G H RAISONI COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)
Accredited by NAAC with 'A+' Grade
CRPF Gate No.3, Hingna Road, Digdoh Hills, Nagpur – 440 016. (INDIA)
Phone : +91 9604787184, 9689903286, 9921008391 Fax : +91 – 7104 – 232560
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Note: Applicable from 2018-19

Institute Vision and Mission

Vision

To achieve excellent standards of quality education by keeping pace with rapidly changing technologies and to create technical manpower of global standards with capabilities of accepting new challenges.

Mission

Our efforts are dedicated to impart quality and value based education to raise satisfaction level of all stake-holders. Our strength is directed to create competent professionals. Our Endeavour is to provide all possible support to promote research and development activities.

Programme: UG in Electrical Engineering

Vision and Mission of Department

Vision

To achieve excellent standards of quality education by keeping pace with rapidly changing technologies and to create technical manpower of global standards in electrical engineering with capabilities of accepting new challenges.

Mission

- To educate next generation of Engineers with strong knowledge base of electrical engineering
- To Produce technical manpower capable of addressing industry problems
- To pursue scholarly research in broad areas of electrical engineering

Program Educational Objectives:

Graduates shall able to

PEO1 Practice electrical engineering in Power System, drives & control.
PEO2 Contribute to technical and economic development of society
PEO3 Pursue higher education and work for research and development of society

Program outcome

Student shall able to

PO1: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO 2: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO 3: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for
public health and safety, cultural, societal and environmental considerations
PO 4: Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
PO 5: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO 6: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PO 7: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PO 8: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO 09: Function effectively as an individual, and as a member or leader in diverse teams and in multi disciplinary settings
PO 10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
PO 11: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PO 12: Recognize the need for and have the preparation and ability to engage in
Independent and life-long learning in the broadest context of technological change.

Program Specific outcomes
Graduates shall

PSO1 Demonstrate industrial practices learned through internship and solve the live-problems of industries.
PSO2 Utilize skills in transforming ideas into hardware project and to protect intellectual property rights.
PSO3 Propose innovative solutions in the area of Power Systems and Electric Drives.

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Department of Electrical Engineering

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int.	Ext.	
SEMESTER-I												
BFYL101	Matrices	1	1	-	2	2	10	15	25	--	--	50
BFYL102	Differential & Vector Calculus	1	1	-	2	2	10	15	25	--	--	50
BEEL101 / BEEP101	AC & DC Circuits	1	-	2	3	2	10	15	25	25	--	75
BEEL102	AC & DC Machine	2	-	-	2	2	10	15	25	--	--	50
BEEL103	Energy Sources & Audit	1		-	1	1	10	15	--	--	--	25
BITL101 / BITP101	Programming for Problem Solving	1	-	4	5	3	10	15	25	50	--	100
BECL104	Bio-System in Engg.	1	1	-	2	2	10	15	25	--	--	50
BCSP101	Data Analytics	-	-	2	2	1	--	--	--	25	--	25
BECL101 / BECP101	Introduction to Digital System	1	1	2	4	3	10	15	25	25	--	75
BHUP103	Foreign Language	-	-	2	2	1	--	--	--	25	--	25
BHUP104	Liberal/ Creative Arts	-	-	1	1	0.5	--	--	--	25	--	25
BFYP131	Waste Management	-	-	2	2	1	--	--	--	25	--	25
BFYP132	Environmental Science	-	-	1	1	0.5	--	--	--	25	--	25
TOTAL		**9**	**4**	**16**	**29**	**21**	**80**	**120**	**175**	**225**	**0**	**600**

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th	Tu	Pr	Total		TAE	CAE	ESE	Int.	Ext.	
SEMESTER-II												
BFYL103	Integral & Multiple Calculus	1	1	-	2	2	10	15	25	--	--	50
BFYL104	Ordinary & Partial Differential Equations	1	-	-	1	1	10	15	25	--	--	50
BCSP102	Data Structure	-	-	4	4	2	--	--	--	50	--	50
BFYP152	Internet of Things	-	-	2	2	1	--	--	--	25	--	25
BFYL121 / BFYP121	Applied Physics	1	1	2	4	3	10	15	25	25	--	75
BECL102 / BECP102	Analog Circuits	1	1	2	4	3	10	15	25	25	--	75
BECP103	Embedded Programming	-	-	2	2	1	--	--	--	25	--	25
BMEP102	Digital Fabrication	-	-	4	4	2	--	--	--	50	--	50
BFYP151	Mini Model through Innovation & Creativity	-	-	4	4	2	--	--	--	50	--	50
BHUL101 / BHUP101	Communication Skills	-	2	2	4	3	10	15	25	50	--	100
BHUP102	Ethics & Professional Competencies	-	-	2	2	1	--	--	--	25	--	25
BMBP101	Entrepreneurship	-	-	2	2	1	--	--	--	25	--	25
TOTAL		**4**	**5**	**26**	**35**	**22**	**50**	**75**	**125**	**350**	**0**	**600**

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.	
SEM-III												
BFYL145	Laplace Transform & Fourier Transform	1	1	-	2	2	10	15	25		-	50
BEEL206/ BEEP206	Network Theory	2	-	2	4	3	10	15	25	25	-	75
BEEL207/ BEEP207	Sensors & Actuators	2	-	2	4	3	10	15	25	25	-	75
BECL215/ BECP215	Electronics Devices & Circuits	2	-	2	4	3	10	15	25	25	-	75
BEEL208	Static machine (Three Phase Transformer)	1	-	-	1	1	10	15	25		-	50
BEEL209/ BEEP209	Rotary machine	1	-	2	3	2	10	15	25	25	-	75
BCSL208/ BCSP208	Database Management System	2	-	2	2	3	10	15	25	25	-	75
BAIL101	Artificial Intelligence & its applications	2	-	-	2	2	10	15	25		-	50
BAIP202	Skill development 1 (Linear Algebra)	-	-	2	2	1	-	-	-	25	-	25
BHUP202	Reasoning	-	-	1	1	0.5	-	-	-	25	-	25
BHUP 203	Quants	-	-	1	1	0.5	-	-	-	25	-	25
Total		**13**	**1**	**14**	**28**	**21**	**80**	**120**	**200**	**200**	**0**	**600**

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.	
SEM-IV												
BFYL146	Fourier series and Partial differential equations	1	1	-	2	2	10	15	25			50
BEEL210/ BEEP210	Synchronous machine	1	-	2	3	2	10	15	25	25		75
BECL212	Signals and Systems	1	-	-	1	1	10	15	25			50
BEEL211	Elements of Electromagnetics	1	-	-	1	1	10	15	25			50
BECL213	Analog and Digital Communication	1	1	-	2	2	10	15	25			50
BMBP102	Entrepreneurship Development	-	-	2	2	1				25		25
BEEL212	Fundamentals of power Systems	2	-	-	2	2	10	15	25			50
BECL218	Embeded Systems Design	2	1	-	3	3	10	15	25			50
BEEP213	Skill Development 2 :	-	-	1	1	1				25		25
BHUP205	Business English Certification	-	-	4	4	2				50		50
BEEL214 BEEP214	Basic Power Electronics	2	-	2	4	3	10	15	25	25		75
BHUP204	Liberal Arts	-	-	1	1	0.5				25		25
BHUP206	Aptitude 1	-	-	1	1	0.5				25		25
Total		**11**	**3**	**13**	**27**	**21**	**80**	**120**	**200**	**200**	**0**	**600**

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.	
SEM-V												
BFYL147	Z-Transform & Steady state Variable	1	1	-	2	2	10	15	25			50
BEEL319/ BEEP319	Basic Control System	1	-	2	3	2	10	15	25	25		75
BEEL320/ BEEP320	Power System Analysis	2	-	2	4	3	10	15	25	25		75
BEEL321	Electrical Installation & Design	1	-	-	1	1	10	15	25			50
BEEP322	Skill development-III	-	-	2	2	1				25		25
BEEP323	Project Manangement:	-	-	2	2	1				25		25
BAIL203	Machine Learning Algorithm	2	-	-	2	2	10	15	25			50
MBP 301	Financial Management for Engineers	0	-	1	1	0.5				25		25
BEEL324/ BEEP324	Electric Drives	2	-	2	4	3	10	15	25	25		75
BHUP302	Aptitude 2	-	-	1	1	0.5				25		25
BEEP325	Internship	-	-	2	2	2				50		50
MBP104	Advanced Communication skill	-	-	4	4	2				50		50
Total		**9**	**1**	**18**	**28**	**20**	**60**	**90**	**150**	**275**	**0**	**575**

