First Year Engineering

First Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
BS	Mathematics-I	3-1	4	100	50	-	-	-
BS	Chemistry/ Physics	3-0	3	100	50	2	1	50
ES	Basics of Electronics / Basic Electrical Engineering	3-0	3	100	50	2	1	50
ES	Mechanics/ Thermodynamics	3-0	3	100	50			
ES	Programming in 'c"	3-0	3	100	50	2	2	50
HS	English Communication Skill	3-0	2	100	50	2	1	50
ES	Engineering Workshop/ Engineering Drawing					4	2	100
Total		16	18	600	300	18	7	300
Total Marks: 1200								
Total Credits: 25								

Second Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/ week L/T**	**Credit Theory**	**University marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
BS	Mathematics-II	3-1	4	100	50	-	-	-
BS	Chemistry/ Physics	3-0	3	100	50	2	1	50
ES	Basics of Electronics / Basic Electrical Engineering	3-0	3	100	50	2	1	50
ES	Mechanics/ Thermodynamics	3-1	3	100	50			
ES	Data Structure Using 'C"	3-0	3	100	50	2	2	50
HS	Business communication	3-0	2	100	50	2	1	50
ES	Engineering Workshop/ Engineering Drawing					4	2	100
MC	NSS/NCC	-	-	-	-			
Total		17	18	600	300	14	7	300
Total Marks: 1200								
Total Credits: 25								

Second Year Engineering

Third Semester

		Theory				Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
PC	Network Theory	3-0	3	100	50	2	1	50
PC	Analog Electronics Circuit	3-0	3	100	50	2	1	50
PC	Electrical Machines I	3-0	3	100	50	2	1	50
PC	Electrical & Electronics Measurement	3-0	3	100	50	2	1	50
PC	Electromagnetic Theory	3-1	4	100	50			
HS	Engineering Economics/ Organizational Behavior	2-1	3	100	50			
Total		19	19	600	300	8	4	200
Total Marks: 1100								
Total Credits: 23								
Honors Paper	Electrical Engineering Materials	4	4	100	50			
Minor Specialization	Electrical & Electronics Measurement/ Electromagnetic Theory							

Fourth Semester

		Theory				Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
HS	Purely Applied Mathematics for Specific Branch of Engineering	3-0	3	100	50			
PC	Electrical Machines II	3-0	3	100	50	2	1	50
PC	Control System Engg I	3-0	3	100	50	2	1	50
PC	Digital Electronics Circuits	3-0	3	100	50	2	1	50
PC	Electrical Power Transmission & Distribution	3-0	3	100	50	2	1	50
HS	Engineering Economics/ Organizational Behavior	2-1	3	100	50			
	*Skill Project and Hands on					6	3	100
Total		18	18	600	300	14	7	300
Total Marks: 1200								
Total Credits: 25								
Honors Paper	Sensors & Transducers (E&I)	4	4	100	50			
Minor Specialization	Electrical Power Transmission & Distribution / Control System Engineering-I							

*College should conduct at least one NSDC program under this category.

B.Tech (Electrical Engineering) Syllabus for Admission Batch 2015-16

Third Year Engineering

Fifth Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/week L/T**	**Credit Practical**	**Marks**
PC	Power Electronics	3-0	3	100	50	2	1	50
PC	Microprocessor & Microcontroller	3-0	3	100	50	2	1	50
PC	Digital signal Processing	3-0	3	100	50	2	1	50
PE	Renewable Energy systems/Optoelectronics Device & Instrumentation	3-1	4	100	50			
OE	Optimization in Engg.	3-1	4	100	50			
PC	Advance Lab-I(Advanced Electrical Computational Lab-I)					8	4	200
Total		17	17	500	250	14	7	350
Total Marks: 1100								
Total Credits: 24								
Honors Paper	Electrical Machine Design/ Industrial Process Control and Dynamics /Distributed Generation System Design	4	4	100	50			
Minor Specialization	Electrical Machines-I/ Microprocessor and Microcontrollers/ Renewable Energy Systems							

TENTATIVE
Likely to be Modified

Sixth Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/week L/T**	**Credit Practical**	**Marks**
PC	Electrical Drives	3-0	3	100	50	2	1	50
PC	Power System & Operation & Control	3-0	3	100	50	2	1	50
PE	VLSI Design/Generalized Theory of Electrical Machines/HVDC Transmission	3-1	4	100	50			
PE	Control System Engg-II/Advanced Digital Signal Processing	3-1	4	100	50			
MC & GS	Environmental Science & Engineering	3-0	3	100	50			
OE	Industrial Lecture #					3	1	50
HS	Presentation Skill & Skill for Interview # #	2-0	1		50	4	2	100
MC	Yoga					2	1	50
Total		19	18	500	300	13	6	300
Total Marks: 1100								
Total Credits: 24								
Honors Paper	Special Electromechanical Devices / Flexible AC Transmission Systems / Utilization of Electrical Energy	4	4	100	50			
Minor Specialization	Electrical Machines-II/ Control System Engineering-II							

To be conducted by the Training & Placement department by inviting experts from the industry. No academician to be called. Record may be asked by the University for verification. Evaluation to be done by the TPO.

To be conducted by the Training & Placement department of the College.

TENTATIVE Like to be Modified

Final Year Engineering

Seventh Semester								
	Theory					Practical		
Code	Course Name	Hours/week L/T	Credit Theory	University Marks	Internal Evaluation	Hours/week L/T	Credit Practical	Marks
GS	Nano Science & Bio Technology	3-1	4	100	50			
PE	Switch Gear & Protective Devices/Biomedical Instrumentation/Mobile Communication	3-1	4	100	50			
PE	Communication Engg./Digital Image Processing/adaptive Control	3-1	4	100	50			
OE	Soft Computing */ Other subjects	3-1	4	100	50			
PC	Advance Lab-II/ Project					8	4	200
	Projects on Internet of Things					8	4	200
Total		16	16	400	200	16	8	400
Total Marks: 1000								
Total Credits: 24								
Honors Paper	High Voltage Engineering./ Electrical Power Quality/ Smart Grid/ PLC & SCADA	4	4	100	50			
Minor Specialization	Power Station Engg. & Economy							

*Student can choose from any department but subject must be running in that semester.

Eighth Semester						
	Training cum Project				Evaluation Scheme	
Code	Course Name	Hours/week L/T	Credit Theory	Total Marks		Marks
	Industrial Training cum Project/ Entrepreneurship Training cum Project / Stratup Training cum Project	30	20	1000	Evaluation by the Industry / Training Organisation	500
					Evaluation by the Institute (Report & Institute Viva)	500
Total		30	20	1000		1000
Total Marks:1000						
Total Credits:20						

Note- Minimum Pass Mark from Industry Evaluation is 300 (i.e. 60%)

Distribution of Credit Semester wise:

Semester	Credit
First	25
Second	25
Third	23
Fourth	25
Fifth	24
Sixth	24
Seventh	24
Eighth	20
Total	190

Internal Evaluation Scheme

Attendance & Class Interaction	05
Assignment	05
Surprise Test	05
Quiz	05
Class Test I & II	30
Total	50
Class Test Time(Hrs.): 1	

Pass Mark in Internal is 50% of total marks i.e. 25

External Evaluation Scheme

University Semester Examination of 3 Hours duration.

Pass mark will be 35% which means students have to score 35 out of 100.

Practical/Sessional Evaluation Scheme

Pass mark will be 50% which means students have to score 25 out of 50.

Evaluation Scheme

Attendance & Daily Performance	-10
Lab Record	- 10
Lab Quiz	- 05
Final Experiments & Viva	– 25
Total	=50

All Lab examinations are to be completed one week before the end semester examination and marks are to be displayed on the college notice board.

DETAIL SYLLABUS
FROM
III - VIII SEMESTER OF B.TECH. DEGREE PROGRAMME

for

ADMISSION BATCH 2015-16

BRANCH-ELECTRICAL ENGINEERING

TENTATIVE
Likely to be Modified

Second Year Engineering								
Third Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
PC	Network Theory	3-0	3	100	50	2	1	50
PC	Analog Electronics Circuit	3-0	3	100	50	2	1	50
PC	Electrical Machines I	3-0	3	100	50	2	1	50
PC	Electrical & Electronics Measurement	3-0	3	100	50	2	1	50
PC	Electromagnetic Theory	3-1	4	100	50			
HS	Engineering Economics/ Organizational Behavior	2-1	3	100	50			
Total		19	19	600	300	8	4	200
Total Marks: 1100								
Total Credits: 23								
Honors Paper	Electrical Engineering Materials	4	4	100	50			
Minor Specialization	Electrical & Electronics Measurement/ Electromagnetic Theory							

TENTATIVE
Likely to be Modified

NETWORK THEORY

Module- I **[11 Hours]**

University Portion (80%)

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power transfer theorem, Tellegen's theorem, Millman's theorem, Compensation theorem.

Coupled Circuits: Coupled Circuits, Dot Convention for representing coupled circuits, Coefficient of coupling.

Resonance: Band Width and Q-factor for series and parallel resonant circuits.

College/Institute Portion (20%):

Electrical equivalent of magnetically Coupled Circuit, Tuned Couple Circuit: Single tuned and double tuned or related advanced topics as decided by the concerned faculty teaching the subject.

Module- II **[9 Hours]**

University Portion (80%)

Laplace Transform & its Application: Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Application of Laplace transform: Circuit Analysis (Steady State and Transient).

Two Port Network Functions& Responses: z, y, ABCD and h-parameters, Reciprocity and Symmetry, Interrelation of two-port parameters, Interconnection of two-port networks.

Network Functions: Significance of Poles and Zeros, Restriction on location of Poles and Zeros, Time domain behavior from Pole-Zero plots.

College/Institute Portion (20%):

Necessary conditions for transfer function, natural response of a network, Routh Hurwitz criterion of stability of network function or related advanced topics as decided by the concerned faculty teaching the subject.

Module- III **[5 Hours]**

University Portion (80%)

Fourier Series& its Application: Fourier series, Fourier analysis and evaluation of coefficients, Steady state response of network to periodic signals, Fourier transform and convergence, Fourier transform of some functions.

Passive Filter: Brief idea about network filters (Low pass, High pass, Band pass and Band elimination) and their frequency response

College/Institute Portion (20%):

Active filter-Butterworth, Chebyshev filter or related advanced topics as decided by the concerned faculty teaching the subject.

Module- IV **[5 Hours]**

University Portion (80%)

Network Synthesis: Realizability concept, Hurwitz property, positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions in Foster and Cauer forms.

College/Institute Portion (20%):

Network Topology: Graph of a network, Concept of tree, Incidence matrix, Tie-set matrix, Cut-set matrix, Formulation and solution of network equilibrium equations on loop and node basis, Dual of a network or related advanced topics as decided by the concerned faculty teaching the subject.

Text Book:

1. *Fundamentals of Electric Circuits – Alexander & Sadiku – Tata McGraw Hil,5th Editionl.*
2. *Circuits & Networks: Analysis, Design and Synthesis- Sukhija & Nagsarkar- Oxford*

Reference Book(s):

1. *Network Analysis – M E Van Valkenburg – Pearson Education, 3rd Edition.*
2. *Network Synthesis – M E Van Valkenburg – Pearson Education.*
3. *Network Analysis and Synthesis – Franklin F. Kuo – Wiley Student Edition.*
4. *Linear Circuits Analysis and Synthesis – A Ramakalyan – Oxford University Press.*
5. *Problems & Solutions in Electric Circuit Analysis – Sivananda & Deepa – Jaico Book.*
6. *Theory and problem of electrical circuits, Schaum's Outline Series, TMH – Joseph A. Edminister, MahmoodMaqvi.*
7. *Electric Circuits – David A.Bell – Oxford, 7th Edition, 2015.*

NETWORK THEORY LAB

Select any 8 experiments from the list of 10 experiments

1. *Verification of Network Theorems using AC circuits. (Superposition, Thevenin, Norton, Maximum Power Transfer).*
2. *Study of DC and AC Transients for R-L, R-C & R-L-C circuits using storage oscilloscope.*
3. *Determination of circuit parameters: Open Circuit and Short Circuit parameters.*
4. *Determination of circuit parameters: Hybrid and Transmission parameters.*
5. *Frequency response of Low pass and High Pass Filters.*
6. *Frequency response of Band pass and Band Elimination Filters.*
7. *Determination of self inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit.*
8. *Study of resonance in R-L-C series circuit using oscilloscope.*
9. *Study of resonance in R-L-C parallel circuit using oscilloscope.*
10. *Spectral analysis of a non-sinusoidal waveform.*

3rd Semester

ANALOG ELECTRONICS CIRCUIT (3-0-2)

MODULE – I **(12 Hours)**

MOS Field-Effect Transistor: Principle and Operation of FETs and MOSFETs; P-Channel and N-Channel MOSFET; Complimentary MOS; V-I Characteristics of E- MOSFET and D-MOSFET; MOSFET as an Amplifier and as a Switch. (4 Hours)

Biasing of BJTs: Load lines (AC and DC); Operating Points; Fixed Bias and Self Bias, DC Bias with Voltage Feedback; Bias Stabilization; Examples. (4 Hours)

Biasing of FETs and MOSFETs: Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design (4 Hours)

MODULE – II **(12 Hours)**

Small Signal Analysis of BJTs: Small-Signal Equivalent-Circuit Models; Small Signal Analysis of CE, CC, CB amplifiers. Effects of R_S and R_L on CE amplifier operation, Emitter Follower; Cascade amplifier, Darlington Connection and Current Mirror Circuits. (6 Hours)

Small Signal Analysis of FETs: Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifiers. Effects of R_{SIG} and R_L on CS Amplifier; Source Follower and Cascaded System. (6 Hours)

MODULE – III **(5 hours)**

High Frequency Response of FETs and BJTs: High Frequency equivalent models and frequency Response of BJTs and FETs; Frequency Response of CS Amplifier, Frequency Response of CE Amplifier. (5 Hours)

MODULE – IV (9 hours)

Feedback amplifier and Oscillators: Concepts of negative and positive feedback; Four Basic Feedback Topologies, Practical Feedback Circuits, Principle of Sinusoidal Oscillator, Wein-Bridge, Phase Shift and Crystal Oscillator Circuits. (4 Hours)

Operational Amplifier: Ideal Op-Amp, Differential Amplifier, Op-Amp Parameters, Non-inverting Configurations, Open-loop and Closed-loop Gains, Differentiator and Integrator, Instrumentation amplifier. (5Hours)

Additional Module (Terminal Examination-Internal) **(6 hours)**

Basic analysis of difference amplifier, Simulation of analog circuits i.e., different single and cascaded amplifier circuits, difference amplifier circuits and validating the theoretical parameters using PSpice and MULTISIM. Analysis op-amp IC circuits using LF411 and μA 741, Signal Generators using OPAMP: Square, triangle and ramp generator circuits using opamps - Effect of slew rate on waveform generation-introduction to analog simulation OPAMP as nonlinear element: comparator, Voltage controlled oscillator (VCO). Concept of Schmitt triggers circuit and sample/hold circuit using operational amplifier

Text Books

1. *Electronic Devices and Circuits theory, R.L. Boylestad and L. Nashelsky, Pearson Education, New Delhi , 9th/10th Edition,2013. (Selected portions of Chapter 4, 5, 6, 7, 8, 9, 10, 11, 12, and 14)*
2. *Milliman's Electronics Devices and Circuits, J. Milliman, C. Halkias, S. Jit., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition,2008.*

