliability models, Morkov process Reliability function, Mean time to failure, Hazard Rate Function, Bathtub Curve	05
5	**Reliability of Systems** Serial Configuration, Parallel Configuration, Combined Series – Parallel Systems, System Structure Faction, Minimal Cuts and Minimal Paths	06

6	**Generating Capacity: Basic probability methods and Frequency & Duration method**: Introduction, , Generation system model, capacity outage probability table, recursive algorithm, Evaluation of: loss of load indices, Loss of load expectation, Loss of energy	06
7	**Operating Reserve:** General concept, PJM method, Modified PJM method, Security function approach	06
8	**Composite generation and transmission system:** Data requirement, system and load point indices, Impact of component outage on the system reliability, application to simple system	06

Term Work:

The term work will consist of at least Six Simulations/Computer Programs/Assignments
The distribution of the Term Work shall be as follows,
Practical Work (Computer Program/simulations) : 15 Marks
Tests : 10 Marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work

Books Recommended:

Text Books:

1. Roy Billinton and Ronald N Allan, 'Reliability Evaluation of Power System', Plenum, Press, 1984
2. Power System Planning - R.L. Sullivan, Tata McGraw Hill Publishing Company

Reference Book:

3. Roy Billinton and Ronald N Allan 'Reliability Assessment of Large Electric Power Systems', Kluwer academic publishers, 1988
4. Modern Power System Planning – X. Wang and J.R. McDonald, McGraw Hill

University of Mumbai			
Class: B.E.	**Branch: Electrical Engineering**	**Semester:** VIII	
Subject: Power Quality (Abbreviated as PQ)			
Periods per Week (Each 60 min)	Lecture	**04**	
	Practical	**02**	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	**03**	**100**
	Practical and Oral	**---**	**---**
	Oral	**---**	**25**
	Term Work	**---**	**25**
	Total	---	**150**
Objective:- To get awareness about latest and future problems in power system due to nonlinear load and its solution.			

Module	Contents	Hours
1	**Introduction** Overview of Power Quality- Power Quality- Voltage Quality- Disturbances-Unbalance-Distortion-Voltage Fluctuations-Flicker-Quality Assessment	04
2	**Power Quality Indices & standards** Classification of power Quality phenomena-Disturbances-Waveform distortion - Voltage unbalance-voltage fluctuation & flicker	04
3	**Non-linear Loads in Power system (Only short notes)** CFL lamps- HVDC Transmission-HVDC Light-Static Var Compensator (SVC)-Thyristor Controlled Series Compensator (TCSC)-Static Compensator (STATCOM)-Static Synchronous Series Compensator (SSSC)-Unified Power Flow Controller (UPFC)- Distributed Generators	06
4	**Non-sinusoidal waveforms under steady state** Fourier Analysis of Repetitive waveforms-Line Current Distortion-Power and Power Factor	04
5	**Effects of harmonics** Rotating Machines – Transformers – Cables – Capacitors – Harmonic resonance – Voltage Notching – EMI (Electromagnetic Interference) – Overloading of Neutral – Protective relays and Meters – Circuit Breakers and fuses – Telephone Influence Factor	08

6	**Harmonic mitigation** Mitigation of harmonics- Passive filters(no design)- Limitation of passive filters- Active filters-shunt connection, series connection and hybrid connection	08
7	**Load Compensation Using DSTATCOM** Compensating Single-Phase Loads-Ideal Three-Phase Shunt Compensator Structure-Generating Reference Currents Using Instantaneous PQ Theory (with problems)	08

Term work:

Term Work will consist of four **assignments**, minimum one **simulation** and one **seminar** on power quality from IEEE Journal Paper

Laboratory work (Tutorial, simulation and seminar) :15 marks
Test (at least one) :10 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Suggested List of Simulations:

1. Simulation on any power electronic devices(as given in module 3.) connected to power system and see how it affects the shape of current and voltage
2. Connect passive filter to the same load and see how it affects power factor and THD
3. Connect active filter to the same load and see its effect on shape of input current

Books Recommended:

Text Books:

1. " Power System Quality Assessment", J. Arrillaga, N.R.Watson, S.Chen
2. "Power Quality Enhancement Using Custom Devices" Arindam Ghosh, Gerard Ledwich
3. "Power Electronics" Ned Mohan, Undeland, Robbins, John Wiley Publication
4. "Power System Analysis- Short Circuit Load Flow and Harmonics" J.C.Das.
5. " Understanding Power Quality Problems,Voltage Sag and Interruptions " Math H.J.Bollen

Reference Book:

1. "Power System Harmonics" Jos Arrillaga, Neville R Watson
2. "Electric Power Quality" , G.T.Heydt
3. "Electric Power Systems and Quality" , Roger C. Dugan,Mark F. McGranaghan, H.Wayne Beaty
4. "IEEE-519 Standard"

University of Mumbai			
Class: B.E.	**Branch: Electrical Engineering**	**Semester:** VIII	
Subject: Electric Traction (Abbreviated as E.T.)			
Periods per Week (Each 60 min)	Lecture	**04**	
	Practical	--	
	Tutorial	**02**	
		Hours	Marks
Evaluation System	Theory	**03**	**100**
	Practical and Oral	**---**	**---**
	Oral	**---**	**25**
	Term Work	**---**	**25**
	Total	---	**150**
Course Objective:- To impart the knowledge on electric traction as it is one of the most important application of Electrical Engineering.			