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.	
SEM-VI												
BFYL148	Optimization	1	1	-	2	2	10	15	25			50
BEEL326	Power Station Practice	2	-	-	2	2	10	15	25			50
BEEL327	Non Linear Control Systems	1	-	-	1	1	10	15	25			50
BEEL328/ BEEP328	Switch gear and Protection	2	-	2	4	3	10	15	25	25		75
XXXXXX	Elective-II	1	-	-	1	1	10	15				50
BEEL329	Skill development-IV:	0	-	2	2	1				25		25
BEEL330/ BEEP330	High Voltage Engg.	2	-	2	4	3	10	15	25	25		50
BEEL331	Power System Dynamics	1	-	-	1	1	10	15	25			50
BHUP207	Soft Employbility skill	0	-	1	1	0.5				25		25
BMEP319	Product Development & IPR	0	-	2	2	1				25		25
XXXXXX	Open Elective -II	2	-	-	2	2	10	15	25			50
XXXXXX	Elective-I	1	-	-	1	1	10	15	25			50
BHUP303	Aptitude 3	-	-	1	1	0.5				25		25
Total		**13**	**1**	**10**	**24**	**19**	**90**	**135**	**200**	**150**	**0**	**575**

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.	
SEM-VII												
BEEP417	Industry Internship	-	-	12	12	12	-	-	-	100	200	300
BEEP418	Project Phase-I	-	-	4	4	4	-	-	-	50	50	100
BEEL419	Open Elective MOOCS I	2	-	0	2	2	10	15	50	-	-	75
Total		**2**	**-**	**16**	18	**18**	**10**	**15**	**50**	**150**	**250**	**475**

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.	
SEM-VIII												
XXXXXX	Elective-III	2	-	-	2	2	10	15	25			50
XXXXXX	Elective-IV	2	-	-	2	2	10	15	25			50
XXXXXX	Elective-V	2	-	-	2	2	10	15	25			50
XXXXXX	Elective-VI	2	-	-	2	2	10	15	25			50
XXXXXX	Elective-VII	2	-	-	2	2	10	15	25			50
XXXXXX	Elective-VIII	2	-	-	2	2	10	15	25			50
BHUP304	Career Development Practices	-	-	2	2	1	-	-	-	50	-	50
BEEL421	Open Elective MOOCS -II	1	-	-	1	1	5	5	15		-	25
BEEP422	Project Phase-II	-	-	4	4	4				50	50	100
Total		**13**	**0**	**6**	**19**	**18**	**65**	**95**	**165**	**100**	**50**	**475**
TOTAL 1st SEMESTER TO 8th SEMESTER		**73**	**16**	**109**	**195**	**160**	**505**	**755**	**1265**	**1650**	**300**	**4500**

Pool of Electives
Battery Technology
Super capacitors
Charging Station
Utilization of Non Conventional Energy Sources
Mechtronics
Power Semiconductor Based Drives
Digital Signal Processing
Analysis of Special Machines
Application of Sensor and Actuators in Electric Vehicle
Advanced Electricsl Drives and Control
Advanced Power Electronics
Digital Control
Digital Design
Energy Efficient Systems (Optimization of Electricity)
FACTS

III SEM (EE)

Mathematics –V

Laplace Transform & Fourier Transform (2 Credit)[30Hrs]

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						
							Theory			Practical		Total	Duration of Paper
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.		
	SEM-III												
BFYL145	Mathematics-V (Laplace Transform & Fourier Transform)	1	1	0	2	2	10	15	25			50	1.5

Course Objectives:

1. Understand the mathematical descriptions in Laplace Transform & Fourier Transform
2. Analyze problems, recognize appropriate methods of solution, solve the problems, and find the solutions.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Understand and use Laplace transform to solve engineering problems.
2. Apply the concept of of laplace transform to solve applications based problems in field of engineering
3. Calculate Fourier Transforms for the variety of simple functions.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	3.0	3.0	0.0	0	0	0	0	0	0	0	0	2	3	1	
CO2	3.0	3.0	0.0	0	0	0	0	0	0	0	0	2	3	1	
CO3	3.0	3.0	0.0	0	0	0	0	0	0	0	0	2	3	1	
CO4	3.0	3.0	0.0	0	0	0	0	0	0	0	0	2	3	1	
CO5	3.0	3.0	0.0	0	0	0	0	0	0	0	0	2	3	1	
CO6	3.0	3.0	0.0	0	0	0	0	0	0	0	0	2	3	1	

UNIT 1: LAPLACE TRANSFORM: (10HRS)

Definition and their simple properties, Transform of derivatives and integrals, Evaluation of integrals by L.T. Inverse L.T. & its properties, Convolution theorem, Laplace transforms of periodic function & unit step function,

UNIT 2: APPLICATIONS OF LAPLACE TRANSFORM:(10HRS)

Applications of Laplace transform to solve ordinary differential equations.Applications of Laplace Transform in control System: Analogues system, Closed loop system and open loop system, Transfer function . And problems based on it.Laplace transform of signals: Unit step , Ramp, Parabolic, impulse , Dirac Delta

UNIT 3 : FOURIER TRANSFORMS: (10HRS)

Statement of Fourier integral theorem - Fourier transform pairs - Fourier Sine and Cosine transforms - Properties - Transforms of simple functions - Convolution theorem - Parseval's identity

Text Books:

1. Higher engineering Mathematics by B S Grewal, 43rd edition, Khanna Publication.
2. Advanced engineering Mathematics by Erwin Kreysizig, 8th edition Wiley India
3. **Control System by Nagrath & Gopal**

Reference Books:

1. Advanced Mathematics for Engineers and Scientists ; Spiegel, M. R, McGraw-Hill
2. Advanced Engineering Mathematics, Jain, R.K. and Iyengar, S.R.K, Narosa Publishers; Alpha Science International, Ltd

Quantifiers - Predicate calculus including theory of inference.

SUBJECT 3: ELECTRONIC DEVICES AND CIRCUIT

SCHEME:E&TC

Sub code : - BECL211/BECP211

Third Term													Course Category
A Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						Duration of Paper	
						Theory			Practical		Total Marks		
	Th.	Tu.	Pr.	Hours		TAE	CAE	ESE	Int.	Ext.		Hours	
Electronic Devices & Circuits	2	-	2	4	3	10	15	25	25		75	2	Program Core

COURSE OBJECTIVES:

1. To gain knowledge of transistor small signal analysis.
2. To study need different types of amplifiers and oscillator.
3. To familiarize the students with the analysis of unipolar devices

4. To use appropriate experimentation techniques to evaluate circuit performance.

COURSE OUTCOMES:

On successful completion of the course, Students shall be able to:

CO1:Understand the concept of compensation techniques, Low frequency and High frequency analysis.

CO2: Understand the concepts of feedback and apply the concepts for improvement of performance of amplifier and oscillator

CO3: Understand , analyze and design different types of power amplifiers and use methods for reduction of distortions

CO4: Understand the operation of the Field Effect Transistor (FET), Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and design FET circuits

CO5: Apply concepts of transistors & amplifier Circuits

CO6: Design simple circuits containing non-linear elements.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	3.0	2.0	2.0	2					2	2	2	2	3	2	
CO2	3.0	2.0	2.0	2					2	2	2	2	3	2	
CO3	3.0	2.0	2.0	2					2	2	2	2	3	2	
CO4	3.0	2.0	2.0	2					2	2	2	2	3	2	
CO5	3.0	2.0	2.0	2					2	2	2	2	3	2	
CO6	3.0	2.0	2.0	2					2	2	2	2	3	2	

SYLLABUS:

Unit I: Transistor Biasing & Small Signal Analysis (9 Hours)

Review of Transistor, Transistor current equations, Thermal Runaway ,Transistor Biasing & Stability, Compensation Methods, Two-port Devices & the Transistor Hybrid model, analysis of a transistor amplifier circuit using h parameters, comparison of transistor amplifier configuration, Miller's Theorem, the alpha cut-off frequency, the hybrid pi (II) common –emitter transistor model.

Unit II: Feedback Amplifiers & Oscillators (8 Hours)

Types of Feedback, Advantages & Disadvantages of Negative Feedback, Topology, Classification of Oscillators, Stability, Barkhausen Criteria, Design of RC, LC and Crystal Oscillators, Numerical

Unit III: Power Amplifier (7 Hours)

Classification A, B, AB, C, Efficiency, Push Pull Configuration (A, B, AB) Complementary symmetry, Second Harmonic and Cross over Distortion., Design of Power Amplifiers (Class A and Class AB)

Unit IV: Unipolar Devices (6 Hours)

Field Effect Transistor, MOSFET, NMOS, PMOS Principles of operation and characteristics, Biasing arrangement, small signal analysis of CG, CB and CD

TEXT BOOKS:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Electronics Devices and Circuits	S Salivahanan, N Suresh Kumar	Tata Mcgraw-Hill	2008	3
2	Integrated Electronics	Jacob Millman	Tata Mcgraw-Hill	2009	2
3	Electronic Devices & Circuits	Sanjiv Gupta Sanjay Gupta	DhampatRai Publication	2012	3

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Electronics devices and Circuits and Theory	Robert L. Boylestad, Louis Nashelsky	Pearson India	2009	10
2	Microelectronics Circuits	A.S. Sedra& K. C. Smith,	Oxford University Press	2013	7
3	Electronics Devices and Circuits	Nagrath I J	Phi Learning Pvt Ltd	2009	3

Sensors & Actuators (3 Credit) [36Hrs]

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						Duration of Paper
							Theory			Practical		Total	
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.		
	SEM-III												
BEEL207/ BEEP207	Sensors & Actuators	2	1	0	3	3	10	15	25			50	1.5

Course Objective

1. To make students understand the construction, working principle and application of various transducers used for different parameters such as flow measurement, strain measurement, pressure

and vacuum measurement, force, torque and power measurement

2. To solve industrial problems related to monitoring, co-ordination, measurement and control using various instrumentation used in application industry.