Reference Books

1. *Microelectronics Circuits, Adel Sedra and Kenneth C Smith, Oxford University Press, New Delhi, 5th Edition, International Student Edition,2009. (Selected portion of Chapter 2,4, 5, 6, 8, 13, and 14)*
2. *Electronic Devices and Circuits, Jimmie J. Cathey adapted by Ajay Kumar Singh, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, (For Problem Solving)*
3. *Electronics Circuits Analysis and Design, Donald A. Neamen, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition,2002.*
4. *Integrated Electronics: Analog and Digital Circuits and Systems, J. Milliman, C. Halkias, Tata McGraw Hill Publishing Company Ltd., New Delhi,2nd Edition.2004.*
5. *Microelectronic Circuits: Analysis and Design, M.H. Rashid, PWS Publishing Company, a division of Thomson Learning Inc. India Edition.*
6. *Electronic device and circuits, David A. Bell, Oxford University Press, 5thedition,2008.*
7. *Electronics devices and circuits, Anil.K.Maini, Wiley India Pvt.Ltd,2009*

ANALOG ELECTRONICS CIRCUIT LAB

List of Experiments

(At least 10 out of 12 experiments should be done)

1. Design and simulate BJT bias circuit and compare the results.
2. *Design and simulate JEET/MOSFET bias circuit and compare the results.*
3. *Design and simulate BJT common-emitter circuit and compare D.C and A.C performance:*
4. *Design and simulate JFET/MOSFET common-emitter circuit and compare D.C and A.C performance:*
5. *Determining the frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response and compare with simulated results.*
6. *Differential amplifiers circuits: D.C bias and A.C operation without and with current source.*
7. *Study of Darlington connection and current mirror circuits.*
8. *OP-Amp Frequency Response and Compensation.*
9. *Application of Op-Amp as differentiator, integrator, square wave generator.*
10. *Obtain the band width of FET/ BJT using Square wave testing of an amplifier.*
11. *R.C phase shift oscillator/Wien-Bridge Oscillator using OP-Amp/Crystal Oscillator.*
12. *Class A and Class B Power Amplifier.*

3rd Semester

ELECTRICAL MACHINES- I

Module- I

University Portion (80%):

Single phase transformers: Phasor Diagrams at No -Load and Load Conditions of an Ideal transformer and practical transformer, Equivalent Circuit, Determination of Parameters from Tests (Polarity Test, Open Circuit Test and Short Circuit Test, Back to Back test), Per Unit Calculation and its importance, Voltage Regulation, Losses, Efficiency and all day efficiency. Parallel operation of transformers and load sharing.

Auto Transformer: Basic constructional features; VA conducted magnetically and electrically. Comparative study with two winding transformer. Conversion of a two winding transformer into a single winding transformer.

College/Institute Portion (20%):

Qualitative explanation for origin of harmonic current and voltage and its suppression. Inrush of switching currents, magnetizing current wave form or related advanced topics as decided by the concerned faculty teaching the subject.

Module- II

University Portion (80%):

Three phase transformers: Constructional features, As a single unit and as a bank of three single phase transformers. Three-Phase Transformer connections, The per unit system for Three Phase Transformer, Transformer Ratings and Related problems, Two Single-Phase Transformers connected in Open Delta (V-Connection) and their rating. T-Connection (Scott Connection) of Two Single-Phase Transformers. Transformer Three phase Connections: Various Phase Displacements (0o, 180o, +30o and -30o), Connection Diagrams and Phasor Diagrams of various Vector Groups (Yy0, Dd0, Dz0, Yy6, Dd6, Dz6, Yd1, Dy1, Yz1, Yd11, Dy11, and Yz11)

College/Institute Portion (20%):

3-winding transformer or related advanced topics as decided by the concerned faculty teaching the subject.

Module- III

University Portion (80%):

Three phase induction machines: Constructional features and types; 3-phase distributed winding production of rotating magnetic field, Principle of Operation, The Effect of Coil Pitch and distribution factor on A.C. Machines, winding factor, Concept of Slip, Slip Speed; Phasor diagram and Development of equivalent circuit and derivation of torque equation; Typical torque-slip characteristic and influence of different parameters on it, No-Load and Blocked Rotor tests, Determination of Parameters, power flow diagram, Losses and Efficiency, Methods of starting and speed control. Cogging, Crawling.

College/Institute Portion (20%):

Brief Idea on Induction Generators, Different types of braking or related advanced topics as decided by the concerned faculty teaching the subject.

Module- IV

University Portion (80%):

Single phase induction machines: Double field revolving theory, Methods of starting using auxiliary winding, development of equivalent circuit. No-Load and Blocked Rotor tests, Determination of Parameters Speed Control of Single Phase Induction Motors.

College/Institute Portion (20%):

Selection of capacitor value during starting and running or related advanced topics as decided by the concerned faculty teaching the subject.

Text Book:

1. *Theory and Performance of AC Machines – M G Say*
2. *Electric Machinery – Fitzgerald, Charles Kingsley Jr., S. D. Umans – Tata Mc Graw Hill.*

Reference Book(s):

1. *Electrical Machinery – P S Bimbhra – Khanna Publishers*
2. *The Performance and Design of DC Machines – A E Clayton.*
3. *Electric Machines – D P Kothari and I J Nagrath – Tata McGraw Hill, Fourth Edition.*
4. *Electric Machines – Charles Hubert – Pearson Education.*
5. *Electrical Machines – P K Mukherjee and S Chakravorti – Dhanpat Rai Publications.*
6. *Electric Machinery and Transformers – Guru & Hiziroglu – Oxford University Press.*

ELECTRICAL MACHINES LAB-I

Select any 8 experiments from the list of 10 experiments

1. *Determination of Efficiency and Voltage Regulation by Open Circuit and Short Circuit test on single phase transformer.*
2. *Parallel operation of two single phase transformers.*
3. *Back-to Back test on two single phase transformers.*
4. *Study of open delta and Scott connection of two single phase transformers.*
5. *Speed control of a three phase induction motor using variable frequency drives*
6. *Determination of parameters of three phase induction motor from No load Test and Blocked Rotor Test.*
7. *Determination of Efficiency, Plotting of Torque-Slip Characteristics of Three Phase Induction motor by Brake Test.*
8. *Performance of grid connected induction generator.*
9. *Determination of parameter of a single phase induction motor and study of*
   - *(a) Capacitor start induction motor*
   - *(b) Capacitor start and capacitor run induction motor*
   - *(c) Universal motor*
   - *(d) Shaded pole motor*

ELECTRICAL AND ELECTRONICS MEASUREMENT

Module- I **[10 Hours]**

University Portion (80%): (8 Hours)

Measurement and Error: (2Hrs) Definition, Accuracy and Precision, Significant Figures, Types of Errors. Text book-2-Ch-[1.1 to 1.4]

Standards of Measurement: (1 Hrs) Classification of Standards, Electrical Standards, IEEE Standards. Text Book-2- Ch-[3.1,3.4,3.6]

Types of measuring instrument: (5 Hrs) Ammeter and Voltmeter: Derivation for Deflecting Torque of; PMMC, MI (attraction and repulsion types), Electro Dynamometer and Induction type Ammeters and Voltmeters. Energy meters and wattmeter.: Construction, Theory and Principle of operation of Electro-Dynamometer and Induction type wattmeter, compensation, creep, error, testing, Single Phase and Polyphase Induction type Watt-hour meters. Frequency Meters: Vibrating reed type, electrical resonance type, Power Factor Meters. Text Book-1- Ch- [XVIII,XIX,XX,XXI,XXII]

College/Institute Portion (20%): (2 Hours)

Measuring instruments: Absolute and secondary instrument, indicating and recording instrument. Text Book-1- Ch-XVII. Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-II **[10 Hours]**

University Portion(80%): (8 Hours)

Measurement of Resistance, Inductance and Capacitance: (8 Hrs)

Resistance: Measurement of Low Resistance by Kelvin's Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Resistance of Insulating Materials, Portable Resistance Testing set (Megohmmeter), Measurement of Insulation Resistance when Power is ON, Measurement of Resistance of Earth Connections.

Inductance: Measurement of Self Inductance by Ammeter and Voltmeter, and AC Bridges (Maxwell's, Hay's, & Anderson Bridge), Measurement of Mutual Inductance by Felici's Method, and as Self Inductance.

Capacitance: Measurement of Capacitance by Ammeter and Voltmeter, and AC Bridges (Owen's, Schering & Wien's Bridge), Screening of Bridge Components and Wagnor Earthing Device. Text Book-1- Ch-[VI, VII]

College/Institute Portion (20%): (2 Hours)

Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer (LVDT), Capacitive Transducers, Peizo-Electric transducers, Optical Transducer, Torque meters, inductive torque transducers, electric tachometers, photo-electric tachometers, Hall Effect Transducer. (Text Book-2- Ch-11.1 to 11.6). Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- III **[10 Hours]**

University Portion (80%): (8 Hours)

Galvanometer: (5 Hrs) Construction, Theory and Principle of operation of D'Arsonval, Vibration (Moving Magnet & Moving Coil types), and Ballistic Galvanometer, Influence of Resistance on Damping, Logarithmic decrement, Calibration of Galvanometers, Galvanometer Constants, Measurement of Flux and Magnetic Field by using Galvanometers.

Potentiometer: (3 Hrs) Construction, Theory and Principle of operation of DC Potentiometers (Crompton, Vernier, Constant Resistance, & Deflection Potentiometer), and AC Potentiometers (Drysdale-Tinsley & Gall-Tinsley Potentiometer). Text Book-1- Ch-[VIII,IX]

College/Institute Portion (20%): (2 Hours)

pH- Meter, volt ratio boxes and other auxiliary apparatus. Text Book-1- Ch- VIII. Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- IV **[10 Hours]**

University Portion(80%): (8 Hours)

Current Transformer and Potential Transformer :(3 Hrs) Construction, Theory, Characteristics and Testing of CTs and PTs.

Electronic Instruments for Measuring Basic Parameters:(2 Hrs) Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters (Block Diagrams only), Q-meter

Oscilloscope:(3 Hrs) Block Diagrams, Delay Line, Multiple Trace, Oscilloscope Probes, Oscilloscope Techniques, Introduction to Analog and Digital Storage Oscilloscopes, Measurement of Frequency, Phase Angle, and Time Delay using Oscilloscope.

Text Book-2- Ch- [6.2 to 6.9, 7.2, 7.6, 7.7]

College/Institute Portion (20%): (2 Hours)

[Wave analyser and Counter. (Text Book-2- Ch- 9.2,9.3,9.4,10.1)]. Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Book(s):

1. *Electrical Measurements and Measuring Instruments – Golding & Widdis – 5th Edition, Reem Publication.*
2. *Modern Electronic Instrumentation and Measurement Techniques – Helfrick & Cooper – Pearson Education.*

Reference Book(s):

1. *A Course in Electrical and Electronic Measurements and Instrumentation – A K Sawhney – Dhanpat Rai & Co.*
2. *Electronic Instrumentation – H C Kalsi – 2nd Edition, Tata McGraw Hill.*
3. *Electronic Measurement and Instrumentation – Oliver & Cage – Tata McGraw Hill.*
4.

ELECTRICAL AND ELECTRONICS MEASUREMENT LAB

Select any 8 experiments from the list of 10 experiments

1. *Measurement of Low Resistance by Kelvin's Double Bridge Method.*
2. *Measurement of Self Inductance and Capacitance using Bridges.*
3. *Study of Galvanometer and Determination of Sensitivity and Galvanometer Constants.*
4. *Calibration of Voltmeters and Ammeters using Potentiometers.*
5. *Testing of Energy meters (Single phase type).*
6. *Measurement of Iron Loss from B-H Curve by using CRO.*
7. *Measurement of R, L, and C using Q-meter.*
8. *Measurement of Power in a single phase circuit by using CTs and PTs.*
9. *Measurement of Power and Power Factor in a three phase AC circuit by two-wattmeter method.*
10. *Study of Spectrum Analyzers.*

3rd Semester

ELECTROMAGNETIC THEORY

Module – I **[8 Hours]**

University Portion (80%):

Co-ordinate systems & Transformation: Cartesian co-ordinates, circular cylindrical co-ordinates, spherical co-ordinates.

Vector Calculus: Differential length, Area & volume, Line surface and volume Integrals, Del operator, Gradient of a scalar, Divergence of a vector & divergence theorem, curl of a vector & Stoke's theorem, laplacian of a scalar (Text Book 1: Chapter- 1, Chapter-2)

College/Institute Portion (20%):

Field: Scalar Field and Vector Field. Or related advanced topics as decided by the concerned faculty teaching the subject.

Module – II **[11 Hours]**

University Portion (80%):

Electrostatic Fields: Coulomb's Law, Electric Field Intensity, Electric Fields due to point, line, surface and volume charge, Electric Flux Density, Gauss's Law – Maxwell's Equation, Applications of Gauss's Law, Electric Potential, Relationship between E and V –Maxwell's Equation An Electric Dipole & Flux Lines, Energy Density in Electrostatic Fields., Electrostatic Boundary – Value Problems: Possion's & Laplace's Equations, Uniqueness theorem, General procedures for solving possion's or Laplace's Equation. (Textbook-1: Chapter- 3, 4, 5.1 to 5.5)

College/Institute Portion (20%):

Nature of current and current density, the equation of continuity. Or related advanced topics as decided by the concerned faculty teaching the subject.

Module – III **[8 Hours]**

University Portion (80%):

Magnatostatic Fields: Magnetic Field Intensity, Biot-Savart's Law, Ampere's circuit law-Maxwell Equation, applications of Ampere's law, Magnetic Flux Density-Maxwell's equations. Maxwell's equation for static fields, Magnetic Scalar and Vector potentials. (Textbook-1: Chapter- 6.1 to 6.8)

College/Institute Portion (20%):

Energy in Magnetic Field Or related advanced topics as decided by the concerned faculty teaching the subject.

Module – IV **[7 Hours]**

University Portion (80%):

Electromagnetic Fields and Wave Propagation: Faraday's Law, Transformer & Motional Electromagnetic Forces, Displacement Current, Maxwell's Equation in Final forms, Time Varying Potentials, Time-Harmonic Field. Electromagnetic Wave Propagation: Wave Propagation in lossy Dielectrics, Plane Waves in loss less Dielectrics, Power & pointing vector. (Textbook-1: Chapter-8.1 to 8.7, Ch.9.1 to 9.3 & 9.6)

College/Institute Portion (20%):

General Wave Equation, Plane wave in dielectric medium, free space, a conducting medium, a good conductor and good dielectric, Polarization of wave. Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Book:

1. *Matthew N. O. Sadiku, Principles of Electromagnetics, 4th Ed., Oxford Intl. Student Edition.*

Reference Book:

2. *C. R. Paul, K. W. Whites, S. A. Nasor, Introduction to Electromagnetic Fields, 3rd, TMH.*
3. *W.H. Hyat, Electromagnetic Field Theory, 7th Ed, TMH.*

TENTATIVE
Likely to be Modified

ELECTRICAL ENGINEERING MATERIALS

Module – I **[14 Hours]**

Atomic bonding, crystallinity, Miller Indices, X-ray crystallorgraphy, structural imperfections, crystal growth. Free electron theory of metals, factors affecting electric conductivity of metals, thermal conductivity of metals, heat developed in current Carrying conductors, thermo electrice ffect, super conductivity.