Module	Contents	Hours
1	**Electric Traction- Principle and History** • Systems of traction.,The Indian Scenario, vis-à-vis Electric traction. • Present day State of art. • Electric traction as a Viable Transport Strategy for the 21st century. • Advantages of Electric Traction over other systems of traction. • Choice of traction system - Diesel- Electric or Electric.	02
2	**Mechanics of train movement** • Speed - time curve for train movement. • Requirement of tractive effort and T-N curve of a typical train load. • Specific energy consumption. & Factors affecting SEC.	07
3	**Adhesion, types of suspension and mechanism of torque transmission** • Adhesion & Coefficient of adhesion, • Suspension and mechanism of torque transmission, • Concept of Weight Transfer & Effect of unsprung mass and wheel diameter	07
4	**Traction Motor** • Type of traction motor best suited for traction duties. • Available motor characteristics and their suitability for traction duties. • Optimization of design and construction features for improved power to weight ratio.	05
5	**Traction motor drives - Principles and gear** • Power Factor and Harmonics • Tractive Effort and Drive Ratings • Important Features of Traction Drives	10

	• Conventional DC and AC Traction drives • Semiconductor Converter Controlled Drives • DC Traction using Chopper Controlled Drives • Poly phase AC motors for Traction Motors • DC /AC Traction employing Polyphase motors • Diesel Electric Traction • Traction control of DC locomotives and EMU's • Traction control system of AC locomotives • Control gear • PWM control of induction motors • Power & Auxiliary circuit equipment (Other than traction motors)	
6	**Protection of electric locomotive equipment and circuits (Safety considerations and monitoring)** • Broad strategy for protection • Surge protection • Overload protection of main power circuits • Earth fault protection of power of auxiliary circuits • Protection from over-voltage and under-voltage • Differential protection of traction circuits • Protection against high and low air pressure in the compressed air circuit. • Temperature monitoring. • Protection of transformer by Bucholz relay • Protection against accidental contact with HT equipment • Protection against fires.	`
7	**Electric Traction Sub-Systems (Overhead Equipment)** • Overhead Equipment (OHE) • Sectionalizing • Bonding of Rails AND Masts • Materials Employed in OHE	05
8	**Railway Signalling** : • Block Section Concept,Track Circuits • Interlocking Principle • Train speed and signalling • Solid state Interlocking • Automatic Warning Systems • CAB signaling • Signaling level crossing	04
9	**Electric Traction Sub-Systems (Power Supply Installations)** • Lay out design of 137/25 KV Traction Substation/ Protection • Booster Transformers and Return Conductor. • Salient 2x25 kv AC System/ SCADA .	03

Termwork

Termwork shall consist of at least six experiments/assignments carrying weightage of 15 marks and a test covering the entire syllabus carrying weightage of 10 marks.

Text Books:

1. Upadhayay J. & Mahindra S.N., *Electric Traction,* Allied Publishers Ltd., 1st Ed.
2. Rao P.S., *Principle of 25 KV Overhead Equipments.*R.(Nasik) Printpack Pvt Ltd,, 1st Ed,
3. Fundamentals of Electric Drives , Gopal K Dubey, Narosa Publishing.
4. Modern Electric Traction, Partab, Dhanpat Rai & Sons

Websites

www.irieen.com (Indian Railways Institute of Electrical Engineering, Nasik Road)
www.wr.railnet.gov.in/bctweb/ELECTRICAL.htm
www.scrailway.gov.in

University of Mumbai			
Class: B.E.	**Branch: Electrical Engineering**		**Semester: VIII**
Subject: Flexible AC Transmission Systems (Abbreviated as FACTS)			
Periods per Week	Lecture	**04**	
	Practical	---	
(Each 60 min)	Tutorial	**02**	
		Hours	Marks
Evaluation System	Theory Examination	**3**	**100**
	Practical and Oral	**--**	**--**
	Oral	**--**	**25**
	Term Work	**--**	**25**
	Total	--	**150**
Course Objective:- To develop the ability among students for problem formulation and finding solution and also, it open up wide area in research.			