Course Outcome

The students should be able to

CO1: To gain knowledge of analog and digital instrumentation system.

CO2: To identify suitability of measuring instrumentation for desired parameter.

CO3: To illustrate the use of different transducers

CO4: To design integrate and innovate system for motion measurement.

CO5: To design measuring instruments for industrial applications relating to temp measurement

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Unit I: Basics of Instrumentation (6 Hrs)

Classification, Analog & Digital instruments, comparison of Analog & Digital instruments, advantages of digital instruments, classification of analog instruments. Indicating type instruments, recording type instruments.

Unit II: Measuring Instruments (10Hrs) Ammeters, Voltmeters, principle of moving coil, moving iron & Dynamometer type instruments, extension of range using series and shunts, errors due to extension of range. Digital Voltmeters:- Types of DVM, Ramp type DVM, integrating type DVM. Measurement of active and reactive power in polyphase circuits using dynamometer type instruments. General theory, extension of range using C.T. & P.T. Errors in instrument transformers, applications of instrument transformers for metering & protection. TOD Meters.

Unit III: Generalized Instrumentation Systems (6Hrs)

Active and passive transducers, Digital and analog mode of operation. Motion Measurement: - Relative and absolute motion measurement, measurement of velocity and acceleration. Electrical transducer for motion measurement, LVDT, piezoelectric transducer, variable inductance transducer, measurement of shaft torque and power.

Unit IV: Motion measurement: (8 Hrs)

Relative and absolute motion measurement of displacement, velocity and acceleration; Pressure sensing elements – manometers, elastic elements, Bourdon tube, diaphragm, bellows; electrical type, McLeod gauge, Pirani gauge; Flow sensing type – head meters (orifice, venturi), area meters, rotameters, electromagnetic flowmeter, Coriolis flow meter, Ultrasonic flowmeter; pH measurement

Unit V: Temperature Measurement & Miscellaneous Measurements (6Hrs)

Laws of thermo - electric circuits. Thermocouples cold junction compensation thermistors. Brief treatment of principles used in the measurement of liquid level, flow press and PH. Introduction to Hall Effect sensors.

Text Books:

1. A.K. Sawhney., A course in Electrical & Electronics measurement and instrumentation, 11th Edition, Dhanpat Rai And Son Publication, 1996

2. Rajput, Electrical Measurements, 1st Edition, S.Chand , 2009

Reference Books:

1. W.D. Cooper, Prentice Hall, Electronic Instrumentation and measurement Technique, 2nd Edition, P.H.I. Publication, 2007

2. Rangan, Instrumentation Devices and System, 2nd Edition, Tata Mcgraw Hill, 2008

3. Doebelin, Ernest, Measurement System application & Design, 5th Edition, Mc Graw Hill, 2004

Static Machine (Three Phase Transformer) (1 Credit) [14 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-III												
BEL208	Static machine (Three Phase Transformer)	1	0	0	1	1	10	15	25			50

Course Objectives:

1. Understand 3 ph. Transformers.
2. Analyse static machines.

Course Outcomes:

The students should be able to

CO1: Analyze the construction, principle, performance of 3-phase transformers, autotransformer.

CO2: Estimate the parallel operation of three phase transformer, conversion of three phase to two phase.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

UNIT-I: 3-Phase Transformer & Autotransformer (8 Hrs)

Basics of Autotransformers, 3 Phase Transformer principle and operation, Polarity test, various connections and vector groups,online tap changers, Distribution and Power Transformer and All day efficiency.

Unit II Parallel operation of Transformer (6 Hrs)

Three phase to two phase conversion (Scott Connection), parallel operation of three phase transformer, Basics of methods of cooling, temperature rise test, maintenance of transformer, and insulation of transformer,Protection of transformer, Commissioning tests performed on transformer.

Text Books:

1. P.K. Mukherjee, Electrical Machines, 2nd Edition, Dhanpatrai Publications, 1996

2. Dr. P.S. Bimbhra, Electrical Machines, 2 ndEdition, Khanna Publications, 1995

Reference Books:

1. I.S. Nagrath & Dr. D.P. Kothari, Electrical Machines, 1stEdition, Tata Mc Graw Hill, 1997

2. A E Fitzgerald, Charles Kingsley , Stephen Umans, Electrical Machinery, 6thEdition, Mc Graw Hill, 2003

Rotary Machine (1 Credit)[15hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-III												
BEEL209/ BEEP209	Rotary machine	1	0	2	3	2	10	15	25	-	25	75

Course Objectives:

1. To develop familiarity with DC Machines, 1 ph. & 3 ph. Induction machines.
2. To study starting, breaking & reversal of AC & DC Machines.

Course Outcomes:

The students should be able to

CO1: To impart knowledge on construction, principle, performance, control and applications of DC Motors.

CO2: To impart knowledge on understand the construction, principle, performance, control and applications of three phase induction motor.

CO3: Ability to troubleshoot connects, run, control and test 3 ph Induction motor.

CO4: To understand operating principle and performance analysis of special machines.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

Unit-I: D.C. Machines (7 Hrs)

Basic principle of electromagnetic energy conversion, generalized torque expression, Armature reaction & commutation, Types of winding, Compensating winding, interpoles, Characteristics of shunt, series & compound motor and generator, speed control of d.c. shunt & series motor

Unit-II: Three Phase Induction Motor(3 Hrs)

Determination of machine parameters, No load test, blocked rotor test, equivalent circuit, losses, efficiency, operating characteristics & influence of machine parameter on the performance of

motor, Introduction of I2 and I3 (industrial)motors.

Unit-III: Speed control of 3 phase I.M(3 Hrs)
Speed control of I.M. by pole changing, frequency control, Speed control of wound I.M. by varying rotor resistance, varying supply voltage, braking, regenerative braking, plugging, dynamic braking, Crawling & cogging.

Unit-IV: Single phase induction moto(2 Hrs)
Double field revolving and cross field theory, Types of single phase induction motor, Permanent magnet brushless motors: construction, principle and types torque

Text Books:
1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Reference Books:
1. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
2. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
3. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

NETWORK THEORY (3 Credit) [40 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-III												
BEEL206 / BEEP206	Network Theory	2	1	0	3	3	10	15	25			50

Course Objectives:
1. The subject aims at basic components
2. To study various sources and circuit analysis method used in electrical system and their behavior.
3. To study various numerical methods

Course Outcomes
Able to understand:
CO1: Analyze circuits with ideal, independent, and controlled voltage and current sources. using Mesh & Nodal analysis.
CO2: Determine the equivalent circuits of a network that include passive devices, dependent sources, and independent sources
in combination using network theorems.
CO3: Understand and measure the transient and sinusoidal Steady-state Responses of simple RC and RLC circuits CO4 : Determining two port network parameters and one parameter in terms

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	3.0	2.0	1.0	1	1	0	0	0	2	2	2	2	3	2	
CO2	3.0	2.0	1.0	1	1	0	0	0	2	2	2	2	3	2	
CO3	3.0	2.0	1.0	1	1	0	0	0	2	2	2	2	3	2	
CO4	3.0	2.0	1.0	1	1	0	0	0	2	2	2	2	3	2	
CO5	3.0	2.0	1.0	1	1	0	0	0	2	2	2	2	3	2	
CO6	3.0	2.0	1.0	1	1	0	0	0	2	2	2	2	3	2	

Syllabus:
Unit I:Nodal and Mesh analysis (8 Hrs)
Nodal and Mesh analysis, basic equilibrium equations, matrix approach for complicated network, containing voltage, current sources, Mutual Inductances, source transformations, Duality.

Unit II: Network Theroms (7 Hrs)
Reciprocity, Thevenin's, Norton's, maximum power transfer, compensation, Tellegen's theorem as applied to A.C. Circuits.

Unit III: Transfer functions (6 Hrs)
Transient behaviors, concept of complex frequency, Driving points and transfer functions, poles, zeros of admittance function, their properties, sinusoidal response from Pole-zero locations, convolution theorem and integral solution.