Module – II **[10 Hours]**

Polarization mechanism and dielectric constant, behavior of polarization under impulse and frequency switching, dielectric loss, spontaneous polarization, piezoelectric effect. Origin of permanent magnetic dipoles in materials, classifications, diamagnetism, paramagnetism, ferromagnetism, Magnetic Anisotropy magnetostriction.

Module – III **[14 Hours]**

Energy band theory, classification of materials using energy band theory, Hall effect, drift and diffusion currents, continuity equation, P-N diode, volt-amp equation and its temperature dependence. Properties and applications of electrical conducting, semiconducting, insulating and magnetic materials.

Module – IV **[10 Hours]**

Special purpose materials, Nickel iron alloys, high frequency materials, permanent magnet materials, Feebly magnetic materials, Ageing of a permanent magnet, Effect of impurities, Losses in Magnetic materials.

Text Books:-

1. *J. Dekker, 'Electrical Engineering Materials', Prentice hall of India, India*
2. *S. Indulkar & S. Thiruvengadam, 'An introduction to Electrical Engineering Materials', S. Chand & Co., India*
3. *R. K. Rajput, 'Electrical Engineering Materials', Laxmi Publications, India*

Reference Books:-

1. *Ian P. Hones, 'Material Science for Electrical & Electronics Engineers', Oxford University Press*
2. *K. M. Gupta – Electrical Engineering Materials, Umesh Publication, 2nd edition 2003*

B.Tech (Electrical Engineering) Syllabus for Admission Batch 2015-16

Fourth Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
HS	Purely Applied Mathematics for Specific Branch of Engineering	3-0	3	100	50			
PC	Electrical Machines II	3-0	3	100	50	2	1	50
PC	Control System Engg I	3-0	3	100	50	2	1	50
PC	Digital Electronics Circuits	3-0	3	100	50	2	1	50
PC	Electrical Power Transmission & Distribution	3-0	3	100	50	2	1	50
HS	Engineering Economics/ Organizational Behavior	2-1	3	100	50			
	*Skill Project and Hands on					6	3	100
Total		18	18	600	300	14	7	300
Total Marks: 1200								
Total Credits: 25								
Honors Paper	Sensors & Transducers (E&I)	4	4	100	50			
Minor Specialization	Electrical Power Transmission & Distribution / Control System Engineering-I							

TENTATIVE
Likely to be Modified

ELECTRICAL MACHINES-II

Module-I
University Portion (80%):
General principles of DC machines: Armature Windings (Simplex Lap and Simplex Wave), Expression for EMF Induced and Torque developed in the Armature counter Torque and Counter or Back EMF, Methods of Excitation, Armature Reaction, Commutation.
DC Machine Characteristics: Conditions for Self Excitation, Critical Resistance and Critical Speed. Internal and External Characteristics for self and Separately Excited DC Generator. Characteristic for Speed~ Armature Current, Torque~ Armature Current and Speed~ Torque of a DC Shunt, Series and Compound Motor and Comparison.
College/Institute Portion (20%):
Constructional features, Brush Shift and its Effects, Interpoles, Compensating Windings or related advanced topics as decided by the concerned faculty teaching the subject.

Module-II
University Portion (80%):
DC Motor Starting and Performance: Necessity of a Starter, Starting of DC Shunt, Series and Compound Motors, Speed Control of DC Shunt and Series motor Losses, efficiency and power flow diagram.
Three Phase Synchronous Generators: Synchronous Generator Construction (both Cylindrical Rotor and Salient Pole type), the Speed of Rotation of a Synchronous Generator, Induced voltage in A.C Machines, The Internal Generated Voltage of a Synchronous Generator, The Equivalent Circuit of a Synchronous Generator (Armature Reaction Reactance, Synchronous Reactance and Impedance).
Cylindrical Rotor type Three Phase Synchronous Generators: The Phasor Diagram of a Synchronous Generator, Power and Torque in Synchronous Generators (Power Angle Equation and Power Angle Characteristic), Measuring Synchronous Generator Model Parameters (Open Circuit and Short Circuit Tests and Determination of Synchronous Impedance and Reactance, The Short Circuit Ratio), Voltage Regulation and Speed Regulation. Voltage Regulation by Synchronous Impedance Method
College/Institute Portion (20%):
Braking of Dc motor, Application, Zero Power Factor characteristic, Potier Reactance, Voltage Regulation by Potier Reactance (Zero Power Factor = ZPF) Method or related advanced topics as decided by the concerned faculty member teaching the subject.

Module-III
University Portion (80%):
Salient Pole type Three Phase Synchronous Generators: Two Reaction Concept, Development of the Equivalent Circuit of a Salient Pole type Three Phase Synchronous Generator (Direct axis and Quadrature axis Reactance, Phasor Diagram for various load power factors,), Torque and Power Equations of Salient Pole Synchronous Generator (Power Angle Equation and Power Angle Characteristic with stator resistance neglected). Slip Test for determination of Direct axis and Quadrature axis Reactance.
Parallel operation of Three Phase A.C. Synchronous Generators.The Conditions Required for Paralleling, The General Procedure for Paralleling Generators, Frequency - Real Power and Voltage – Reactive Power Characteristics of a Three Phase Synchronous Generator.

College/Institute Portion (20%):
Operation of Generators in Parallel with large Power Systems, Operation of generators in parallel with other Generators of the same size or related advanced topics as decided by the concerned faculty member teaching the subject.

Module-IV

University Portion (80%):
Three Phase Synchronous Motors: Basic Principles of Motor operation, Steady State Synchronous Motor operation, Starting Synchronous Motors, Synchronous Generators and Synchronous Motors, Operation of synchronous motors connected to bus and phasor diagrams for normal, under and over excited conditions, V and Λ curves, Synchronous Motor Ratings. Application.
Special Purpose Motors: The Universal series motor: constructional features and performance characteristics

College/Institute Portion (20%):
Other types of Motors: Reluctance Motors, Stepper Motors or related advanced topics as decided by the concerned faculty member teaching the subject.

Text books:

1. *Stephen J. Chapman-'Electric Machinery and Fundamentals'- Mc Graw Hill International Edition, (Fourth Edition), 2015.*
2. *M.G.Say-'Alternating Current Machines', English Language Book Society (ELBS)/ Longman , 5th Edition, Reprinted 1990.*

Reference books:

1. *B.S.Guru & H.R.Hiziroglu-'Electric Machinery & Transformers'-3rd Ed-Oxford Press, 2014.*
2. *P.C.Sen-'Principles of Electric Machines and Power Electronics'-2nd Edition, John Wiley and Sons, Wiley India Reprint, 2014.*
3. *A.E.Fitgerland, Charles Kingslay Jr. & Stephen D. Umans -Electric machinery – 6th Edition Mc Graw Hill – Reprint 2015.*
4. *D.P. Kothari & I.J. Nagrath - Electric Machines – 4th Edition Mc Graw Hill – Reprint 2015.*
5. *P S Bimbhra – Electrical Machinery –Khanna Publishers.*

TENTATIVE
Likely to be Modified

ELECTRICAL MACHINES LABORATORY-II

List of Experiment:

1. *Determination of critical resistance and critical speed from no load test of a DC shunt generator.*
2. *Plotting of external and internal characteristics of a DC shunt generator.*
3. *Speed control of DC shunt motor by armature voltage control and flux control method.*
4. *Determination of the voltage regulation of an alternator by synchronous impedance method and zero power factor (zpf) method*
5. *Determination of the V and inverted V curves of a synchronous motor*
6. *Determination of parameters of synchronous machine*
7. *Positive sequence reactance*
8. *Negative sequence reactance*
9. *Zero sequence reactance*
10. *Determination of power angle characteristics of an alternator*
11. *Study of parallel operation of two alternators*
12. *Measurement of direct and quadrature axis reactance of a salient pole synchronous machine*
13. *Measurement of transient and sub transient reactance of a salient pole alternator*

TENTATIVE
Likely to be Modified

CONTROL SYSTEM ENGINEERING-I

Module-I **[9 Hours]**

University Portion (80%):

Introduction to Control Systems: Basic Concepts of Control Systems, Open loop and closed loop systems, Servo Mechanism/Tracking System. (Text Book-1-Ch1)

Mathematical Models of Physical Systems: Differential Equations of Physical Systems, Transfer functions, Block Diagram Algebra, Signal flow Graphs. (Text Book-1-Ch 2.1, 2.2, 2.4 2.5 2.6)

Feedback characteristics of Control Systems: Feedback and Non-feedback System, Reduction of parameter variation by use of feedback, control over System Dynamics by use of feedback, Control of the Effects of disturbance signals by use of feedback, linearizing effect of feedback, regenerative feedback, Regenerative feedback.(Text Book-1-Ch 3.1 to 3.7)

College/Institute Portion (20%):

Control System and Components: Modeling of Stepper motor, AC & DC Servomotor, Synchros, AC Tachometer with selected problems.](Text Book-1-Ch 4.3, 4.4) Or any related topic as decided by the concerned faculty member teaching the subject.

Module-II **[9 Hours]**

University Portion (80%):

Time response Analysis: Standard Test Signals, Time response of first order systems, Time Response of Second order systems, Steady State Errors and Static Error Constants of different types of systems, Effect of adding a zero to a system, Design specification of second order system, Performance indices.

(Text Book-1-Ch- 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.9)

Concepts of Stability: The concept of stability, Necessary conditions for stability, Hurwitz Stability Criterion, Routh Stability Criterion, Relative Stability Analysis, More on Routh Stability Criterion.

(Text Book-1 Ch-6.2, 6.3, 6.4, 6.5, 6.6)

The Root locus Technique: Introduction, Root locus Concepts, Construction of Root locus, Rout Contours, Systems with transportation lag. (Text Book-1-Ch- 7.1, 7.2, 7.3, 7.4, 7.5)

College/Institute Portion (20%):

Sensitivity of the Roots of the Characteristics Equation (Text Book-1-Ch- 7.6)] Or any related topic as decided by the concerned faculty member teaching the subject.

Module-III **[9 Hours]**

University Portion (80%):

Frequency Response Analysis: Correlation between Time and Frequency Response, Polar plots, Bode plots, All Pass and Minimum- Phase Systems. (Text Book-1-Ch- 8.2, 8.3, 8.4 8.5)

Stability in Frequency Domain: Mathematical Preliminaries, Nyquist Stability Criterion, Assessment of Relative stability using Nyquist Criterion, Closed loop Frequency Response, Sensitivity Analysis in Frequency Domain. (Text Book-1-Ch- 9.2, 9.3, 9.4, 9.5, 9.6

College/Institute Portion (20%):

Closed loop frequency response: Constant M circles, Constant N-Circles, Nichol's chart. (Text Book-2-Ch-)] Or any related topic as decided by the concerned faculty member teaching the subject.

Module-IV **[8 Hours]**

University Portion (80%):

State Variable Analysis: Introduction, Concepts of State, State Variables and State Model, Solution of State Equations, Concepts of Controllability and Observability. (Text Book-1-Ch-12.1, 12.2, 12.4, 12.6, 12.7)

Design Specifications of a control system: Proportional Derivative Error Control (PD Control), Proportional Integral Controller (PI Control), Proportional, Integral and Derivative Controller (PID Control), Derivative Output Control. (Text Book-3-Ch-3.7)

College/Institute Portion (20%):

[Tuning Rules for PID controllers. (Text Book-2-Ch-10.2)] Or any related topic as decided by the concerned faculty member teaching the subject.

Text Books:

1. *Control Systems Engg. by I.J. Nagrath and M.Gopal, 5th Edition, New Age International Publishers (2010)*
2. *Modern Control Engineering by K. Ogata, 5th edition PHI.*
3. *Automatic Control Systems by Benjamin C. Kuo, 7th Edition, Prentice-Hall India publication (1995)*

Reference Books:

1. *Design of Feedback Control Systems by R.T. Stefani, B. Shahian, C.J. Savator, G.H. Hostetter, Fourth Edition (2009), Oxford University Press.*
2. *Control Systems (Principles and Design) by M.Gopal 3rd edition (2008), TMH.*
3. *Analysis of Linear Control Systems by R.L. Narasimham, I.K. International Publications*
4. *Control Systems Engineering by S.P. Eugene Xavier and J. Josheph Cyril Babu, 1st Edition (2004), S. Chand Co. Ltd.*
5. *Problems and solutions in Control System Engineering by S.N. Sivanandam and S.N. Deepa, Jaico Publishing House.*
6. *Modern Control Systems by Richard C.Dorf and Robert H. Bishop, 11th Ed (2009), Pearson.*

CONTROL SYSTEM LABORATORY

List of Experiments:

1. *Study of a dc motor driven position control system*
2. *Study of speed torque characteristics of two phase ac servomotor and determination of its transfer function*
3. *Obtain the frequency response of a lag and lead compensator*
4. *To observe the time response of a second order process with P, PI and PID control and apply PID control to servomotor*
5. *To determine the transfer function of a system (network) using transfer function analyser.*
6. *To study and validate the controllers for a temperature control system*
7. *To study the position control system using Synchroscope.*

DIGITAL ELECTRONICS CIRCUIT (3-0-2)

University Level:

MODULE – I (12 Hours)

Number System: Introduction to various number systems and their Conversion. Arithmetic Operation using 1's and 2`s Compliments, Signed Binary and Floating Point Number Representation Introduction to Binary codes and their applications. (**5 Hours)**
Boolean Algebra and Logic Gates: Boolean algebra and identities, Complete Logic set, logic gates and truth tables. Universal logic gates, Algebraic Reductionand realization using logic gates **(3 Hours)**
Combinational Logic Design: Specifying the Problem, Canonical Logic Forms, Extracting Canonical Forms, EX-OR Equivalence Operations, Logic Array, K-Maps: Two, Three and Four variable K-maps, NAND and NOR Logic Implementations. **(4 Hours)**

MODULE – II (14 Hours)

Logic Components: Concept of Digital Components, Binary Adders, Subtraction and Multiplication, An Equality Detector and comparator, Line Decoder, encoders, Multiplexers and De-multiplexers. **(5 Hours)**
Synchronous Sequential logic Design: sequential circuits, storage elements: Latches (SR, D), Storage elements: Flip-Flops inclusion of Master-Slave, characteristics equation and state diagram of each FFs and Conversion of Flip-Flops. Analysis of Clocked Sequential circuits and Mealy and Moore Models of Finite State Machines **(6 Hours)**
Binary Counters : Introduction, Principle and design of synchronous and asynchronous counters, Design of MOD-N counters, Ring counters. Decade counters, State Diagram of binary counters (4 hour)

MODULE – III (12 hours)

Shift resistors: Principle of 4-bit shift resistors. Shifting principle, Timing Diagram, SISO, SIPO ,PISO and PIPO resistors. (4 hour)
Memory and Programmable Logic: Types of Memories, Memory Decoding, error detection and correction), RAM and ROMs. Programmable Logic Array, Programmable Array Logic, Sequential Programmable Devices. **(5 Hours)**
IC Logic Families: Properties DTL, RTL, TTL, I^2L and CMOS and its gate level implementation. A/D converters and D/A converters **(4 Hours)**
College Level (20%)
Basic hardware description language: Introduction to Verilog/VHDL programming language, Verilog/VHDL program of logic gates, adders, Substractors, Multiplexers, Comparators, Decoders flip-flops, counters, Shift resistors.
Text book:

1. *Digital Design, 3rd Edition, Moris M. Mano, Pearson Education.*
2. *Fundamentals of digital circuits, 8th edition, A. Anand Kumar, PHI*
3. *Digital Fundamentals, 5th Edition, T.L. Floyd and R.P. Jain, Pearson Education, New Delhi.*
4. *Digital Electronics, G K Kharate, Oxford University Press*

Reference Book:

1. *Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.*
2. *A First Course in Digital System Design: An Integrated Approach, India Edition, John P. Uyemura, PWS Publishing Company, a division of Thomson Learning Inc.*
3. *Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.*

DIGITAL ELECTRONICS CIRCUIT LAB

List of Experiments:

(At least 10 experiments should be done, Experiment No. 1 and 2 are compulsory and out of the balance 8 experiments at least 3 experiments has to be implemented through both Verilog /VHDL and hardware implementation as per choice of the student totaling to 6 and the rest 2 can be either through Verilog /VHDL or hardware implementation.)