Module	Contents	Hours
1.	**FACTS Concepts and General System Considerations:** Transmission Interconnections- Flow of Power in AC system- What Limits the 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 Definitions- Benefits from FACTS Technology	4
2.	**Load Compensation:**Reactive Power (VAR) Compensation for isolated loads - Power factor correction-Voltage Regulation-V-Q characteristics for an inductive load-System load line-Effect of characteristics of VAR compensators in terms of short circuit levels-Load balancing in 3-phase loads with parallel compensation	8
3.	**Transmission Line:** Wave equation-Standing Waves-surge impedance and SIL-Voltage and current profile along unloaded line-Ferranti effect-Effect of loading on reactive power requirement-Compensated transmission line-Uniformly distributed fixed compensation-Effect of distributed compensation on line charging reactive power	12
4.	**Voltage Control:** Tap changing transformers-Booster transformers -Static voltage regulators-Thyristorised series voltage injection	4
5.	**Types of compensators:** Passive and active compensators-Shunt reactor/ capacitor compensators-Single-Multiple-Mid-point-Static compensators-Control schemes and characteristics of FC-TCR-TCR-TSC-TSC and other combinations	10
6.	**Dynamic compensation:** Introduction-Effect on stability of a power system	2
7.	**Unified Power Flow Controller (UPFC):** Basic relationships for power flow control-Synchronous Voltage sources-Implementation of synchronous voltage source-Shunt compensation by synchronous voltage source-Reactive power compensation scheme-Series compensation by synchronous voltage source-Reactive series compensation-Unified power flow concept	8

Term work:

Term Work will consist of Eight **Tutorials/Simulations**

Laboratory work (Tutorial/ simulation) :15 marks

Test (at least one) :10 marks

Books Recommended:

Text Books:

1. Miller T.J.E..,Reactive power control in Electric Systems , Wiley Europe, 1st Ed.1983.
2. Hingorani N.G.. & Gyugi L., Understanding FACTS : Concepts and Technology of Flexible AC Transmission Systems, Wiley-IEEE Press, 1st 1999

University of Mumbai			
Class: B.E.	**Branch: Electrical Engineering**	**Semester:** VIII	
Subject: Digital Signal Processors Applications in Power Systems (Abbreviated as DSPAPS)			
Periods per Week (Each 60 min)	Lecture	**04**	
	Practical	**02**	
	Tutorial	**---**	
		Hours	Marks
Evaluation System	Theory Examination	**03**	**100**
	Practical and Oral	**---**	**---**
	Oral	**---**	**25**
	Term Work	**---**	**25**
	Total	---	**150**
Course Objective:- To get awareness about DSP hardware implementation for control and signal processing applications in the field of power systems			

Module	Contents	Hours
1	**Introduction:**Review of microprocessor, microcontroller and digital signal processors architecture, Fixed and floating-point processors and microcontrollers: TMS320 series family	04
2	**Number Representations in DSP processors:** Number formats and operations: Fixed point 16 bit Numbers representations of signed integers and fraction, Q-15 numbers and its operations. Floating Point Numbers. Assemblers and assembly language programming, Binary file formats, COFF file structure for TMS320 processor.	08
3	**DSP Architecture and programming:** Architectural details of TMS320VC33 and TMS320F2407 Memory map, interrupts and addressing mode, programming with assembly language and C compiler	08
4	**Power Electronics applications in Power systems:** Review of power electronics applications: Control applications, Active filtering, Static VAR Compensator, Electric Drives, Hardware in Loop simulations. Implementing power electronics control on digital systems. Issues of harmonics and unbalanced currents in power systems, Harmonic Extraction of current components, Implementation of Active filters in DSP under balanced and unbalanced conditions: reference frame transformation, harmonic oscillator, 3ϕ phase lock loop, oscillator synchronization	20
5	**Integration Methods for Real Time DSP implementation:** Review of numerical integration: Euler's implicit and explicit method, Heun Method, Trapezoidal Method. Implementation of low pass filter.	04

6	**Control Applications of DSP processor:** Generation of PWM signals, sine PWM, ADC interface; basics of implementation of converter control for renewable energy sources: Solar, wind and Fuel cell systems	04

Term work:

1. Implementation of following in DSP architecture: (Any Six)
    a. Number operations on fixed point / floating point processor
    b. Implementation of calculation of any mathematical series like exponential, logarithm etc.
    c. Implementation of Harmonic oscillator
    d. Implementation of Low pass filter
    e. Implementation of reference frame transformation
    f. Generation of PWM signals
    g. Generation of Sine PWM Signals
    h. Converter control application with DSP

2. Minimum two assignments/ tutorials based on theoretical part of the syllabus

The distribution of the Term Work shall be as follows,
Practical Work : 15 Marks
Tests : 10 Marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Books Recommended:

Text Books:

1. "Power Electronics, Converters, Applications & Design", N.Mohan, T.M.Undeland, W.P Robbins, Wiley India Pvt.Ltd.

2. "Modern Power Electronics and AC Drives", B. K Bose, Perason Education

3. "Understanding FACTS", N. G. Hingorani, & Laszlo Gyugyi, IEEE press

4. "Digital signal Processing: A practical Approach", E. C. Ifeachor & B. W. Jervice, Pearson Education

Reference Book:

1. "Numerical Methods for scientific and Engineering Computation", M. K. Jain, S.R.K. Iyengar & R. K. Jain, New Age International Publications
2. "Digital Signal Processing: Principle, Algorithm, & Applications", J.G. Proakis & D. G. Manolokis, Pearson Education
3. TMS320VC33 processor datasheet
4. TMS320F2407 processor datasheet
5. TMS320VC33 Starter Kit manual
6. TMS320F2407 Starter Kit manual