Unit IV: Two port network and filter(7 Hrs)
Two port network parameters and interconnections,Three Phase unbalanced circuits

and power calculations. Introduction of Basic filters (R-C, L-C).
Advanced topic on the subject

Text Books:

- Networks & Systems by D Roy Choudhury [partial ebook]
- Engineering Circuit Analysis by W. H. Hayt, J. E. Kemmerly & S. M. Durbin
- Fundamentals of Electric Circuits by C. K. Alexander & M. N. O. Sadiku

Reference Books:

- Network Analysis and Synthesis by Franklin F. Kuo [ebook]
- Network Analysis, M. Van Valkenburg, Pearson Education, 2006
- Introduction to Modern Network Synthesis, M. Van Valkenburg, John Wiley & Sons.

Object oriented Programming (C++, Java)

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-III												
	Object oriented Programming (C++, Java)	1	1	0	2	2			25			25

Course Objective:

1. This course introduced features of object oriented programming.
2. The course provide carrier opportunities in implementation of various applications as object oriented concepts plays dominant role in software development.

Course Outcome:

Upon successful completion of the course, students shall be able to–

CO 1: Articulate the principles of object oriented programming using C++

CO 2:Understand function overloading, constructor overloading, operator overloading, polymorphism & its uses in programming.

CO3:Implement inheritance concepts and its use for application development

CO4:Analyze of dynamic memory allocation and its use for software development

CO5:Implement concept of file handling in real life problems

CO6: Implement a project for real world problems

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

Unit-I: Principles of Object Oriented Programming - [03 Hrs]

Introduction to OOPS: Differences between C and C++.A look at procedure Oriented programming, object oriented programming paradigm, basic concepts of OOP, Headers & Name Spaces

Unit-II: Functions & Polymorphism - [04 Hrs]

Functions, Types of Functions, Constructor, Destructor, Function overloading & Ambiguity, Operator Overloading, Function Overriding, Friend Function

Unit-III: Inheritance & Virtual Functions - [04 Hrs]

Inheritance and the access specifies, Types of Inheritance, Pointers and references to derived types, Virtual Functions

Unit-IV: Pointers & Dynamic allocations- [03 Hrs]

Static & Dynamic allocation using new and delete,* and ->* operators, Creating conversion functions, this pointer.

Text Books:

1. Object Oriented Programming in C++ -Robert Lafore, edition, Galgotia publications
2. The Complete Reference C++, Herbert Schildt, 4th Edition, TMH

Reference Books:

1. Let's C++ by Y. Kanetkar, BPB publications
2. Object oriented programming with C++, E Balagurusamy, 4th edition, TMH
3. Object-Oriented Programming with C++, SouravSahay, Oxford University Pres

Course Name : Signals & Systems

Course Code : BECL212

Scheme of the Course:													
Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						Duration of Paper Hours	Course Category
						Theory			Practical		Total Marks		
	Theory	Tutorial	Practical	Total Hours		TAE	CAE	ESE	Int.	Ext.			
Signal & Systems	1	1	-	2	2	10	15	25	-	-	50	2	Core

Course Objectives :

To introduce the fundamentals, characteristics, concept techniques of signals & systems.
Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide
Development of the mathematical skills like fourier series, fourier transforms, Random theory to solve problems involving convolution, filtering, modulation and sampling
To define channel capacities and properties using Shannon's Theorem and calculate the information content

Course Outcomes:

Student shall be able to

CO1. Students will be able to represent & classify signals, Systems & identify LTI systems

CO2. Students will be able to derive Fourier series & Fourier transform for different signals

CO3. Students will be able to analyze the Continuous Time systems by performing Convolution

CO4. Students will be understand Discrete time systems and LTI systems.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Course Contents

Introduction to Signals and Systems:
[07 Hours]

Signals and systems as seen in everyday life, and in various branches of engineering and science electrical, mechanical, hydraulic, thermal, biomedical signals and systems as examples. Extracting the common essence and requirements of signal and system analysis from these examples. Formalizing signals: energy and power signals, signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. Formalizing systems: system properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, Realizability. Examples

Continuous Time Fourier Transform:
[07Hours]

Representation of Aperiodic Signal, Fourier Transform for Periodic Signals, Properties of CTFT, Convolution and multiplication property of continuous FT, Systems characterized by Linear Constant Coefficient Differential Equations. Convolution Property. Sampling Theorem, Effect of Under Sampling, and Sampling of Discrete -Time Signals

Continuous time and discrete time Linear shift-invariant (LSI) systems:
[08 Hours]

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations. Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. Parseval's Theorem. The idea of signal space and orthogonal bases of signals. Time de main and
Frequency domain aspects of ideal and non-ideal filters

Discrete Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT):
[08 Hours]

Properties of DTFT and DFT, convolution property, multiplication property, Duality, Systems characterized by Linear Constant Coefficient Difference Equations Laplace Transform for continuous time signals and systems: the notion of eigen functions of LSI systems, a basis of eigen

functions, region of convergence, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior.

Text Books:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Signals and Systems	(Alan V Oppenheim, Alan S Willsky, S Hamid Nawab)	Prentice Hall India	2009	2
2	Signals and Systems,	S. Haykin and B. VanVeen,	Wiley	1998	

Reference Books

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Digital Signal Processing, Principles Algorithms, and Applications	John G. Prokis, Dimitris G. Manolakis	PHI	2007	4
2	SignalProcessing	James H. McClellan	Pearson/Prentice Hal	2006	1
3	Signals and System, Third Edition, 2008	P. Ramesh Babu, R.anandaNatrajan,	Scitech	2008	3

SEMESTER IV

SUBJECT 1: SIGNALS AND SYSTEMS

Subject Code : BECL212

First Term													Course Category
Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						Duration of Paper	
						Theory			Practical		Total Marks		
	Th.	Tu.	Pr.	Total Hours		TAE	CAE	ESE	Int.	Ext.		Hours	
Signal and system	1	1	0	2	2	10	15	25	25	25	100	2	Core

Course Objectives:

1. To introduce the fundamentals ,characterstics, concept techniques of signals & systems.
2. Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide
3. Development of the mathematical skills like fourierseries,fouriertransforms,Random theory to solve problems involving convolution, filtering, modulation and sampling

4. To define channel capacities and properties using Shannon's Theorem and calculate the information content from its probability distribution.

Course Outcomes:

On successful completion of the course, Students shall be able to:

CO1: Students will be able to represent & classify signals, Systems & identify LTI systems

CO2: Students will be able to derive Fourier series for continuous time signals.

CO3: Students will be able to find Fourier transform for different signals

CO4: Students will be able to analyze the Continuous Time systems by performing Convolution.

CO5: Students will be understand Discrete time systems and LTI systems.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

Unit I: (8 Hours)

Representation Of Aperiodic Signal, Fourier Transform For Periodic Signals, Properties Of CTFT, Properties Of CTFT, Convolution Property ,Representation Of Aperiodic Signal, Fourier Transform For Periodic Signals, Properties Of CTFT, Properties Of CTFT, Convolution Property. Sampling Theorem, Effect Of Under Sampling, and Sampling of Discrete -Time Signals.

Unit II: (8 Hours)

CONTINUOUS TIME FOURIER TRANSFORM:

Representation of a periodic Signals by continuous FT, FT of periodic signals, convolution and multiplication property of continuous FT, systems characterized by Linear Constant Coefficient Differential Equations.

Unit III:TIME AND FREQUENCY CHARACTERIZATION OF SIGNALS AND SYSTEMS:

Magnitude and phase representation of FT, Magnitude and phase response of LTI systems, Time de main and Frequency domain aspects of ideal and non ideal filters.

Unit IV: DISCRETE TIME FOURIER TRANSFORM (DTFT) and DISCRETE FOURIER TRANSFORM (6 Hours)

(DFT):Properties of DTFT and DFT, convolution property, multiplication property, Duality, Systems characterized by Linear Constant Coefficient Difference Equations

TEXT BOOKS:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Signals and Systems	(Alan VOppenheim, Alan S Willsky, SHamid Nawab) 2ndEdition	Prentice Hall India	2009	2
2	Signals and Systems,	S.Haykin and B. VanVeen,	Wiley	1998	

REFERENCE BOOKS:

Sn	Title	Author Name	Publisher	Year of Publication	Edition
1	Digital Signal Processing, Principles Algorithms, and Applications	John G. Proakis, Dimitris G. Manolakis	PHI	2007	4
2	SignalProcessing	James H. McClellan	Pearson /Prentice Hall	2006	1
3	Signals and System, Third Edition, 2008	P.RameshBabu, R.anandaNatrajan,	Scitech	2008	3

ELEMENTS OF ELECTROMAGNETICS (1 Credit) [14 Hrs]

Subject Code : BEEL211

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	Marks
SEMESTER-IV												
Elements of Electromagnetics		1	0	0	1	1	10	15	25			50

Course Objective:

1.To introduce the electric & magnetic fields in detail.