1. *Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates, use of Universal NANDGate.*
2. *Gate-level minimization: Two level and multi level implementation of Booleanfunctions.*
3. *Combinational Circuits: design, assemble and test: adders and subtractors, code converters, gray code to binary and 7 segmentdisplay.*
4. *Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number ofGates.*
5. *Design with multiplexers andde-multiplexers.*
6. *Flip-Flop: assemble, test and investigate operation of SR, D & J-Kflip-flops.*
7. *Shift Registers: Design and investigate the operation of all types of shift registers with parallelload.*
8. *Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallelload.*
9. *Memory Unit: Investigate the behaviour of RAM unit and its storage capacity – 16 X 4 RAM: testing, simulating and memoryexpansion.*
10. *Clock-pulse generator: design, implement andtest.*
11. *Parallel adder and accumulator: design, implement andtest.*
12. *Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce a 8-bitproduct.*
13. *Verilog/VHDL simulation and implementation of Experiments listed at Sl. No. 3 to 12*

ELECTRICAL POWER TRANSMISSION & DISTRIBUTION

Module-1 **[13 Hours]**

University portion (80%)

Line Constant Calculations: Introduction to per unit system and calculation for transmission system. Magnetic flux Density, Inductors and Inductance Magnetic field Intensity due to long current carrying conductors, Inductance of two wire transmission line, Flux linkages with one conductor in a group of conductors, Transposition of power lines, Composite Conductors, Inductance of Composite Conductors, Inductance of double circuit three phase line, Concept of GMD, Bundled conductors, Skin and Proximity effect.

Capacitance of Transmission Lines: Electric Field of a Line of charge, Straight Conductor, The Potential Difference between Two Points due to a line Charge, Two infinite lines of charge, Capacitance of a Two Wire Line, Capacitance of a Three Phase Line with Unsymmetrical Spacing, Capacitance of a double circuit line, Inductance of three phase un-symmetrically spaced transmission, Effect of Earth on the Capacitance of conductors.

Module-2 **[10 Hours]**

University portion (80%)

Performance of Lines: Representation of Lines, Short Transmission Lines, The Medium Transmission Lines, The Long Transmission Line: The Long Transmission Line, ABCD constants, Ferranti Effect Hyperbolic Form of The Equations, The Equivalent Circuit of a Long Line, Power Flow Through Transmission Line, Reactive Compensation of Transmission Line. Series and shunt compensation.

College/Institute portion-20%)

Corona: Critical Disruptive Voltage, Corona Loss, Disadvantage of Corona, Radio Interference, Inductive Interference between Power and Communication Lines. Or Related advanced topics as decided by the concerned faculty teaching the subject.

Module-3 **[10 Hours]**

University portion (80%)

Overhead Line Insulators: Insulator Materials, Types of Insulators, Voltage Distribution over Insulator String, Methods of Equalizing the potential

Mechanical Design of Overhead Transmission Lines: The catenary curve, Sag Tension calculation, supports at different levels, Stringing chart, sag Template, Equivalent span, Stringing of Conductors, Vibration and Vibration Dampers

Distribution: Comparison of various Distribution Systems, AC three-phase four-wire Distribution System, Types of Primary Distribution Systems, Types of Secondary Distribution Systems, Voltage Drop in DC Distributors, Voltage Drop in AC Distributors, Kelvin's Law, Limitations of Kelvin's Law, General Design Considerations

College/Institute portion (20%)

Load Estimation, Design of Primary Distribution, Sub-Stations, Secondary Distribution Design, Economical Design of Distributors, Design of Secondary Network, Lamp Flicker, Application of Capacitors to Distribution Systems. Or Related advanced topics as decided by the concerned faculty teaching the subject.

Module-4 **[6 Hours]**

University portion (80%)

Insulated Cables: The Insulation, Extra High Voltages Cable, Insulation Resistance of Cable, Grading of Cables, Capacitance of Single Core Cables, Heating of cables, Current rating of cables, Overhead lines Vs Underground Cables, Types of cable

Power System Earthing: Soil Resistivity, Earth Resistance, Tolerable Step and Touch Voltage, Actual Touch and Step Voltages, Design of Earthing Grid.

College/Institute portion (20%)

Tower Footing Resistance, Neutral Earthing. Or Related advanced topics as decided by the concerned faculty teaching the subject.

Text books:

1. *Power System Analysis- By John J. Grainger & W. D. Stevenson, Jr, Tata Mcgraw-Hill, 2003 Edition, 15th Reprint, 2010.*

Reference books:

2. *Weedy B.M. and Cory B.J., "Electric Power Systems", 4th Ed., 2008 Wiley India.*
3. *Electrical Power Systems-C. L. Wadhwa, New Age International Publishers, Sixth Edition.*
4. *Power System Analysis & Design- By B. R. Gupta, S. Chand Publications, 3rd Edition, Reprint, 2003.*

ELECTRICAL POWER TRANSMISSION & DISTRIBUTION LAB

1. *Study and of Ferranti Effect.*
2. *Determination of ABCD Parameter.*
3. *Determination of string efficiency.*
4. *Earth resistance measurement.*
5. *Series and shunt capacitance computation in transmission line.*
6. *Transformer oil test.*
7. *Study of various lightning arresters.*
8. *Distribution system power factor improvement using switched capacitor.*
9. *Study of corona discharge.*

SENSORS AND TRANSDUCERS

Module -1 **[9 Hours]**

University Portion (80%): (8 Hours)

Elements of a general measurement system: Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems. (Bentley: Chapters 1-4)

College/Institute Portion (20%): (1 Hours)

[Techniques for dynamic compensation, Loading Effects and Two-port Networks (Bentley: Sections 4.4 and 5.1-5.2)] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-2 **[8 Hours]**

University Portion (80%): (7 Hours)

Sensing elements: Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gages. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance and LVDT displacement sensors; Electromagnetic sensing elements: velocity sensors (Bentley: Sections 8.1 to 8.6)

College/Institute Portion (20%): (1 Hours)

[RVDT, Hall Effect sensors (Bentley: Sections 8.3 and 8.10)] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-3 **[8 Hours]**

University Portion (80%):(7 Hours)

Thermoelectric sensing elements: laws, thermocouple characteristics, installation problems, cold junction compensation. IC temperature sensor Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement. (Ghosh: Section 10.3 to 10.4)

College/Institute Portion (20%): (1 Hours)

[Piezoelectric sensing elements, Piezoresistive sensing elements (Bentley: Sections 8.7 and 8.8)] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-4 **[9 Hours]**

University Portion (80%): (8 Hours)

Signal Conditioning Elements: Deflection bridges: design of resistive and reactive bridges, push-pull configuration for improvement of linearity and sensitivity. Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation (Bentley: Sections 9.1 to 9.3; Ghosh: Sections 15.1 and 15.2)

College/Institute Portion (20%): (1 Hours)

[Current transmitters, Oscillators and resonators (Bentley: Sections 9.4 and 9.5)] Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Books:

1. *Principles of Measurement Systems- J.P. Bentley (3/e), Pearson Education, New Delhi, 2007.*
2. *Introduction to Measurement and Instrumentation- A.K. Ghosh (3/e), PHI Learning, New Delhi, 2009.*

Reference Books:

1. *Measurement Systems Application and Design- E.O. Doeblin (4/e), McGraw-Hill, International, NY.*
2. *Instrumentation for Engineering Measurements- J.W. Dally, W.F. Riley and K.G. McConnel (2/e), John Wiley, NY, 2003.*
3. *Industrial Instrumentation- T.R. Padmanabhan, Springer, London, 2000.*

TENTATIVE
Likely to be Modified

Fifth Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/week L/T**	**Credit Practical**	**Marks**
PC	Power Electronics	3-0	3	100	50	2	1	50
PC	Microprocessor & Microcontroller	3-0	3	100	50	2	1	50
PC	Digital signal Processing	3-0	3	100	50	2	1	50
PE	Renewable Energy systems/Optoelectronics Device & Instrumentation	3-1	4	100	50			
OE	Optimization in Engg.	3-1	4	100	50			
PC	Advance Lab-I(Advanced Electrical Computational Lab-I)					8	4	200
Total		17	17	500	250	14	7	350
Total Marks: 1100								
Total Credits: 24								
Honors Paper	Electrical Machine Design/ Industrial Process Control and Dynamics /Distributed Generation System Design	4	4	100	50			
Minor Specialization	Electrical Machines-I/ Microprocessor and Microcontrollers/ Renewable Energy Systems							

TENTATIVE
Likely to be Modified

POWER ELECTRONICS

Module-1 **[12 Hours]**

University portion (80%): (10 Hours)

Power semiconductor devices: (6 Hours)

Switching and V-I characteristic of devices: power diode, Thyristor family: SCR, TRIAC, GTO, Transistor Family: BJT, IGBT, and MOSFET, Series and parallel grouping of SCR. [Chapter: 1.3, 1.4, 4.2.2, 4.2.3, 4.3.2, 4.6, 4.10, 7.2, 7.4, 7.5]

Triggering Methods: (2 Hours)

SCR: (Cosine Firing Scheme), BJT gate drive, IGBT gate drive, TRIAC firing circuit, Isolation of gate and base drive [Chapter: 17.5, 17.2, 17.3, 17.4]

Protection of Devices: (2 Hours)

SCR: Over voltage, Over Current, dv/dt, di/dt, Gate Protection. Transistor: protection of power BJT, IGBT and power MOSFET, dv/dt & di/dt limitation. [Chapter: 18.4, 18.5, 18.7, 18.8, 4.8, 7.9, 7.10)

College/Institute portion (20%): (2 Hours)

Two-Transistor Model of SCR, V-I characteristics of RCT, MCT, [Chapter: 7.3, 7.6.6, 7.6.12, 7.7, 7.8] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module 2 **[12 Hours]**

University portion (80%): (10 Hours)

AC to DC converter: (6 Hours)

Un-controlled Diode rectifier: Single phase half wave and full wave rectifiers with R-L and R -L-E load, 3 phase bridge rectifier with R-L and R-L-E load. Phase Controlled Converter: Principle of phase controlled converter operation, single phase full converter with R-L and R-L-E load,3 phase full converter with R-L and R-L-E load ,single phase semi converter with R-L and R-L-E load, 3 phase semi-converter with R-L and R-L-E load and effect of source inductance. [Chapter: 3.2, 3.3, 3.4, 3.5, 3.8, 3.12, 10.2, 10.3, 10.6, 10.9, 10.10]

AC –AC converter: (4 Hours)

AC voltage controller: Single phase bi-directional controllers with R and R-L load, single phase cycloconverters. [Chapter: 11.4, 11.5, 11.9.1, 11.10]

College/Institute portion (20%): (2 Hours)

Effect of Source and Load Inductance, Single phase PWM rectifier, Three phase PWM rectifier. [Chapter: 6.6,11.13] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module 3 **[8 Hours]**

University portion (80%): (6 Hours)

DC to DC converter:

Classification: First quadrant, second quardrant, first and second quardrant, third and fourth quardrant, fourth quardrant converter. Switching mode regulators: Buck regulators, Boost regulators, Buck-Boost regulators, Cuk regulators, Isolated Types: Fly Back Converters, Forward converters, Push Pull Converters, Bridge Converter [Chapter: 5.7, 5.8.1, 5.8.2, 5.8.3, 5.8.4]

College/Institute portion (20%): (2 Hours)
Multioutput boost converter, Diode rectifier-fed Boost converter [Chapter: 5.10, 5.11] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module 4 **[8 Hours]**
University portion (80%): (6 Hours)
DC to AC converter: (4 Hours)
Inverters: Single phase Bridge Inverters, 3-Phase Inverters-1800 mode conduction, 1200 mode conduction. Voltage control of 3-Phase Inverters by Sinusoidal PWM, Current Source Inverter [Chapter: 6.4, 6.5, 6.8.1, 6.8.4, 6.10, 8.8, 8.9]
Applications: (2 Hours)
UPS, SMPS, Battery Chargers, SVC. [Chapter: 14.2.1, 14.2.2, 14.2.3, 14.2.4, 14.2.6, 13.6.4]
College/Institute portion (20%): (2 Hours)
Zero Current Switching, Zero voltage Switching technology in DC-DC converter, Zero Voltage Switching resonant inverter.[Chapter: 8.8, 8.9] Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Books:

1. *Power Electronics: Circuits, Devices and Applications by M H Rashid, 3rd Edition, Pearson*
2. *Power Electronics: By P. C. Sen, Tata McGraw Hill Education, 12th Edition*
3. *Power Electronics, V R Moorthi, Oxford University Press*

Reference Books:

1. *Power Electronics Converters, Applications & Design: by N. Mohan, 2nd Edition, John Wiley & Sons*
2. *Elements Of Power Electronics: Philip T. Krein, Oxford University Press*
3. *Power Converter Circuits: by W Shepherd and L Zhang, CRC, Taylor and Francis,Special Indian Edition*

POWER ELECTRONICS LABORATORY

List of Experiment : (any ten)

1. *Study of the V-I characteristics of SCR, TRIAC, IGBT and MOSFET.*
2. *Study of the cosine controlled triggering circuit*
3. *To measure the latching and holding current of a SCR*
4. *Study of the single phase half wave controlled rectifier and semi converter circuit with R and R-L Load*
5. *Study of single phase full wave controlled rectifier circuits (mid point and Bridge type) with R and R-L Load*
6. *Study of three phase full wave controlled rectifier circuits (Full and Semi converter) with R and R-L Load*
7. *Study of the Buck converter and boost converter.*
8. *Study of the single phase pwm voltage source inverter.*
9. *Study the performance of three phase VSI with PWM control.*
10. *Study of the forward converter and flyback converter.*

MICROPROCESSORS AND MICROCONTROLLER

Module-I **[10 Hours]**

University Portion (80%):(08 Hours)

Introduction of Microcomputer System: Fundamental block diagram, signal, interfacing, I/O ports and data transfer concepts, timing diagram, interrupt structure of Intel 8085 processor. Introduction of Intel 8086 processor. Basic difference between 8085 and 8086 processor. Timer and Counter. (Book 1: 2.2, 2.3, 2.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 13.1)

College/Institute Portion (20%):(02 Hours)

Logic diagram of the 74LS244 octal buffer. Logic diagram of the 2114 memory device.(Book 2: 2.52, 2.56) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-II **[10 Hours]**

University Portion (80%): (08 hours)

Instructions and programming of 8085 and 8086: Instruction format and addressing modes, assembly language format, data transfer, data manipulation, Arithmetic instructions, Logical instructions, control and string instruction, programming: loop structure with counting and indexing, look up table, sub routine instruction stack. Stack operation, branching programming.(Book 2: Ch. 5 and 6)

College/Institute Portion (20%): (02 Hours)

BCD to seven segment LED code conversion, microprocessor based development systems and assemblers.(Book 2: 9.3, 10.1) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-III **[10 Hours]**

University Portion (80%):(08 Hours)

I/O Interfacing devices

Study of Architecture and programming of ICs : 8-bit input output port 8255 PPI, 8259 PIC, 8257 DMA, 8251 USART, 8279 Keyboard display controller and 8253 timer/counter-interfacing with 8085- A/D and D/A converter interfacing(Book 1: Ch. 7)

College/Institute Portion (20%):(02 Hours)

Interfacing of EPROM chip with 8085, Interfacing RAM chip with 8085(Book 1: 6.2.2, 6.2.3) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-IV **[10 Hours]**

University Portion (80%): (08 Hours)

Micro controller 8051 programming and applications. Architecture of 8051. Data Transfer, manipulation, control and I/O instruction, simple programming, keyboard and display interface.(Book 1: Ch. 9 and 10)

College/Institute Portion (20%): (02 Hours)

Close loop control of stepper motor and servo motor.RTC interfacing using I2C bus (Book 1: 12.7, 12.9, 12.13) Or related advanced topics as decided by the concerned faculty teaching the subject.