2.To study the laws related to electric and magnetic fields

3.To know applications of Electromagnetic in electrical engineering applications

Course Outcomes:

Upon successful completion of the course,students shall be able to

CO1: Apply Knowledge of science to design of electrical systems involving electric fields

CO2: Apply Knowledge of engineering to design of electrical systems involving electric fields

CO3: Understand the design of electrical system involving magnetic fields

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	3.0	2.0	1.0	1	2	0	1					1	3	2	
CO2	3.0	2.0	1.0	1	2	0	1					1	3	2	
CO3	3.0	2.0	1.0	1	2	0	1					1	3	2	
CO4	3.0	2.0	1.0	1	2	0	1					1	3	2	
CO5	3.0	3.0	1.0	1	2	0	1					1	3	2	
CO6	3.0	3.0	1.0	1	2	0	1					1	3	2	

Unit I: Coulomb's law & Gauss's law, Energy and Potential of charge system (7Hrs)

Coulomb's law, electric field intensity, field often, point charges, field due to continuous volume charge distribution, field of line charge, field of sheet charges, concept of flux density.Gauss's

law, Application of Gauss's law, divergence theorem, definition of potential difference and potential, potential of a point charges, potential field of system of charge, potential gradient,

Unit-II:Steady Magnetic Field and Magnetic Forces (8Hrs)

Biot Savarts law, Ampere's Circuital Law, Strokes theorem, Magnetic flux density, Scalar and Vector Magnetic potentials, force on moving charge, Magnetization and permeability, Magnetic circuit.Maxwell equations

Text Books:

1.William H. Hayt, Jr., John A. Buck, Engineering Electromagnetic, 7thEdition, Tata McGraw Hill Publishing Company Limited, 2006

2.Matthew N. O. Sadiku, Elements of Electromagnetic, 5th Edition, Oxford University Press, 2010

Reference Books:

1.A Tinguria, Fundamentals Of Electromagnetic Fields, 2ndEdition, Denett & Co, 2006

2.Rajeev Bansal, Handbook of Engineering Electromagnetic, 1st Edition, CRC Press, 2004

Mathematics-VI

Fourier series and Partial differential equations

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						
							Theory			Practical		Total	Duration of Paper
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.		
	SEM IV												
BFYL 146	Mathematics-VI Fourier Series and Partial differential equations	1	1	0	2	2	10	15	25			50	1.5

Course Objectives:

1. To introduce Partial Differential Equations and Fourier Series and its applications in the field of Electrical Engineering.
2. To develop skills to use Partial differential equations and its applications in the field of Electrical engineering.

Course Outcomes :

Upon successful completion of the course, students will be able to:

1. Understand and use Fourier Series to solve engineering problems.
2. Apply the concept of Partial differential equations in field of engineering.
3. Obtain Fourier series expansion of periodic functions
4. Understand and solve Partial differential equations in engineering.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

FOURIER SERIES : (12hrs)

Dirichlet's conditions, fourier series of Trigonometric and exponential functions, Fourier series and its convergence. Fourier series of even and odd functions. Fourier half-range series.Fourier series of discontinuous functions, Parseval`s identity. Harmonic analysis.

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PARTIAL DIFFERENTIAL EQUATIONS: (18hrs)

Formation - Solution of standard types of first order equations - Lagrange's equation - Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

Method of separation of variables, Applications of PDE to transmission line.

Text Books:

1. Higher engineering Mathematics by B S Grewal, 43rd edition, Khanna Publication.
2. Advanced engineering Mathematics by Erwin Kreysizig, 8th edition Wiley India

Reference Books:

1. Advanced Mathematics for Engineers and Scientists ; Spiegel, M. R, McGraw-Hill

2.Advanced Engineering Mathematics, Jain, R.K. and Iyengar, S.R.K, Narosa Publishers; Alpha Science International, Ltd

Synchronous machine (2 Credit) [30 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-IV												
BEEL210	Synchronous Machine	1	1	0	2	2	10	15	25			50

Course Objectives:

1. To introduce synchronous machines to students.
2. To lay firm foundation of electrical machines for understanding its behavior in power- system.

Course Outcomes:

The students should be able to

CO1 Understand the construction, principle of 3-phase synchronous machines, able to identify different types of synchronous machine.

CO2 Analyze load characteristics of synchronous machine and able to solve the problems on regulation and performance.

CO3 Demonstrate the parallel operation of synchronous generator and able to find various performance parameters of synchronous generator.

CO5 Analyze the transient behavior and performance of synchronous machine in power system.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

Unit I: Three Phase Synchronous Generators (7 Hrs)

Introductions, constructional features of cylindrical and salient pole rotor machines, introduction to armature winding and field windings, MMF of armature and field windings, induced EMF.

Unit- II: Steady State Operation of Three Phase Synchronous Generators (7Hrs)

Phasor diagram, steady state performance of three phase synchronous generators, Voltage Regulation, Measurement of load angle, Slip test.

Unit III: Synchronizing of Generator with another Generator (6Hrs)

Parallel operation, experimental determination of parameters X_d, X_q/X_s, short circuit ratio, losses and efficiency.

Unit-IV: Synchronizing Machines on Infinite Bus (10Hrs)

Phasor diagram, expression for torque, load / torque angle, synchronous motor operation, effects of variable excitation and power input on generator operation and effect of variable excitation and load on motor operation, Reactive Power supplied/absorbed by the generator, AVR and its significance.

Text Books:

1. Dr.P.S.Bhimbra, Electrical machinery, 7th Edition, KHANNA Publisher, 2008
2. Ashfaq Husain, Electric Machine, Dhanpat Rai publication, 2012

Reference Books:

1. Dr. P.K. Mukherjee and S. Chakravarti, Elect. Machinery, Dhanpatrai Publications, 2011
2. Fitzgerald and Kingsley and Kusco, Elect. Machinery, Tata Mc Graw Hill, 2010

Basic Power Electronics (3 Credit) [40 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-IV												
BEEL214	Basic Power Electronics	2	1	0	3	3	10	15	25			50

Course Objectives:

1) To introduce different power electronic switches and other devices etc along with their performance characteristics and applications.

2) To introduce different types of power electronic convertors, their control and performance aspects for various applications.

3) To study single phase and three phase bridge inverters.

Course Outcomes:

The students should be able to

CO1 Analyze the circuit involving solid state power electronics devices.

CO2 Select components for designing the circuitry for power convertors
CO3 Use Solid state Power electronics devices for control, conversion and protection of SCR
CO4 Design Single phase and Three phase AC-DC convertors.
CO5 Examine Close loop control of DC-DC converter.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	1.0	1.0	3.0	2	2	0	1	0	2	2	2	2	2	3	2
CO2	1.0	1.0	3.0	2	2	0	1	0	2	2	2	2	2	3	2
CO3	1.0	1.0	3.0	2	2	0	1	0	2	2	2	2	2	3	2
CO4	1.0	1.0	3.0	2	2	0	1	0	2	2	2	2	2	3	2
CO5	1.0	1.0	3.0	2	2	0	1	0	2	2	2	2	2	3	2
CO6	1.0	1.0	3.0	2	2	0	1	0	2	2	2	2	2	3	2

Error! Not a valid link.Syllabus:

Unit I: SCR and its characteristics (7 Hrs)
Characteristic and basic working principle of SCR, SCR turn on & turn off times, ratings, series and parallel connections of SCRs, Triac and its applications, Triggering circuits, protection of SCR gate circuit protection, over voltage and over current protection, snubber circuit design.

Unit II: Static controllable switches(7 Hrs)
Characteristic and basic working principle of MOSFET, GTO, IGBT, Basic Driving Circuits and protection mechanism.

Unit III: Line commutated converter(8 Hrs)
Working principle of single phase and three phase line commutated converters, effect of source inductance, principle operation of dual converters and Cycloconverter.

Unit IV: Inverters (8 Hrs)
Single phase and three phase bridge invertors (voltage source inverter), Six step operation, SPWM, Determination of Harmonic content, THD, current source inverter, Basic series resonant Inverter.

Unit V: DC-DC Converters (10 Hrs)
Buck, Boost, Buck-Boost, Cuk Converters, Continuous and discontinuous mode of operation, Flyback, Forward, and PushPull Converters, classification of chopper circuits (A, B, C, D, E). Advanced Topics.

Text Books:
1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

Reference Books:
1. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
2. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

Microcontroller & Embedded Systems
(3 Credit) (40 Hrs)

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-IV												
BECL204	Microcontroller & Embedded Systems	2	1	0	3	3	10	15	25			50

Course Objective
1. To make students understand the use of embedded system to effectively automate the system under consideration.
2. Students should understand the working of these systems and should be able to determine hardware and software interfacing with real time systems.
3. To deploy hardware, coding, protocols and interfacing for achieving control tasks assigned in industries.