Text book:

1. *Ramesh S.Gaonkar, "Microprocessor - Architecture, Programming and Applications with the 8085", Penram International publishing private limited, fifth edition.*
2. *Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware",*
3. *Microprocessor & Microcontroller, N.Senthil Kumar, M.Saravanan,S. Jeevananthan, Oxford University Press*

Reference Book:

1. *Muhammad Ali Mazdi & Janice Gilli Mazdi, The 8051 Microcontroller and Embedded System, Pearson Education , 5th Indian reprint, 2003.*
2. *Microprocessors and microcontrollers Architecture, programming and system Design 8085, 8086, 8051, 8096: by Krishna Kant : PHI*
3. *The 8051 Microcontroller, Kenneth Ayala, Third Edition*

MICROPROCESSOR & MICROCONTROLLER LABORATORY

List of Experiment : 8085

1. *Addition, subtraction, multiplication and division of two 8 bit numbers*
2. *Smallest/largest number among n numbers in a given data array, Binary to Gray code, Hexadecimal to decimal conversion*

Interfacing

1. *Generate square wave on all lines of 8255 with different frequencies*
2. *Study of stepper motor and its operations*

Optional (any two)

1. *Study of traffic light controller*
2. *Study of elevator simulator*
3. *Generation of square, triangular and saw tooth wave using D to A Converter*
4. *Study of 8253 and its operation(Mode0, Mode2, Mode3)*
5. *Study of Mode0,Mode1 and BSR Mode operation of 8255*
6. *Study of 8279 (keyboard and display interface)*
7. *Study of 8259 Programmable Interrupt Controller*
8. *8051 Microcontroller: Initialize data to registers and memory using immediate, register, direct and indirect Addressing mode*

Optional (any one)

1. *Addition and subtraction of 16 bit numbers*
2. *Multiplication and division of two 16 bit numbers*
3. *Transfer a block of data to another memory location using indexing*
4. *Operation of 8255 using 8051 microcontroller 8086*
5. *1.Addition , subtraction ,multiplication and division of 16 bit numbers, 2's complement of a 16 bit number*

Optional (any one)

1. *Finding a particular data element in a given data array*
2. *Marking a specific bit of a number using look-up table*
3. *Largest/smallest number of a given data array*
4. *To separate the odd and even numbers from a given data array*
5. *Sorting an array of numbers in ascending/descending order*

5th Semester

RENEWABLE ENERGY SYSTEMS

Module I **[15 Hours]**

University Portion (80%): (13 Hours)

Introduction: Conventional energy Sources and its Impacts, Non conventional energy– seasonal variations and availability, Renewable energy – sources and features, Distributed energy systems and dispersed generation (DG) (Textbook-1, Chapter-1.10, 1.13, 1.14)

Solar Energy: Solar processes and spectral composition of solar radiation. Solar Thermal system- Solar collectors, Types and performance characteristics, Applications- Solar water heating systems (active & passive) , Solar space heating & cooling systems , Solar desalination systems, Solar cooker. Solar photovoltaic system-Operating principle, Photovoltaic cell concepts, Cell, module, array, Losses in Solar Cell, Effects of Shadowing-Partial and Complete Shadowing, Series and parallel connections, Cell mismatching, Maximum power point tracking, Applications-Battery charging, Pumping, Lighting, Peltier cooling. Modeling of PV cell. (Textbook-1, Chapter- 4.1, 4.2, 4.5, 4.10, 4.11, 5, 6)

College/Institute Portion (20%):(2 Hours)

Classification of energy Sources, Extra-terrestrial and terrestrial Radiation, Azimuth angle, Zenith angle, Hour angle, Irradiance, Solar constant Or related advanced topics as decided by the concerned faculty teaching the subject.

Module II **[10 Hours]**

University Portion (80%): (8 Hours)

Wind Energy: Wind energy, Wind energy conversion; Wind power density, efficiency limit for wind energy conversion, types of converters, aerodynamics of wind rotors, power ~ speed and torque ~ speed characteristics of wind turbines, wind turbine control systems; conversion to electrical power: induction and synchronous generators, grid connected and self excited induction generator operation, constant voltage and constant frequency generation with power electronic control, single and double output systems, reactive power compensation, Characteristics of wind power plant, Concept of DFIG. (Textbook-2, Chapter-1.2, 1.4, 1.5, 1.6, 1.7, 1.8, 1.10, 1.11, 1.12, 3, 5)

College/Institute Portion (20%):(2 Hours)

Velocity at different heights, Basics of Fluid Mechanics (Textbook-1, Chapter-7.1, 7.2, 7.5) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module III **[9 Hours]**

University Portion (80%):(9 Hours)

Biomass Power: Principles of biomass conversion, Combustion and fermentation, Anaerobic digestion, Types of biogas digester, Wood gassifier, Pyrolysis, Applications. Bio gas, Wood stoves, Bio diesel, Combustion engine, Application.
(Textbook-1, Chapter-8)

College/Institute Portion (20%): (2 Hours)

Urban Waste to Energy Conversion, Fuel cell. (Textbook-1, Chapter-8.6) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module IV **[6 Hours]**

University Portion (80%): (4 Hours)

Hybrid Systems: Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles.

(Textbook-2, Chapter-7)

College/Institute Portion (20%):(2 Hours)

Small hydro Resources, Magnetohydrodynamics power conversion (Textbook-1, Chapter-11.4,12.2) Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Books:

1. *Renewable Energy- Power for a Sustainable Future, Godfrey Boyle, Oxford University Press*
2. *B.H.Khan, Non-Conventional Energy Resources, Tata McGrawHill, 2009*
3. *S. N. Bhadra, D. Kastha, S. Banerjee, Wind Electrical Systems, Oxford Univ. Press, New Delhi, 2005.*

Reference Books:

1. *S. A. Abbasi, N. Abbasi, Renewable Energy Sources and Their Environmental Impact, Prentice Hall of India, New Delhi, 2006*

TENTATIVE Likely to be Modified

ADVANCED ELECTRICAL COMPUTATIONAL LAB-I
"will be uploaded soon"

ELECTRICAL MACHINE DESIGN
"will be uploaded soon"

INDUSTRIAL PROCESS CONTROL AND DYNAMICS
"will be uploaded soon"

DISTRIBUTED GENERATION SYSTEM DESIGN
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TENTATIVE
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Sixth Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/week L/T**	**Credit Practical**	**Marks**
PC	Electrical Drives	3-0	3	100	50	2	1	50
PC	Power System & Operation & Control	3-0	3	100	50	2	1	50
PE	VLSI Design/Generalized Theory of Electrical Machines/HVDC Transmission	3-1	4	100	50			
PE	Control System Engg-II/Advanced Digital Signal Processing	3-1	4	100	50			
MC & GS	Environmental Science & Engineering	3-0	3	100	50			
OE	Industrial Lecture #					3	1	50
HS	Presentation Skill & Skill for Interview # #	2-0	1		50	4	2	100
MC	Yoga					2	1	50
Total		19	18	500	300	13	6	300
Total Marks: 1100								
Total Credits: 24								
Honors Paper	Special Electromechanical Devices / Flexible AC Transmission Systems / Utilization of Electrical Energy	4	4	100	50			
Minor Specialization	Electrical Machines-II/ Control System Engineering-II							

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ELECTRIC DRIVES

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POWER SYSTEM OPERATION & CONTROL

Module – I **[14 Hours]**

University Portion (80%): (12 Hours)

Fundamentals of Power System (Book No.1, Ch. 1)

Introduction, Single Subscript Notation, Double Subscript Notation, Power in Single Phase AC Circuit, Complex Power, The Power Triangle, Direction of Power Flow, Voltage and Current in Balanced Three Phase Circuits, Power in Balanced Three Phase Circuits, Per-Unit Quantities, Changing the Base in Per- Unit Quantities, Node Equations, The Single Line or One Line Diagram, Impedance and Reactance Diagrams. (Book-1:Ch. 1.1, Ch. 1.2, Ch. 1.3, Ch. 1.4, Ch. 1.5, Ch. 1.6, Ch. 1.7, Ch. 1.8, Ch. 1.9, Ch. 1.10, Ch. 1.11, Ch. 1.12, Ch. 1.13, Ch. 1.14).

The Admittance Models & Network Calculations (Book – 1: Ch. 7 (7.1 To 7.5))

Branch and Node Admittances, Mutually Coupled Branches in Ybus, an Equivalent Admittance Network, Modification of Ybus, the Network Incidence Matrix and Ybus. (Book-1:Ch. 7.1, Ch. 7.2, Ch. 7.3, Ch. 7.4, Ch. 7.5.)

Power Flow Solutions (Book – 1, Ch. 9)

The Power-Flow Problem, the Gauss-Seidal Method, the Newton-Raphson Method, the Newton-Raphson Method, Power-Flow Studies in System Design and Operation, Regulating Transformers, the Decoupled Method. (Book-1:Ch. 9.1, Ch. 9.2, Ch. 9.3, Ch. 9.4, Ch. 9.5, Ch. 9.6, Ch. 9.7.)

College/Institute Portion (20%) : (2 Hours)

Power system structure: (Reference 1: 1.1, 1.2, 1.3,) Power factor correction, three phase loads, delta to star transformation: (Reference1: 2.5, 2.8, 2.9, 2.10, 2.11) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module – II **[14 Hours]**

University Portion (80%): (12 Hours)

Economic Operation of Power System (Book – 1, Ch.13)

Distribution of Load between Units within a Plant, Distribution of Load between Plants, The Transmission-Loss Equation, An interpretation of Transformation C, Classical Economic Dispatch with Losses, Automatic Generation Control, Unit Commitment, Solving the Unit Commitment Problems.

(Book-1: Ch. 13.1, Ch. 13.2, Ch. 13.3, Ch. 13.4, Ch. 13.5, Ch. 13.6, Ch. 13.7, Ch. 13.8.)

Load Frequency Control, Control Area Concept (Book – 2, Ch.9)

Automatic Load-Frequency Control of Single Area Systems: Speed-Governing System, Hydraulic Valve Actuator, Turbine-Generator Response, Static Performance of Speed Governor, Closing the ALFC Loop, Concept of Control Area, Static Response of Primary ALFC Loop, Dynamic Response of ALFC Loop, Physical Interpretation of Results, The Secondary ("Reset") ALFC Loop, Economic Dispatch Control. (Book – 2: Ch. 9.3.1, Ch. 9.3.2, Ch. 9.3.3,Ch. 9.3.1, Ch. 9.3.4, Ch. 9.3.5, Ch. 9.3.6, Ch. 9.3.7, Ch. 9.3.8, Ch. 9.3.9, Ch. 9.3.10, Ch. 9.3.11.)

College/Institute Portion (20%) : (2 Hours)

Load frequency control: (Reference 1:12.3) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module – III **[6 Hours]**

University Portion (80%) : (4 Hours)

Two Area Systems (Book – 2, Ch.9)

ALFC of Multi-Control-Area Systems (Pool Operation): The Two Area Systems, Modeling the Tie-Line, Block Diagram Representation of Two Area System, Mechanical Analog of Two Area System, Dynamic Response of Two Area System, Static System Response, Tie-Line Bias Control of Multi-area Systems. (Book – 2: Ch. 9.4.1, Ch. 9.4.2, Ch. 9.4.3 Ch. 9.4.1, Ch. 9.4.4, Ch. 9.4.5, Ch. 9.4.6, Ch. 9.4.7, Ch. 9.4.8, Ch. 9.4.9, Ch. 9.4.10.)

College/Institute Portion (20%) : (2 Hours)

Tie line bias control: (Reference 1: 12.4) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- IV **[6 Hours]**

University Portion (80%) : (4 Hours)

Power System Stability (Book-1, Ch.16)

The Stability Problem, Rotor Dynamics and the Swing Equation, Further Considerations of the Swing Equations, The Power-Angle Equation, Synchronizing Power Coefficients, Equal-Area Criterion for Stability, Further Applications of the Equal-Area Criterion, Multi-machine Stability Studies: Classical Representation, Step-By-Step Solution of the Swing Curve, Computer Programs for Transient Stability Studies, Factors Affecting Transient Stability. (Book-1:Ch. 16.1, Ch. 16.2, Ch. 16.3, Ch. 16.4, Ch. 16.5, Ch. 16.6, Ch. 16.7, Ch. 16.8, Ch. 16.9, Ch. 16.10, Ch. 16.11.)

College/Institute Portion (20%) : (2 Hours)

Synchronous machine,Steady state stability, Transient Stability: (Reference 1:11.3, 11.4, 11.5) Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Books:

1. *Power System Analysis- By John. J. Grainger & W. D. Stevenson, Jr., TMH, 2003 Edition, Fifteenth Reprint.*
2. *An Introduction to Electric Energy System Theory- By O. I. Elgerd, TMH, Second Edition.*
3. *Power System Analysis, T K Nagsarkar and M S Sukhija, Oxford University Press*

Reference:

1) *Power System Analysis- By Hadi Saadat, TMH, 2002 Edition, Eighth Reprint.*
2) *Power System Analysis Operation and Control- By A. Chakrabarti and S. Haldar, Third Edition, PHI Publications, 6th Reprint, 2010.*

POWER SYSTEM LAB

Any 10 experiments out of which atleast 7 experiments from Group-A and 3 experiments from Group-B.