Course Outcome
The students should be able to
CO1. Select Appropriate Microcontroller, Techniques & understand the Embedded System.
CO2. To learn interfacing and programming of Microcontrollers for Embedded Applications.
CO3. To develop Arduino based boards for applications.
CO4. To Understand various industrial sensors and interfacing with embedded boards
CO5. To get knowhow of ARM processors.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus: Unit1: (8 Hrs)

Embedded Systems: Introduction to embedded Systems, Requirements /Components of Embedded Systems, Design Process in Embedded System

Microcontrollers: Introduction to microcontrollers, 8051 architecture, Addressing modes and instruction set, Assembly language programming, Introduction to Embedded C Programming

Unit 2: (8 Hrs)

Programming: Interrupts and serial communications, Serial I/O, Programming in embedded C, Programming Tools, Interfacing with 8051: ADC and DAC interfaces for microcontrollers, Real time interfacing with LED, Keypad, LCD display, Applications using microcontrollers.

Unit 3: (8 Hrs)

Advance Microcontroller: Introducing the Arduino Board, Installing and familiarizing the Arduino IDE, Interfacing the Arduino Uno into Keypad and 7-Segment, Interfacing the Arduino Uno into Keypad and LCD

Unit 4: (8 Hrs)

Interfacing various sensors like PIR, TMP35, gas sensor, Ultrasonic sensor, LDR and WiFi ESP8266 module with Arduino.

Unit5: (8 Hrs)

ARM Processors: Brief history of ARM, ARM Architecture, Addressing modes, Instruction sets, Arm Thumb and instruction sets, Memory concepts, ARM Programming

Overview of components of an embedded system with ARM architecture as an example (CPU, memory, buses, peripherals etc.), CPU internals. Hands on with a single board computer (LPC1768). Software issues: processes and their management, memory overview

Text Books:

1) Mazidi M. A., Mazidi J. G., " 8051 Microcontroller & Embedded Systems", 2nd edition Pearson Education,2008

2) Kenneth Ayala, "Microcontroller & Embedded Systems using Assembly & C.", 2nd edition Cengage Delmar Learning,2010

Reference Books :

1) Ayala, Kenneth J, "Microcontroller Architecture, Programming & Application.", 2nd edition Prentice Hall 1996

2) Dhananjay Gadre, "The AVR Microcontroller", 2nd edition, Tata McGraw-Hill, 2003

3Subrata Ghoshal, "8051 Microcontroller-Internals, Instructions, Programming & Interfacing", 1st Pearson , 2010

FUNDAMENTALS OF POWER SYSTEMS (2 Credit) [30 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-IV												
BEEL 212	Fundamentals of power Systems	2	0	0	2	2	10	15	25			30

Course Objectives:

1. To introduce Per unit system. cables, distribution system, transmission systems and different models represents Load flow studies.
2. To introduce elementary distribution schemes.
3. To study concepts of real and reactive power control

Course Outcomes

CO1: Understand the structure of electrical power systems

CO2: Understand the representation of power systems elements

CO3: Apply knowledge to the elementary distribution schemes

CO4: Understand the voltage regulation and efficiency of power transmission lines

CO5: Analyses the load Flow Studies

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

Unit I: (10 Hrs)
Structure of electrical power system, brief exposure to generation, transmission and distribution aspects, elementary consideration of economic bulk power supply system, idea about substation, concept of real, reactive and complex power, voltage and frequency dependence of loads, Per Unit Representation of parameters.

Unit II: (7 Hrs)
Feeders and distributors, Various distribution network topologies (Ring, Radial, etc)LT and HT cables, insulators

Unit III: (7 Hrs)
Voltage regulation of power transmission lines, Different models of Transmission line (T and π) and determination of power transfer capability in a symmetric bus (two bus system).

Unit-IV: (6 Hrs)
Types of buses and introduction to load flow analysis,

Text Books:
Power System Engineering by *Kothari D. P Nagrath I. J*
Electrical Power Systems by *Wadhawa C. L*

Reference Books:
Power System Analysis - John J Grainger and William D Stevenson
Modern Power system Analysis - Nagrath and Kothari
Power System Analysis - NagoorKani
Power Sytem Analysis – HadiSaadat
Computational methods of electric power systems - Mariessa L Crow

Course Name : ANALOG AND DIGITAL COMMUNICATION

Course Code : BECL213

Scheme of the Course:

Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						Duration of Paper	Course Category
						Theory			Practical		Total Marks		
	Theory	Tutorial	Practical	Total Hours		TAE	CAE	ESE	Int.	Ext.		Hours	
Communication Electronics	1	1	0	2	2	10	15	25		-	50	2	

Course Objectives

To understand the basic concept of communication systems.
To understand the concept of analog modulation techniques.
To understand theory of analog pulse modulation techniques.
To understand working of radio receivers.
To understand the classification of multiplexing and multiplexing hierarchy.

Course Outcomes:
Student shall be able to

CO1. Understand the fundamentals of communication systems and interpret the presence of noise in communication systems.
CO2. Perform and analyze Amplitude Modulation and Frequency modulation.
CO3. Understand the fundamentals of analog pulse modulation techniques.

Unit 1

Block Schematic of Communication System,Base Band Signals & their bandwidth requirements,RF Bands, Types of Communication Channels (Transmission Lines,ParallelWires,Co-axial Cables,Waveguidesand Optical Fiber

AM Modulators, Block Diagram of AM Receiver,AMDetection:Envelope detection,

FM transmitters, Super heterodyne Receiver,Performance characteristics: Sensitivity,Selectivity,Fidelity,Image Frequency Rejection,IFRR,Tracking, De-emphasis,Mixers.

Unit II Source Coding & Transmission Methods:-

Data formats-Unipolar and Polar NRZ,RZ,Bipolar (AMI),Huffman and L-Z encoding algorithm,Vitrebi algorithm and Fanoalgorithm.Trellis coded modulation methods.

Unit III Block and Convolution Channel Code:-

Linear block codes,generator matrix and parity check matrix,some specific linear block codes,cycliccodes,transfer function of a convolution code,

Text Books:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Electronics Communication System	Kennedy, Davis	Tata McGraw-Hill	2010	4
2	Communication Electronics	Roddy &Coolen	PHI	2010	4
3	Communication Electronics Principles and Applications	Frenzel	Tata McGraw-Hill	2011	3
4	Communication Engineering	U. A. Bakshi, A. P. Godse	Technical Publications	2009	3

Reference Books:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Modern Digital & Analog Communication Systems	B. P. Lathi	Oxford Press Publication	1998	3
2	Digital Communication	Simon Haykin	Wiley and sons	2003	3
3	Digital Communication	John G.Prokis	Tata Mcgraw-Hill	2002	3
4	Digital Communication	Shanmugham	Wiley student	2009	4

SEMESTER V

Z Transform & Steady State Variable

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						
							Theory			Practical		Total	Duration of Paper
		Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.		
	SEM-V												
BFYL147	Z Transform & Steady State Variable	1	0	0	1	1	10	15	25			50	_

Course Objectives:

1. Analyze problems, recognize appropriate methods of solution, solve the problems and find the solutions.
2. Apply principles from mathematics to solve applied problems in engineering.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Understand and use Z- transform to solve engineering problems.
2. Apply the concept of Z-Transform to solve difference equations
3. Apply the concepts of Numerical methods to solve engineering problems

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

NUMERICAL METHODS: (**8hrs**)

Error Analysis, Solutions of algebraic and transcendental equations, method of false position, Newton – Raphson method and their convergence. System of linear equations, Guass elimination method, Gauss seidel method, Crouts methods. Numerical solution of ordinary differential equation by Taylors series method, Runge Kutta methods, Euler Modified method, Milne's predictor corrector method.

Z-TRANSFORMS AND ITS APPLICATIONS: (7hrs)

Definition & properties, Inverse Z- Transform & Relation with Laplace Transform.
Application to Z-Transform to solve difference equations with constant coefficients.

Text Books:

1. Higher engineering Mathematics by B S Grewal, 43rd edition, Khanna Publication.

2. Advanced Engineering Mathematics, Jain, R.K. and Iyengar, S.R.K, Narosa Publishers; Alpha Science International, Ltd

Basic Control System (1 Credit) [15 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-V												
BEEL 319/ BEEP 319	Basic Control System	1	0	2	3	2	10	15	25	25		75

Course Objective

1. The students should be able to learn the different types systems and governing differential equations and mathematical representation in terms of output and input correlation.
2. The students should able to learn time response analysis and demonstrate their knowledge to frequency response.
3. Students can be able to learn stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot.
4. To get insight of modern control theory based on matrix approach and state variables.

Course Outcome

The students should be able to

CO1 : To build classical mathematical foundation for control philosophy and time response of systems.

CO2 : To determine performance of system and its stability issues.