Group A: *HARDWARE BASED*

2. *To determine negative and zero sequence synchronous reactance of an alternator.*
3. *To determine sub-transient direct axis and sub-transient quadrature axis synchronous reactance of a 3-ph salient pole alternator.*
4. *To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.*
5. *To study the IDMT over-current relay and with different plug setting and time setting multipliers and plot its time – current characteristics.*
6. *To determine the operating characteristics of biased different relay with different % of biasing.*
7. *To study the MHO and reactance type distance relays.*
8. *To determine A, B, C, D parameters of an artificial transmission line.*
9. *To compute series inductance and shunt capacitance per phase per km of a three phase line with flat horizontal spacing for single stranded and bundle conductor configuration.*
10. *To determine location of fault in a cable using cable fault locator.*
11. *To study the Ferranti Effect and voltage distribution in HV long transmission line using transmission line model.*
12. *Insulation test for Transformer oil.*
    a) *Study of various types of Lightning arrestors.*
    b) *Study of layout of outdoor pole mounted & plinth mounted sub-stations.*

Group B : *SIMULATION BASED (USING MATLAB OR ANY OTHER SOFTWARE)*

1. *To obtain steady-state, transient and sub-transient short-circuit currents in an alternator.*
2. *To formulate the Y-Bus matrix and perform load flow analysis.*
3. *To compute voltage, current, power factor, regulation and efficiency at the receiving end of a three phase Transmission line when the voltage and power at the sending end are given. Use Π model.*
4. *To perform symmetrical fault analysis in a power system.*
5. *To perform unsymmetrical fault analysis in a power system.*
6. *Write a program in 'C' language to solve economic dispatch problem of a power system with only thermal units. Take production cost function as quadratic and neglect transmission loss.*

Text books:

1. *Hadi Sadat- Power System Analysis – TMH*
2. *T. K. Nagsarkar and M. S. Sukhija - Power System Analysis – Oxford University Press*

HIGH VOLTAGE DC TRANSMISSION

Module- I **[12 Hours]**

University Portion (80%): (10 Hours)

HVDC Transmission: General Classes of Power Quality Problems, Transients, Long Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuations, Power Frequency Variations, Power Quality Terms.

6-Pulse Converter Operation and Analysis: Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Fundamental Principles of Protection, Solutions at the End-User Level, Evaluating the Economics of Different Ride-Through Alternatives, Motor Starting Sags, Utility System Fault-Clearing Issues.

(Chapter-1: 1.3 to 1.6 & 1.9 to 1.10, Chapter-2: 2.5 to 2.8 and Chapter-3: 3.2 to 3.6 & 3.8 to 3.11)

College/Institute Portion (20%): (2 Hours)

Historical Background, Comparison of AC and DC transmission, Cost structure of HVDC transmission, Applications odf HVDC transmission.

Module- II **[14 Hours]**

University Portion (80%): (12 Hours)

Control of HVDC Converter and Systems: Mechanism of AC Power Transmission, Principle of Control, Necessity of Control in case of a DC link, Rectifier Control, Compounding of Rectifiers, Power Reversal in a DC Link, Voltage Dependent Current Order Limit (VDCOL)-Characteristics of the Converter, System Control Hierarchy and Basic Philosophy, Inverter Extinction Angle Control (EAG), Pulse Phase Control, Starting and Stopping of a DC Link, Constant Power Control, Control Systems for HVDC Converters, Inverter Operation Problems, Control of VSC Converters.

Harmonics in HVDC Systems: Importance of Harmonic Study, Generation of Harmonics by Converters, Characteristic Harmonics on the DC Side, Characteristic Current Harmonics, Characteristic variations of Harmonic Currents with Variation of α & μ, Effect of Control modes on Harmonics, Non-Characteristic Harmonics, Harmonics in VSC Converters. (Chapter-4: 4.2 to 4.16 and Chapter-5: 5.2 to 5.9)

College/Institute Portion (20%): (2 Hours)

Valve Configuration, Converter Theory, Types of DC links, Converter Station, Priniciple of DC link Control and characteristics.

Module-III **[10 Hours]**

University Portion (80%): (8 Hours)

Harmonic Suppression in HVDC System-Filters: Harmonic Model & Equivalent Circuit, Use of Filters, Filter Configurations, Design of a Band-Pass Filter, Design of High-Pass Filters, Protection of Filters, DC Filters.

Faults and Protection Schemes in HVDC Systems: Nature and Types of Faults, Faults on AC Side of Converter Stations, Converter Faults, Faults on DC Side of the System, Protection against Over Currents/ Over Voltages, Protection of Filter Units.

Multi-terminal HVDC Systems : Types of Multi-terminal (MTDC) Systems, Parallel Operation Aspects of MTDC, Paralleling (Disconnecting) of Units or Converter, Control of Power in MTDC, VSC-Multi-level DC Systems. (Chapter-6: 6.2 to 6.5 & 6.7 to 6.8, 6.10, Chapter-8: 8.2 to 8.7 and Chapter-10: 10.2 to 10.6)

College/Institute Portion (20%): (2 Hours)

Types of converter faults,Converter station protection against faults,Harmonics and Filters,starting,stopping and power flow reversal in HVDC system.

Text Book :

1. "***HVDC Transmission***" *By S. Kamakshaiah & V. Kamaraju, TMH Education Private Ltd., 2011, New Delhi.*

Reference Book(s):

1. *HVDC Power Transmissions Systems: Technology & Systems Interaction, K.R.Padiyar, New Age Publication, 2005*

TENTATIVE
Likely to be Modified

CONTROL SYSTEM ENGINEERING-II

Module-I **[15 Hours]**

Discrete - Time Control Systems :

Introduction: Discrete Time Control Systems and Continuous Time Control Systems, Sampling Process.

Digital Control Systems: Sample and Hold, Analog to digital conversion, Digital to analog conversion.The Z-transform: Discrete-Time Signals, The Z-transform, Z-transform of Elementary functions, Important properties and Theorms of the Z-transform. The inverse Ztransform, Z Transform method for solving Difference Equations.

Z-Plane Analysis of Discrete Time Control Systems: Impulse sampling & Data Hold, Reconstruction of Original signals from sampled signals: Sampling theorm, folding, aliasing. Pulse Transfer function: Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems. Mapping between the s-plane and the z-plane, Stability analysis of closed loop systems in the z-plane: Stability analysis by use of the Bilinear Transformation and Routh stability critgion, Jury stability Test. Book No. 1: 1.1; 1.2; 1.4; 2.1; 2.2; 2.3; 2.4; 2.5; 2.6; 3.2; 3.4; 3.5; 4.2; 4.3.

Module -II **[15 Hours]**

State Variable Analysis & Design:

Introduction: Concepts of State, State Variables and State Model (of continuous time systems): State Model of Linear Systems, State Model for Single-Input-Single-Output Linear Systems, Linearization of the State Equation. State Models for Linear Continuous – Time Systems: State-Space Representation Using Physical Variables, State – space Representation Using Phase Variables, Phase variable formulations for transfer function with poles and zeros, State – space Representation using Canonical Variables, Derivation of Transfer Function for State Model. Diagonalization: Eigenvalues and Eigenvectors, Generalized Eigenvectors.

Solution of State Equations: Properties of the State Transition Matrix, Computation of State Transition Matrix, Computation by Techniques Based on the Cayley-Hamilton Theorem, Sylvester's Expansion theorm. Concepts of Controllability and Observability: Controllability, Observability, Effect of Pole-zero Cancellation in Transfer Function. Pole Placement by State Feedback, Observer Systems. State Variables and Linear Discrete – Time Systems: State Models from Linear Difference Equations/z-transfer Functions, Solution of State Equations (Discrete Case), An Efficient Method of Discretization and Solution, Linear Transformation of State Vector (Discrete-Time Case), Derivation of z-Transfer Function from Discrete-Time State Model. Book No. 2: 12.1 to 12.9.

Module -III **[12 Hours]**

Nonlinear Systems :

Introduction : Behaviour of Non linear Systems, Investigation of nonlinear systems. Common Physical Non Linearities: Saturation, Friction, Backlash, Relay, MultivariableNonlinearity. The Phase Plane Method: Basic Concepts, Singular Points: Nodal Point, Saddle Point, Focus Point, Centre or Vortex Point, Stability of Non Linear Systems: Limit Cycles, Construction of Phase Trajectories: Construction by Analytical Method, Construction by Graphical Methods. The Describing Function Method: Basic Concepts: Derivation of Describing Functions: Dead-zone and Saturation, Relay with Dead-zone and Hysteresis, Backlash. Stability Analysis by Describing Function Method: Relay with Dead Zone, Relay with Hysteresis, Stability Analysis by Gain-phase Plots. Jump Resonance. Liapunov's Stability Analysis: Introduction, Liapunov's Stability Critrion: Basic Stability Theores, Liapunov Functions, Instability. Direct Method of Liapunov & the Linear System: Methods of constructing Liapunov functions for Non linear Systems. Book No. 2: 13.1 to 13.4; 15.1 to 15.10.

Text Book:

1. *Discrete-Time Control System, by K.Ogata, 2nd edition (2009), PHI.*
2. *Control Systems Engineering, by I.J. Nagrath and M.Gopal., 5th Edition (2007 / 2009), New Age International (P) Ltd. Publishers.*

Reference Book:

1. *Design of Feedback Control Systems by Stefani, Shahian, Savant, Hostetter, Fourth Edition (2009), Oxford University Press.*
2. *Modern Control Systems by K.Ogata, 5th Edition (2010), PHI.*
3. *Modern Control Systems by Richard C. Dorf. And Robert, H.Bishop, 11th Edition (2008), Pearson Education Inc. Publication.*
4. *Control Systems (Principles & Design) by M.Gopal, 3rd Edition (2008), Tata Mc.Graw Hill Publishing Company Ltd.*
5. *Control Systems Engineering by Norman S.Nise, 4th Edition (2008), Wiley India (P) Ltd.*

TENTATIVE
Likely to be Modified

INDUSTRIAL INSTRUMENTATION

Module 1 **[18 Hours]**

Introduction: Functional Units, Classification, Performance characteristics, Dynamic Calibration, Errors: An Overview, Statistical Error Analysis, Reliability and Related Topics (Chapter 1 of Text book)

Instruments for Analysis: Introduction, Gas Analysers, Liquid Analysers, X-ray Methods, Chromatography (Chapter 8 of Text Book)

Module II **[10 Hours]**

Telemetry: Introduction, Pneumatic Means, Electrical Means, Frequency Telemetring, Multiplexing, Modulation, Modulation of Digital Data, Transmission Channels, Briefing of a Telemetry System in Operation, Wireless I/O (Chapter 10 of Text Book)

Module III **[10 Hours]**

Power Plant Instruments: Introduction, The Power Plant Scheme, Pressure, Temperature, Flow and Level, Vibration and Expansion, Analysis, Flue Gas Analysis (Chapter 12 of Text Book)

Hazard and Safety: Initial consideration, Enclosures, Intrinsic Safety, Prevention of Ignition, Methods of Production, Analysis Evaluation and Construction (Chapter 13 of Text Book)

Text Book:

1. *Principles of Industrial Instrumentation, Third Edition, D Patranabis, Tata McGraw Hill Education Private Limited, New Delhi*

Reference Books:

1. *Process/Industrial Instruments and Controls Handbook, Gregory K. Mc Millian Editor-in-Chief, Douglas M. Considine Late Editor-in-Chief*

TENTATIVE
Likely to be Modified

ELECTRICAL POWER QUALITY

Module-I **[12 Hours]**

Terms & Definitions: General Classes of Power Quality Problems, Transients, Long Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuations, Power Frequency Variations, Power Quality Terms.

Voltage Sags & Interruptions: Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Fundamental Principles of Protection, Solutions at the End-User Level, Evaluating the Economics of Different Ride-Through Alternatives, Motor Starting Sags, Utility System Fault-Clearing Issues.

(Chapter-2: 2.2 to 2.10 and Chapter-3: 3.1 to 3.7)

Module-II **[12 Hours]**

Transient Over Voltages: Sources of Transient Over Voltages, Principle of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor-Switching Transients, Utility System Lightning Protection, Managing Ferro-resonance, Switching Transient Problems with Loads, Computer Tools for Transient Analysis.

Fundamentals of Harmonics: Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Locating Harmonic Sources, System Response Characteristics, Effects of Harmonic Distortion, Inter-harmonics.

(Chapter-4: 4.1 to 4.8 and Chapter-5: 5.1 to 5.11)

Module-III **[10 Hours]**

Long Duration Voltage Variations: Principles of Regulating the Voltage, Devices for Voltage Regulation, Utility Voltage Regulator Application, Capacitors for Voltage Regulation, End-User Capacitor Application, Regulating Utility Voltage with Distributed resources, Flicker.

Power Quality Monitoring: Monitoring Considerations, Historical Perspective of Power Quality Measuring Instruments, Power Quality Measurement Equipments, Assessment of Power Quality Measurement Data, Application of Intelligent Systems, Power Quality Monitoring Standards.

(Chapter-7: 7.1 to 7.7 and Chapter-11: 11.1 to 11.6)

Text book:

1. *1."Electrical Power Systems Quality" By Roger C. Dugan, Mark F. Mcgranaghan, Surya Santoso & H.Wayne Beaty, 2nd Edition, TMH Education Private Ltd., New Delhi.*

Reference Book:

1. *Power System Quality Assesment, J.Arrilaga, N.R.Watson, S.Chen, John Wiley & Sons.*
2. *Understanding Power Quality Problems: Voltage Sags & Interruptions, M.H.J. Boller IEEE, 1999*

ADVANCED POWER ELECTRONICS

Module- I **[10 Hours]**

University Portion(80%): (8 Hours)

Switched Mode Power Supply: Isolated switched mode power supplies, Forward converter, Fly back converter, Half bridge converter, Full bridge converter, Push pull converter, Switched mode power supply with multiple outputs.

Text Book- 1- Ch- [14.2.1,14.2.2,14.2.3,14.2.4,14.2.5,14.2.6]

Resonant Converters: Series Resonant Converters, Parallel Resonant Converters.

Text Book- 1- Ch- [8.2,8.4]

College/Institute Portion(20%): (2 Hours)

Zero current switching, Zero voltage switching. [Text Book-1- Ch-[8.8,8.9]. Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- II **[10 Hours]**

University Portion(80%): (8 Hours)

Regulators: Boost regulator, Buck-boost regulator, Multi output Boost Converter, Diode rectifier fed boost converter, State space analysis of regulators. Text Book- 1- Ch- [5.8.2,5.8.3,5.10,5.11,5.13]

SMPS Control: Control requirements and technique, PWM controller, Isolation in the feed back loop, Power supplies with multiple output. Text Book- 1- Ch- [14.3,14.5]

College/Institute Portion(20%): (2 Hours)

Buck regulator, Cuk regulator. . Text Book- 1- Ch-[5.8.1,5.8.4]. Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- III **[10 Hours]**

University Portion(80%): (8 Hours)

Inverters:

Voltage Fed Converters: Pulse width modulation techniques, Sinusoidal PWM, Selected harmonic elimination PWM, Space vector PWM, Hysteresis band current control PWM, Sigma delta modulation. Three level inverters, Resonant inverters, Soft switched inverters

Current Fed Converters: Load commuted inverters, Forced commutated inverters, Inverters with self commutated devices.

Text Book-3- Ch-[5.5, 5.6,5.7,5.8,5.9,6.3,6.4,6.7,6.7.2.2,6.8]

College/Institute Portion(20%): (2 Hours)

Applications of these converters. Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- IV **[10 Hours]**

University Portion(80%): (8 Hours)

AC voltage controllers: AC voltage controllers with PWM Control, Matrix Converter.

Application: High Voltage DC Transmission, Interconnection of renewable energy sources and energy storage system to the utility grid, Active harmonic filter.

Book-1- Ch- 11.10,11.11

Book-2- Ch- 11.4, 17.2, 17.4

College/Institute Portion(20%): (2 Hours)

Related advanced topics as decided by the concerned faculty teaching the subject.

Text Books:

1. *Power Electronics: Circuits, Devices and Applications by M H Rashid, 3rd Edition, Pearson.*
2. *Power Electronics: Converters , Applications and Design by Mohan, Undeland and Robbin, Wiley India Edition.*
3. *Modern Power Electronics and AC Drives by Bimal K Bose, Eastern Economy Edition, PHI.*

Reference Books:

1. *Switched Mode Power Supplies: Design and Construction by H W Whittington, B.W Flynn and D E Macpherson, 2nd Edition, Universities Press)*

TENTATIVE
Likely to be Modified

SPECIAL ELECTROMECHANICAL DEVICES

Module- I **[12 HOURS]**

University Portion (80%):

STEPPER MOTOR (6 hours)

Variable Reluctance (VR) Stepper Motor, Permanent Magnet Stepper Motor, Hybrid Stepper Motor (HSM), Windings in Stepper Motor, Torque Equation, Characteristics of Stepper Motor, Open Loop Control of Stepper Motor, Closed Loop Control of Stepper Motor, Comparison of Stepper Motor, Application of Stepper Motor. Ch.1.1 to 1.9, Ch. 1.11, Ch. 1.12

SWITCHED RELUCTANCE MOTOR (SRM) (5 hours)

Construction, Principle of Working, Basics of SRM Analysis, Constraints on Pole Arc and Tooth Arc, Torque equation and Characteristics, Power Converter Circuits, Control of SRM, Rotor Position Sensor, Current Regulators Ch.2.1 to 2.9

College/Institute Portion (20%): (1 Hour)

Microprocessor-Based Control of Stepper Motor and SRM [Ch. 1.10, Ch.2.10) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- II **[10 HOURS]**

University Portion (80%):(9 Hours)

Permanent Magnet DC (PMDC) Motors: Construction, Principle of Working, Torque Equation and Equivalent Circuit, Performance Characteristics, Moving Coil (MC) Motors, Printed Circuit (PC) Motors, Shell Type PMDC Motors, Disc Motors

Ch. 3.1 (3.1.1 to 3.1.8)

Brushless Permanent Dc (BLDC) Motors: Classification of BLDC Motors, Construction, Electronic Commutation, Principle of Operation, Type of BLDC Motor, Control of BLDC Motor, Microprocessor Based Control of BLDC Motor, DSP Based Control of BLDC Motor, Sensor less Control of BLDC Motor, Comparison of Conventional DC Motor and BLDC Motor, Application of BLDC Motor

Ch. 3.2 (3.2.1 to 3.2.4, 3.2.6 to 3.2.12)

College/Institute Portion (20%) (1 Hours)

BLDC Square Wave Motors, [Ch.3.2.5]) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- III **[8 HOURS]**

University Portion (80%):

PERMANENT MAGNET SYNCHRONOUS MOTOR (PMSM) (4 hours)

Construction, Principle of Operation, EMF Equation of PMSM, Torque Equation, Phasor Diagram, Circle Diagram of PMSM, Comparison of Conventional and PM Synchronous Motor, Application of PMSM

Ch. 4.1 to 4.7, 4.9

SYNCHRONOUS RELUCTANCE MOTOR (SyRM)(3hours)

Construction of SyRM, Working of SyRM, Phasor Diagram and Torque Equation of SyRM, Control of SyRM, Advantages of SyRM, Applications of SyRM

Ch. 5.1 to 5.6

College/Institute Portion (20%): (1 Hour)
Control of PMSM: Vector Control of PMSM, Self Control of PMSM, Sensor Control of PMSM, [Ch. 4.8(4.8.1 to 4.8.3)]) Or related advanced topics as decided by the concerned faculty teaching the subject.

MODULE- IV **[10 HOURS]**

University Portion (80%): (9 Hours)

LINEAR ELECTRIC MACHINES
Linear Induction Motor (LIM): Construction of LIM, Thrust equation of LIM, Performance Equation Based on Current Sheet Concept, Goodness Factor, Equivalent Circuit of LIM, Characteristic of LIM, Certain Design Aspects of LIM, Control of LIM.
Linear Synchronous Motor (LSM): Type and Construction of LSM, Thrust equation of LSM, Control of LSM, Application of LSM.
DC Linear Motor (DCLM): Type and Construction of DCLM, Persistent Current Tubular Electromagnetic Launcher, Induction Tubular EML, DC Pulsed Flat Series EML, DC Tubular Series EML.
Ch. 8.1(8.1.1 to 8.1.8), Ch. 8.2(8.2.1 to 8.1.4), Ch. 8.3(8.3.1 to 8.3.6)

College/Institute Portion (20%): (1 Hour)
Linear Reluctance Motor (LRM): Construction, Working and Features of LRM, Operation of LRM with AC and DC Supply [Ch. 8.4:8.4.1 to 8.4.3]) Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Book:

1. *Special Electric Machines – E.G.JANARDANAN – PHI Learning Pvt. Ltd,.*

Reference Book(s):

1. *Special Electric Machines –K. VENKATARATNAM- Universities Press Pvt. Ltd.*
2. *Electromechanical System and Devices- Sergey E. Lyshevski-CRC Press*
3. *Linear Motion Electromagnetic Devices- I.Boldea, S.A. Nasar-Taylor and Francis*

TENTATIVE
Likely to be Modified

FLEXIBLE AC TRANSMISSION SYSTEMS

Module-I **[12 Hours]**

FACTS concept and General System Considerations: Transmission Interconnections, Flow of Power in an 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, Basic Description and Definitions of FACTS Controllers.

Static Shunt Compensation: Objectives of Shunt Compensation, Methods of Controllable VAR Generation, Static VAR Compensators, SVC and STATCOM.

(Chapter-1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 and 1.7)

(Chapter-5: 5.1, 5.2 and 5.3)

Module-II **[12 Hours]**

Static Series Compensators: Objective of Series Compensation (GCSC, TSSC, TCSC), Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators (SSSC) Static Voltage and Phase Angle Regulators: Objectives of Voltage and Phase Angle Regulators, Approaches to Thyristor-Controlled Voltage and Phase Angle Regulators (TCVRs and TCPARs).

(Chapter-6: 6.1, 6.2 and 6.3)

(Chapter-7: 7.1 and 7.2)

MODULE-III **[10 Hours]**

Combined Compensators: Introduction, Unified Power Flow Controller (UPFC), The Interline Power Flow Controller (IPFC), Generalized and Multifunctional FACTS Controllers.

(Chapter-8: 8.1, 8.2, 8.3 and 8.4)

Text book:

1. *"Understanding FACTS: Concepts & Technology of Flexible AC Transmission Systems" By N.G.Hingorani & L.Gyugyi, IEEE Press, Standard Publishers Distributors, Delhi.*

Reference Book:

1. *Facts Controllers in Power Transmission & Distribution by K.R.Padiyan, New Age International.*
2. *Modelling & Simulation in Power Networks, Enrique Acha, Clandio Esquival & H.A.Perez,CA Camcho, John Wiley & Sons.*

TENTATIVE
Likely to be Modified

GENERALIZED THEORY OF ELECTRICAL MACHINES
"will be uploaded soon"

SMART GRID
"will be uploaded soon"

UTILIZATION OF ELECTRICAL ENERGY
"will be uploaded soon"

TENTATIVE
Likely to be Modified

Seventh Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/week L/T**	**Credit Practical**	**Marks**
GS	Nano Science & Bio Technology	3-1	4	100	50			
PE	Switch Gear & Protective Devices/Biomedical Instrumentation/Mobile Communication	3-1	4	100	50			
PE	Communication Engg./Digital Image Processing/adaptive Control	3-1	4	100	50			
OE	Soft Computing */ Other subjects	3-1	4	100	50			
PC	Advance Lab-II/ Project					8	4	200
	Projects on Internet of Things					8	4	200
Total		16	16	400	200	16	8	400
Total Marks: 1000								
Total Credits: 24								
Honors Paper	High Voltage Engineering./ Electrical Power Quality/ Smart Grid/ PLC & SCADA	4	4	100	50			
Minor Specialization	Power Station Engg. & Economy							

TENTATIVE
Likely to be Modified

SWITCH GEAR AND PROTECTIVE DEVICES

Module- I **[10 Hours]**

University Portion (80%) : (8 Hours)

Introduction: Principle and need for protective schemes, Nature and causes of faults, Zones of protection, Primary and back-up protection, Basic principle of operation of protective system, Components of Protection System.

[Text Book 1 : CH 1.1, 1.2, 1.5, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3]

Sequence Components and Fault Analysis: Sequence components (positive, negative and zero) and their significance, Average 3-phase power in terms of symmetrical components, sequence impedance, fault calculations, Single line to ground fault, Line to ground fault with Zf, Faults in Power systems, Concept of short circuit capacity of a Bus.[Ref. Book 1: CH 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.8, 13.10, 13.13]

College/Institute Portion (20%) : (2 Hours)

Fault limiting Reactors and Fuses: Use of Reactors, Construction of Reactors, Types of Reactors, Methods of locating Reactors, Fuse element material, types of fuses, High voltage H.R,C. Fuses and its application, Selection of fuses, Advantages and Disadvantages of Fuse.

[Ref. Book 2: CH 2.1, 2.2, 2.3, 2.4, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- II **[10 Hours]**

University Portion (80%) : (8 Hours)

Operating Principles and Relay Construction: Relay design and construction, Relay classification, Types of Electromagnetic relays, Theory of Induction relay torque, General Equations of Comparators and Electromagnetic Relays, Over Current relays, Directional relays, Distance relays, Differential relays.

Feeder Protection: Over current, Distance and Pilot Protection.

Static Relays: (Comparators and different relays)

Amplitude comparator, Phase Comparator, Coincidence type phase comparator, Basic elements of a static relay, Over Current Relays, Differential Protection, Static distance Protection.

[Text Book 1: CH 3.1, 3.2, 3.3, 3.4, 4.2, 4.3, 4.4, 4.7, 4.8, 4.9, 5.2, 5.3, 5.4, 11.1, 11.2, 11.3, CH 12.1, 12.2, 12.3, 12.4]

College/Institute Portion (20%): (2 Hours)

Power System Grounding: Ungrounded system, Grounded neutral system, Choice of the method of neutral grounding, Grounding Practice, Equipment Grounding (Earthing), Grounding at substations, Grounding of [Ref. Book 2: CH 7.2, 7.5, 7.6, 7.7, 7.8, 7.9] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- III **[10 Hours]**

University Portion (80%) : (8 Hours)

Apparatus Protection: Transformer Protection, Generator Protection, Motor Protection, Bus bar protection schemes. [Text Book 1: CH 6.2, 6.3, 6.4, 6.5]

Numerical relays: Block Diagram of Numerical Relay, Signal Sampling & Processing, Numerical Over-current protection, Numerical Transformer differential Protection, Numerical distance Protection of Transmission Line. [Text Book 2: CH 11.2, 11.3, 11.7, 11.8, 11.9]

College/Institute Portion (20%): (2 Hours)

Protection of Transmission Lines: (Over current and Carrier-aided Protection)
Over current Relay, Application of Definite Time OC Relay and IDMT Relay for protection of a distribution feeder, protection of a three phase feeder, Directional Over current Relay, Need for Carrier-aided Protection, Various options for a Carrier, Coupling and Trapping the carrier into the desired line section, Unit type Carrier-aided Directional comparison Relaying, Carrier-aided Distance schemes for Acceleration of Zone II, Phase comparison Relaying.[Text Book 2 : CH 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- I V **[10 Hours]**

University Portion (80%) : (8 Hours)

Switchgears: Auto reclosing, Theory of Circuit interruption, Circuit constants in relation to Circuit breaking, Re-striking voltage transient, characteristics of Re-striking Voltage, Interaction between breaker and circuit, Current chopping.
Circuit Breakers: Types of circuit breakers (air blast, air break, oil, vacuum, SF6 , DC circuit breaker), advantages and testing of circuit breaker.[Text Book 1: CH 7.1, 7.2, 7.3, 7.4, CH 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 14.2,14.3, 14.4, 14.5, 14.6, 14.7, 15.2, 15.3, 15.5, 16.2, 16.3, 16.4, 18.2, 18.5, 18.6, 18.7, 18.8]

College/Institute Portion (20%): (2 Hours)

Protection against Over voltage due to lightning: Mechanism of Lightning, Lightning stroke, Over voltage due to lightning, Protection against lightning, Different types of Arrester, Arrester Ratings, Arrester locations and effect of cables, Surge Absorber.[Ref. Book 2: CH12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8] Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Books:

1. *Power System Protection and Switchgear – B.Ravindranath & M.Chander–New Age International Publishers (Second Edition).*
2. *Bhavesh Bhalja, R P Maheshwari, Nilesh G.Chothani, Oxford University Press*
3. *Fundamentals of Power System Protection – Y.G.Paithankar and S.R.Bhide, PHI Publication. (Second Edition)*

Reference Books:

1. *Electrical Power System - C.L.Wadhwa New Age International Publishers. (Sixth Edition).*
2. *Power System Engineering - M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, Dhanpat Rai & Co. (P) Ltd.*
3. *Protection and Switchgear - B.Bhalja, R.P.Maheshwari, N.G. Chothani, OXFORD University Press.*
4. *Power System Protection and Switchgear - Badri Ram, Vishwakarma, Tata McGraw hill.*
5. *Switchgear and Protection – Sunil S Rao , Khanna Publishers, New Delhi.*
6. *Power System relaying by Horwitz, Phadke, Research Press.*

POWER STATION ENGG. & ECONOMY

Module-I **[10 Hours]**

University Portion (80%):

Introduction (1 hour)

Introduction to different sources of energy and general discussion on their application to generation, Indian Energy Scenario. (Nag-1.5)

Prediction of Load (2 hours)

Connected Load, Maximum Load, Demand Factor, Average load, Load Factor, Load duration curves,Diversity Factor, Choice of Type of Generation, Capacity Factor, Reserve Factor, Plant Use Factor, Base Load, Intermediate Load and Peak Load Plants. (Nag-1.2)

Economics of power generation (5 hours)

Cost of Electrical Energy, Construction costs, Fixed cost, Costs for Energy, Depreciation of Plant, Fuel cost, Economic scheduling principle, Annual Operating Costs, Effect of Load Factor on cost per kWh, Tariff or Charge to Consumer. (Nag-1.4, Deshpande-2.2, 2.3, 2.6, 2.7, 2.8, 2.9)

College/Institute Portion (20%): (2 hours)

Tariff or Charge to Consumer, Specific Economic Energy Problems (Deshpande-2.9, Vopat-33.1, 33.2, 33.3, 33.4, 33.5) or related advanced topics as decided by the concerned faculty teaching the subject.

Module-II **[8 Hours]**

University Portion (80%):

Nuclear power station (6 hours)

Introduction to fission & fusion, Principle of Nuclear Energy, Reactor Construction, Controlled Chain Reaction, Brief study of various Types of Power Reactor, Operational Control of Reactors, Location and layout of nuclear power plant ,Economics of Nuclear Power Station. (Nag- 9.5, 9.6, 9.13, 9.15 - 9.21, Deshpande-6.2, 6.3, 6.4, 6.5, 6.6, 6.9, 6.13)

College/Institute Portion (20%): (2 Hours)

Different types of generators and Exciters, earthing of a power system (Deshpande-10.2, 10.3) or related advanced topics as decided by the concerned faculty teaching the subject.