CO3 : To evaluate performance of system for broad range of frequency.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	1.0	3.0	1.0	1	2	0	0	0	2	2	2	2	2	3	
CO2	1.0	3.0	1.0	1	2	0	0	0	2	2	2	2	2	3	
CO3	1.0	3.0	1.0	1	2	0	0	0	2	2	2	2	2	3	
CO4	1.0	3.0	2.0	1	2	0	0	0	2	2	2	2	2	3	
CO5	1.0	3.0	2.0	1	2	0	0	0	2	2	2	2	2	3	
CO6	1.0	3.0	2.0	1	2	0	0	0	2	2	2	2	2	3	

Syllabus:

Unit I Introduction to need for automation and automatic control ,use of feedback, broad spectrum of system application, Mathematical modeling,(Electrical & Electromechanical) diff. Equations., transfer functions, block diagram, signal flow graphs, application to elementary systems, simplifications, effect of feedback on parameter variations, disturbance signal. Time response of system, first order and second order system, standard inputs, concept of gain and time constants, Steady state error, type of control system, approximate methods for higher order system.

Unit II Stability of control systems, conditions of stability, characteristics equations, RouthHurwitz criterion, special cases for determining relative stability, Root location and its effect on time response, elementary idea of root locus, effect of addition of pole and zero on proximity of imaginary axis.

Unit III Frequency response method of analyzing linear system, Nyquist and Bode Plots, Stability and accuracy analysis from frequency response, open loop and close loop frequency response, Nyquist Criterion, Effect of variation of gain and addition of pole and zero on response plot, stability margin in frequency response. Design by state variable feedback: Review of state variable representations. Solution of State equations. Controllability & Observablity

Text Books:

1. B. C. Kuo, Automatic Control Systems, 3rd Edition, Prentice Hall India, 1975
2. Nagrath, Gopal, Control System Analysis. 5th Edition, New Age International, 2010

Reference Books:

1. M.Gopal, Control Systems, Principles & Design, 3rd Edition, TMH Publishers, 2010
2. Norman S. Nise, Control Systems Engineering, 5th Edition, John Wiley & Sons, 2008

Electrical Installation Design (1 Credit) [21 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-V												
BEEL 321	Electrical Installation & Design	1	0	0	1	1	10	15	25			50

Course Objective:

1. To explain how the Regulations and Codes are intended to be applied in practice, with the emphasis on design and specification of electrical installation.
2. Acquire knowledge of standard clearances, design and estimation methods of service connections and its safety aspects.

Course Outcome

The students should be able to

1. To understand specifications, methods, components used for different electrical installations, the design & Construction of different types of underground Cables
2. Learn about the design and installation of illumination systems, the configuration and function of common equipment found in a substation
3. Understand the fundamental principles for the design and installation of associated protective systems relating to electrical installations and understand the fundamental transformer testing and recognizes the limits of acceptance of each test.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	1.0	1.0	2.0	2	0	3	2	1	0	0	0	1	2	3	2
CO2	1.0	1.0	2.0	2	0	3	2	1	0	0	0	1	2	3	2
CO3	1.0	1.0	2.0	2	0	3	2	1	0	0	0	1	2	3	2
CO4	1.0	1.0	2.0	2	0	3	2	1	0	0	0	1	2	3	2
CO5	1.0	1.0	2.0	2	0	3	2	1	0	0	0	1	2	3	2
CO6	1.0	1.0	2.0	1	0	3	2	1	0	0	0	1	2	3	2

Syllabus:

Unit-I:-

General awareness of IS Codes (IS 3043, IS 732, IS 2675, IS 5216-P1- 2, IS 2309), The Indian Electricity Act 1910, The Indian Electricity supply Act 1948, Indian Electricity Rules 1956, The Electricity Regulatory Commission Act 1998, Electricity Act 2003, Bureau of Energy Efficiency (BEE) and its labeling. National Electric Code (NEC) - scope and safety aspects applicable to low and medium (domestic) voltage installations, Electric services in buildings, Classification of voltages, standards and specifications

Basic Standards in electric Vehicle Charging Station

Unit-II:-

Safety aspects applicable to low and medium voltage installations. General aspects of the design of electrical installations for domestic dwellings (low and medium voltage installations)–connected load calculation, sub circuit determination, selection of main distribution board, sub distribution board, MCB, ELCB, MCCB and cables for subcircuits. Pre-commissioning tests of domestic installations. Design of earthing system for an HT consumer, Dimensions and drawings of typical earth electrodes (1) Pipe Earthing, (2) Plate Earthing.

You Tube Video Lecture : https://www.youtube.com/watch?v=CH23wcN0b6g

https://www.youtube.com/watch?v=TTh8eT_g9yI

Text Book:

1. J. B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria & Sons; Reprint 2013 edition (2013).
2. K. B. Raina, S. K. Bhattacharya, Electrical Design Estimating Costing, NEW AGE; Reprint edition (2010).
3. M.K.Giridharan, Electrical Systems Design, , M/s I K International Publishers, New Delhi, 2nd edition, 2016

Reference Books:

1. Pabla, Electric Power Distribution system, 4th Edition, Tata Mac graw Hill, 1998
2. Soni Gupta Bhatnagar, Electric Power, 9th Edition, Dhanpat Rai, 1997
3. Uppal, Electrical power system, 15th Edition, Khanna publication, 2009
4. Wadhwa, Electrical Power System Engineering, 2nd Edition, New age Pub., 1995 3. J.B. Gupta, Electrical Installation estimating.

Electric Drives (2 Credit) [30Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	Marks
SEMESTER-V												
BEEL324/ BEEP324	Drives & Electrical Vehicle	2	0	2	4	3	10	15	25	25		75

Course Objectives:
1. To introduce the fundamentals, classification, selection, control of Modern Drives.
2. To study electric vehicles & recent developments.

Course Outcomes:
The students should be able to
CO1Understand the fundamentals of different types of electric drives
CO2Categorize modern drives used in industries.
CO3 Understand the use of energy sources for electric vehicles in cost effective way.
CO4 Describe the main hybrid and electric vehicle development considerations and performance requirements for various vehicle system

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:
Unit I: Introduction to Electric Drives(10 Hrs)
Classification, and speed-torque characteristics of typical loads,equilibrium points and their stability issues pertaining to sizing of electric drives. speed-torque characteristics of DC Motor and their various speed control methods. Realization of various control methods.
Unit II: Induction motor Drives (10 Hrs)
speed-torque characteristics, starting, braking, control, and their realization.

Unit III Synchronous Motor Drives (04 Hrs)
speed-torque characteristics, starting, braking, control, and their realization.

Unit IV Special Drives(6 Hrs)
Permenant magnet synchronous machines,Switch Reluctance Machine
Speed-torque characteristics control and their realization.

Text Books:
1. Dubey G.K., Fundamentals of electrical drives, 2nd Edition, Narosa Publications, 2000
2. V.Subramanyam, Electric Drives, 2nd Edition, PHI publication, 2002
3. Sandeep Dharmeja, Electric Vehicle Battery Systems, 1st Edition, Newnes, 2001
4. 2. K. T. Chau , Zheng Wang, Chaos in ElectricalDrive Systems: Analysis, Control &Applications, 1st Edition, John Wiley and Sons, 2011

Reference Books:
1. Sharkawi , Fundamentals of Electrical Drives, 1st Edition, Coli publications, 2002
2. Chung Chow Chan, K.T.Chau, Modern Electric Vehicle Technology, 1st Edition, Oxford University Press, 2001

POWER SYSTEMS ANALYSIS

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-V												
BEEL320/ BE	Power System Analysis	2	0	2	4	3	10	15	25	25		75

EP 320												

Course Objectives -

1 To introduce the techniques to control the system voltage, voltage regulation, real and reactive power, power quality,efficiency, practical stability limits during healthy and faulty conditions .

Course Outcome

CO1: Analyze the formation of symmetrical components

CO2: Locate the symmetrical faults in power system

CO3: Locate the unsymmetrical faults in power system

CO4: Travelling waves and insulation coordination

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

Unit I (07 Hrs)

Symmetrical Component transformation: Three phase power in unbalanced circuit in terms of symmetrical component, Sequence impedances of Generator, Transformer, Transmission line & Passive loads, Phase shift in Star *I* delta three phase transformer (Yd l, Yd ll connection.).

Unit II : (08 Hrs)

Symmetrical fault analysis: Without & with pre fault load current. Selection of Circuit Breakers ratings, current limiting reactors

Unit-III : (07 Hrs)

Unsymmetrical fault Analysis: L-G, L-L-G, L-L, open conductor's faults analysis using symmetrical components.

Unit IV : (08 Hrs)

Traveling waves and Insulation coordination: Traveling waves on transmission lines, Classification of lines attenuation and distortion of traveling waves, reflection and transmission of waves, behavior of rectangular waves at transition points. Introduction to insulation coordination, associated terms, impulse wave-form. Introduction to BIL, Reduced BIL and SIL.

Text Books

Power System Engineering by *Kothari D. P Nagrath I. J*

Electrical Power Systems by *Wadhawa C. L*

Reference Books:

Power System Analysis - John J Grainger and William D Stevenson

Modern Power system Analysis - Nagrath and Kothari

Power System Analysis - NagoorKani

Power Sytem Analysis – HadiSaadat

Computational methods of electric power systems - Mariessa L Crow

Machine Learning

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-V												
BAIL203	Machine Learning	2	0	0	2	2	10	15	25			50

Course Objectives:

- Be able to formulate machine learning problems corresponding to different applications.
- Be able to apply machine learning algorithms to solve problems of moderate complexity.