Module-III **[10 Hours]**

University Portion (80%):

Hydro Electric power station: (2 hours)

Selection of site for hydro-electric power plant. (Nag-10.4)

Hydrology: Hydrological cycle, precipitation, run-off and its measurement, hydrograph, flow duration and mass curves, Estimation of amount stored by a dam across the river,Storage and Pondage, Elementary idea about Earthen and Concrete Dam. (Deshpande-7.2, 7.3, 7.4, 7.5, 7.6, Nag – 10.5 - 10.7)

Types of Turbines: (3 hours)

Operational principle of Kaplan and Francis Turbine and Pelton wheel, Speed and Pressure Regulation, Work done and Efficiency .(Nag- 10.10 – 10.15, 10.24 - 10.25,Deshpande-8.3)

Arrangement and location of Hydroelectric Station: (3 hours)

Catchment area, Reservoir, Dam, Head Gate, Spillways, Pen stock, Surge Tanks, Scroll case, Draft tubes and Tail Race, Power House, Classification of Hydroelectric Power Plants. (Deshpande-7.7, Nag-10.8, 10.9) Governors, Plant auxiliaries. (Nag – 10.21)

College/Institute Portion (20%): (2 Hours)
Types of Hydroelectric Plant and their fields of use, characteristics of generators, Power station control (Deshpande-7.8, 8.8, 8.9)or related advanced topics as decided by the concerned faculty teaching the subject.

Module-IV **[10 Hours]**
University Portion (80%):
Thermal power station: (3 hours)
Selection of site for thermal power plant. (Nag-1.3)
Main Parts and Working of a Steam Station:
Overall Block Diagram indicating the air circuit, coal and ash circuit, water and steam circuit, various types of steam turbines, ash and coal handling system, High Pressure and High capacity water tube boilers, Economizer, Superheaters, De-Superheater, Re-heater, Air Pre-heater. (Vopat – 7.4, Chap-8, Chap-10, Nag-2.15, 6.3.1, 6.3.2, 6.4-6.6, 6.8, 6.12 - 6.15)
Draft System: (3 hours)
Natural, Induced Forced and Balance Draft, PA fan, FD fan, ID fan, Chimney. (Vopat – 9.1, 9.4, Nag- 4.14.1, 4.14.3, 4.15)
Condensers, Feed water heaters, Evaporators, Make-up water, bleeding of steam, cooling water system. (Vopat- 14.1, 14.6, 18.2, 18.13, Nag – 8.1- 8.6)
Electrostatic Precipitator: (2 hours)
Basic working Principle and constructional details Governors, Plant auxiliaries. (Nag-6.10, Vopat- 12.14)
College/Institute Portion (20%): (2 Hours)
Brief idea about national grid and its operational problems or related advanced topics as decided by the concerned faculty teaching the subject.

Text books:

1. *P. K. Nag, "Power Plant Engineering", 3rd Edition, Tata McGraw Hill Publication.*
2. *M. V. Deshpande, "Elements of Electrical Power Station Design", PHI .*
3. *Bernhardt G. A. Skrotzki, William A. Vopat, "Power Station Engineering and Economy", 2nd Edition, Tata McGraw Hill Publication.*

References Books:

1. *Arora &Domkundwar, "A Course in Power Plant Engineering", Dhanpat Rai and sons.*
2. *R. K. Rajput, "A Text Book of Power Plant Engineering", 3rd Edition, Laxmi Publishing.*

HIGH VOLTAGE ENGINEERING

Module-I **[8 Hours]**

University Portion (80%): (7 Hours)

Generation of high voltage, Generation of high direct current- voltage, Alternating Current-voltage, Impulse voltage and Impulse currents. [Text Book 1:6.1, 6.2,6.3]

College/Institute Portion (20%): (1 Hour)

Tripping and control of impulse generators [Text Book 1:6.5] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-II **[12 Hours]**

University Portion (80%): (10 Hours)

Electrical breakdown in gas solid and liquid, Collision processes, Gaseous breakdown in uniform and non-uniform fields and corona. Ionisation process. Townsend's current growth equation. Townsend's criterion for breakdown. Determination of coefficients α and γ. Streamer's theory of breakdown in gases. Paschen's Law. Conduction and breakdown in pure and commercial liquid. Breakdown mechanism in solid and dielectric
[Text Book 1:2.2, 2.3, 2.4, 2.6, 2.7, 2.10, 2.11, 2.12, 3.4]

College/Institute Portion (20%): (2 Hours)

Post-Breakdown Phenomenon and Application, Testing of transformer oil [Text Book 1:2.13, 3.5] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-III **[12 Hours]**

University Portion (80%): (10 Hours)

Study of over voltage in electrical power system and measurement of high voltage :
Causes of overvoltage and its effect on power system. Lightning and switching surges and temporary high voltage, protection against over voltage. Measurement of high voltage and high current. [Text Book 1:8.1,8.2]

College/Institute Portion (20%): (2 Hours)

Digital technique in high voltage measurement. .Cathode-Ray Oscillographs for Impulse Voltage and current Measurement [Text Book 1:7.4] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module-IV **[8 Hours]**

University Portion (80%): (7 Hours)

High voltage testing and insulation coordination
High voltage testing of electrical apparatus [Insulator, Bushing, Isolator, Circuit breaker, Transformer, Surge Arrester, Cable] [Text Book 1:10.1, 10.2, 10.3, 10.4, 10.5]

College/Institute Portion (20%): (1 Hour)

Radio Interference Measurement, Testing HVDC valves and equipment [Text Book 1:10.6, 10.7] Or related advanced topics as decided by the concerned faculty teaching the subject.

Text book:

1. *M.S Naidu and V. Kamaraju, 'High Voltage Engineering'. Tata McGraw Hill,6th Edition 2015.*

Reference book:

2. *:E. Kuffel and W. S Zaengel,' High voltage engineering Fundamentals', Pergamon Press Oxford, London, 1986*

ELECTRICAL POWER QUALITY

Module-I **[12 Hours]**

Terms & Definitions: General Classes of Power Quality Problems, Transients, Long Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuations, Power Frequency Variations, Power Quality Terms.

Voltage Sags & Interruptions: Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Fundamental Principles of Protection, Solutions at the End-User Level, Evaluating the Economics of Different Ride-Through Alternatives, Motor Starting Sags, Utility System Fault-Clearing Issues.

(Chapter-2: 2.2 to 2.10 and Chapter-3: 3.1 to 3.7)

Module-II **[12 Hours]**

Transient Over Voltages: Sources of Transient Over Voltages, Principle of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor-Switching Transients, Utility System Lightning Protection, Managing Ferro-resonance, Switching Transient Problems with Loads, Computer Tools for Transient Analysis.

Fundamentals of Harmonics: Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Locating Harmonic Sources, System Response Characteristics, Effects of Harmonic Distortion, Inter-harmonics.

(Chapter-4: 4.1 to 4.8 and Chapter-5: 5.1 to 5.11)

Module-III **[10 Hours]**

Long Duration Voltage Variations: Principles of Regulating the Voltage, Devices for Voltage Regulation, Utility Voltage Regulator Application, Capacitors for Voltage Regulation, End-User Capacitor Application, Regulating Utility Voltage with Distributed resources, Flicker.

Power Quality Monitoring: Monitoring Considerations, Historical Perspective of Power Quality Measuring Instruments, Power Quality Measurement Equipments, Assessment of Power Quality Measurement Data, Application of Intelligent Systems, Power Quality Monitoring Standards.

(Chapter-7: 7.1 to 7.7 and Chapter-11: 11.1 to 11.6)

Text book:

1. *"Electrical Power Systems Quality" By Roger C. Dugan, Mark F. Mcgranaghan, Surya Santoso & H.Wayne Beaty, 2nd Edition, TMH Education Private Ltd., New Delhi.*

Reference Book:

1. *Power System Quality Assesment, J.Arrilaga, N.R.Watson, S.Chen, John Wiley & Sons.*
2. *Understanding Power Quality Problems: Voltage Sags & Interruptions, M.H.J. Boller IEEE, 1999*

DIGITAL IMAGE PROCESSING

MODULE-I

Fundamentals – Steps in digital image processing, sampling and quantization, relationship between pixels, imaging geometry

Image Transforms – Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Hotelling Transform.

MODULE-II

Image Enhancement – Point processing, spatial filtering (smoothing and sharpening filters), enhancement in frequency domain.

Filtering in the Frequency Domain: preliminary concepts, 2D DFT and its properties, basic filtering in the frequency domain, image smoothing and sharpening.

MODULE-III

Image Restoration and Reconstruction: Image restoration/degradation model, noise models, restoration in the presence of noise only, estimating the degradation function.

Color Image Processing: Color models, Color transformation.

MODULE-IV

Wavelets and Multi-resolution Processing: multiresolution expansions, wavelet transforms in one and two dimension.

Image Compression: Fundamentals, Some basic compression methods (Chapt: 8 of Text book 1)

ADDITIONAL MODULE (Terminal Examination-Internal)

Morphological Image Processing: Erosion and Dilation, opening and closing.

Text books

1) Digital Image Processing, R.C. Gonzalez, R.E. Woods, Pearson Education , 3rd Edition, 2007
2) Digital Image Processing, S. Sridhar, Oxford University Press,2011
3) Digital Image Processing And Analysis, B. Chanda, Dutta D. Majumder ,PHI

Reference Books

1) Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard E. Woods Pearson Education, Inc., Seventh Edition, 2004.
2) Digital Image Processing, S. Sridhar, Oxford University Press,2011
3) Digital Image Processing, William K. Pratt, John Wiley, New York, 2002

TENTATIVE
Likely to be Modified

ADAPTIVE SIGNAL PROCESSING
3-1-0

MODULE–I (10 Hours)

Introduction: Adaptive Systems – Definition and characteristics, General properties, Open and Closed Loop Adaptations, Applications.

The Adaptive Linear Combiner: Performance function, Gradient and Mean Square Error, Examples.

MODULE – II (14 Hours)

Theory of Adaptation with Stationary Signals: Properties of the Quadratic Performance Surface, Significance of eigen values, eigen vectors, correlation matrix.

Searching the Performance Surface: A simple gradient search algorithm, Stability and Rate of convergence, the learning curve.

MODULE-III (16 Hours)

Gradient Estimation and its effects on Adoption: The performance penalty, Variance of the gradient estimate, Misadjustment.

Adaptive Algorithms and Structures: The LMS Algorithm, Convergence, learning Curve, Performance analysis, Filtered X LMS algorithm,

MODULE-IV

Applications: Adaptive Modelling and System Identification using adaptive filter, Inverse Adaptive Modelling, Deconvolution, and equalization using adaptive filter.

ADDITIONAL MODULE (Terminal Examination-Internal)

Adaptive Control Systems using Filtered X LMS Algorithm, Adaptive Noise Cancellation using Adaptive filter

Text Books

1. *Adaptive Signal Processing*, Bernard Widrow and Samuel D. Stearns, Pearson Education, 2nd impression, 2009.

Reference Books

2. *Adaptive Filter Theory*, Simon Haykin, Pearson Education, 4th Edn.

TENTATIVE
Likely to be Modified

BIOMEDICAL INSTRUMENTATION (3-1-0)

University level: 80%

Module I (13 Hours)

Introduction to Bioengineering, Biochemical Engineering, Biomedical Engineering, Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, use of microprocessors in medical instruments, PC based medical Instruments, general constraints in design of medical Instrumentation system & Regulation of Medical devices.

Bioelectrical Signals & Electrodes: Origin of Bioelectric Signals, Electrocardiogram, Electroencephalogram, Electromyogram, Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts.

Module -II (14 Hours)

Electrodes for ECG: Limb Electrode, Floating Electrodes, Prejelled disposable Electrodes, Electrodes for EEG, Electrodes for EMG.

Physiological Transducers: Introduction to Transducers, Classification of Transducers, Performance characteristics of Transducers, Displacement, Position and flow and pressure Transducers.

Strain gauge pressure transducers, Thermocouples, Electrical Resistance Thermometer, The mister, Photovoltaic transducers, Photo emissive Cells & Biosensors or Biochemical sensor

Module –III (13 Hours)

Recording Systems: Basic Recording systems, General considerations for Signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling)

20% Course (Institute Level)

Transformation techniques in biomedical signals ie. Laplace transform, Z-transform, DFT, DTFT, STFT, Wavelet transform, Effects of noise in biomedical instruments- filtering in biomedical instruments.

Text Books:-

1. *Hand Book of Biomedical Instrumentation-2nd Ed by R.S.Khandpur, Tata McGraw Hill, 2003*
2. *Introduction to Biomedical Engineering by Michael M. Domach, Pearson Education Inc,-2004*

Reference Books:

(1) *Introduction to Biomedical equipment technology, 4e. By JOSEPH.J.CAAR & JOHN M.BROWN (Pearson education publication)*

(2) *Medical Instrumentation-application & design. 3e – By JOHN.G.WEBSTER John Wiley & sons publications*

SOFT COMPUTING

MODULE – I ***(8 hours)***

Basic tools of soft Computing: Fuzzy logic, Neural Networks and Evolutionary Computing, Approximations of Multivariate functions, Non – linear Error surface and optimization.

MODULE – II ***(8 hours)***

Fuzzy Logic Systems: Basics of fuzzy logic theory, Crisp and fuzzy sets; Basic set operations; Fuzzy relations, Composition of Fuzzy relations, Fuzzy inference, Zadeh's compositional rule of inference; Defuzzificaiton ; Fuzzy logic control; Mamdani and Takagi and Sugeno architectures. Applications to pattern recognition.

MODULE—III ***(16 hrs)***

Neural networks: Single layer networks, Perceptron; Activation functions; Adalinc- its training and capabilities, weights learning, Multilayer perceptrons; error back propagation, generalized delta rule; Radial basis function networks and least square training algorithm, Kohenen self – organizing map and learning vector quantization networks; Recurrent neural networks, Simulated annealing neural networks; Adaptive neuro-fuzzy information; systems (ANFIS),

MODULE—IV ***(08 hrs)***

Evolutionary Computing: Genetic algorithms: Basic concepts, encoding, fitness function, reproduction. Differences of GA and traditional optimization methods. Basic genetic, basic evolutionary programming concepts Applications, hybrid evolutionary algorithms.

ADDITIONAL MODULE (Terminal Examination-Internal)

Applications to Different Engineering problems.

Text Books

1) *F. O. Karry and C. de Silva, "Soft Computing and Intelligent Systems Design – Theory, Tools and Applications". Pearson Education. (Printed in India).*

Reference Books

2) J. S. R. Jang. C. T. SUN and E. Mizutani, "Neuro-fuzzy and soft-computing". PHI Pvt. Ltd., New Delhi.

3) Fredric M. Ham and Ivica Kostanic, "Principle of Neuro Computing for Science and Engineering", Tata McGraw Hill.

4) S. Haykins, "Neural networks: a comprehensive foundation". Pearson Education, India.

5) V. Keeman, "Learning and Soft computing", Pearson Education, India.

6) R. C. Eberhart and Y. Shi, "Computational Intelligence Concepts to Implementation". Morgan Kaufmann Publishers (Indian Reprint).

TENTATIVE Likely to be Modified