Course Outcomes: Upon completion of the course, students shall be able to:

- 1. Understand a range of machine learning algorithms along with their strengths and weaknesses.
- 2. Apply machine learning algorithms to solve real time problems of moderate complexity.

Unit I: Introduction to Machine Learning (9 Hr)

Introduction, What Is Machine Learning?, Examples of Machine Learning Applications, Learning

Associations, Supervised& UnsupervisedLearning, Reinforcement Learning, Classification, Regression Introduction to clustering, k-Means Clustering,Hierarchical clustering

UNIT II: Introduction to R for ML(6 Hr) R - Basic Syntax, Data Types, Variables, Operators, Decision Making, Loops, Functions, Strings, Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Packages-chart & graphs

Text Books:

1. *Introduction to machine learning,EthemAlpaydin. — 2nd ed.*, The MIT Press, Cambridge, Massachusetts, London, England.

Reference Books:

1. Machine Learning, Tom M Mitchell.

SEM-VI

Optimization

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-VI												
BFYL148	**Optimization**	**1**	1	0	2	2	10	15	25			50

Course Objectives:

1. To introduce the basic methods of optimization in engineering.
2. To develop skills to provide solution to various problems in the field of engineering.
3. To develop analytical skills to provide solution to simple transportation problems and assignment problems in the field of engineering.

Course Outcomes:
Upon successful completion of the course, students will be able to:

1. Apply basic concepts of Optimization Techniques.
2. Use the concept of mathematical modeling and apply various optimization techniques to real life problems.
3. Apply the various techniques to Transportation problems & Assignment problem in job schedliing or route selection.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Optimization Techniques L-T-P-C 1-1-0-2
Unit -I: Introduction to Optimization Techniques(10hrs)
Linear programming, mathematical model formulation ,Solutions by Graphical method , Simplex method ,Big M method , two phase method.
Unit –II (10hrs)
Dual problem – duality theory - dual simplex method – revised simplex method**.**
Unit –III(10hrs)
Transportation problem ,Assignment problem-travelling salesman problem.
Text Books:

1. Higher engineering Mathematics by B S Grewal, 43rd edition, Khanna Publication.
2. Linear Programming: methods and application by Saul I Gass.
3. Linear Programming: theory and application by Catherine Lewis.

Non Linear Control System (1 Credit)[15 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-VI												

BE EL327	Non Linear Control Systems	1	0	0	1	1	10	15	25			50

Course Objective

1. To provide to the students a solid background in analysis and design of nonlinear control systems.
2. The ability to understand the characteristics of various types of nonlinearities present in physical systems.
3. The ability to carry out the stability analysis of non-linear control systems.

Course Outcome

The students should be able

CO1 : To learn about non-linear system in depth and introduction to behavior of non linear system.

CO2 : To determine performance of non-linear system using conventional classical approach.

CO3 : To determine performance of non-linear system using modern control approach.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	1.0	2.0	2.0	3	1	0	0	0	0	0	0	0	2	3	2
CO2	1.0	2.0	3.0	3	2	0	0	0	0	0	0	0	2	3	2
CO3	1.0	2.0	2.0	3	2	0	0	0	0	0	0	1	2	3	2
CO4	1.0	2.0	2.0	3	1	0	0	0	0	0	0	0	2	3	2
CO5	1.0	2.0	2.0	3	1	0	0	0	0	0	0	0	2	3	2
CO6	1.0	2.0	2.0	3	2	0	0	0	0	0	0	2	2	3	2

Syllabus:

Unit – I Non Linear Control Systems: Types of non linearities. Characteristics of Non Linear Control System. Inherent & intentional non- linearities. Describing function method for Analysis. Describing function of some common Nonlinearites. Energy Function and Stability analysis. Limit cycles & stability of limit cycles.

Unit-II Phase Plane Method: Singular points, nature of singular points. Construction of trajectory by Isoclines & Delta method: Computation of time.

Unit III State variable approach for non- linear systems, case studies of non linear systems using state variables, controllability and observability of non linear systems using state variables.

Video Lecture : Dr. Arun D. Mahindrakar, IIT Madras
Link : https://nptel.ac.in/courses/108106024/

Text Books: 1. Nagrath & Gopal, Control system Analysis, 3rd Edition, New Age International, 2010

2. J.J. Dazzo & Houpis, Linear System Analysis, 4th Edition, Mc. Graw Hill, 1995

3. Ogata, Modern Control Engineering, 5th Edition, Prentice Hall, 2009

4. M Gopal, Modern Control Theory, 2nd Edition, New Age International, 1993

Reference Books: 1. Sarkar .B.N., Advanced control system, 2nd Edition, PHI, 2013

3. B.C. Kuo, Automatic control system, 7th Edition, PHI, 2010

High Voltage Engineering (3 Credit)[30 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-VI												
BEEL330 / BEEP330	High Voltage Engineering	2	0	2	4	3	10	15	25	25		50

Course Objectives:

1.To introduce the conduction and electrical breakdown phenomena in liquids, solids, gases or vacuum.

2. To introduce Generation of high voltage, high current and their measurement.

3. To introduce testing units required for the installation of electrical equipments

Course Outcomes

1. Understand the breakdown mechanism in di-electric

2 Analyze the lightning and switching over voltages along with protection and analyze the

traveling waves & should able to select proper insulation coordination

3 Develop & Design the systems for generation of high voltage and current and apply the knowledge of high voltage engineering for measurement of high voltage and current

4. Perform the non-destructive and high voltage test of electrical apparatus by experimentation.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	1.0	1.0	2.0	3	2	1	1	1	2	2	2	2	3	2	
CO2	1.0	1.0	2.0	3	2	1	1	1	2	2	2	2	3	2	
CO3	1.0	1.0	2.0	3	2	1	1	1	2	2	2	2	3	2	
CO4	1.0	2.0	2.0	3	2	1	1	1	2	2	2	2	3	2	
CO5	1.0	2.0	2.0	3	2	1	1	1	2	2	2	2	3	2	
CO6	1.0	2.0	2.0	3	2	1	1	1	2	2	2	2	3	2	

Syllabus:

Unit I [08 Hours]

Breakdown mechanism in Di-electric : Ionization process; Townsend's criterion for B.D. Break down in electro-negative gases, Time-lag for B.D.; Streamer theory for B.D in gases, Paschen's law; B.D in non-uniform field. Corona discharges and introduction of corona post B.D. phenomenon and applications, Practical considerations in using gases for insulation purpose; vacuum insulation, Liquid as insulators, conduction & B.D. in pure and commercial liquids. Intrinsic, electromechanical &.thermal B.D., B.D. of solid di-electrics in practice; B.D. in composite dielectrics.

Unit II [07 Hours]

Lightning and switching over voltages: Mechanism of lightning, types of strokes, parameter and characteristics of lightning strokes, characteristics of switching surges, power frequency over voltages. Control of overvoltage due to switching. Protection of lines by ground wires, protection by lightning Arrester, gap type and gapless L.A., selection of L.A. ratings, surge-absorbers, Introduction to Basic impulse level (BIL).

Unit III [08 Hours]

Generation of high voltage and currents: Generation of High D.C voltages by rectifiers, voltage doubler and multiplier, circuits (Derivations of expression not required), electrostatic machines, Generation of high AC voltages by Cascaded transformers, Resonant transformers, generation high frequency AC high voltage. Generation of impulse voltages: Standard impulse wave shapes, analyses of model and commercial impulse generation circuits, wave shape control, Marx circuit, tripping and control of impulse generation, generation of switching surges, generation of impulse current.Measurement of high voltage and current: Measurement of high AC and DC voltage by micro ammeter, generating voltmeter,resistance and capacitance potential divider, series impedance voltmeter, CVT, Magnetic type potential transformers, electrostatic voltmeter. Peak reading AC voltmeter, Sphere gap arrangement. Measurement of impulse voltage by potential dividers and peak reading voltmeters. Measurement of High AC/DC current, measurement of high frequency and impulse current by resistive shunt (Bifilar strip shunt only)

Unit IV [7 Hours]

Non destructive and high voltage testing of electrical apparatus: Non- destructive testing, Measurement of DC Resistivity, measurement of Dielectric constant and loop-factor *(low* and power frequency only), Schering bridge for high charging circuits, high dissipation factor , three terminal measurement, transformer ratio arm bridges, partial discharge measurements by straight detectors & by balance detectors , calibration of detectors, discharge detection *in* power cables. High voltage testing. Testing of insulators, bushings, Isolators, circuit breakers, cables, transformer, lightning arresters and power capacitors. Recent trends in industrial testing & introduction to partial discharge. Advanced topic on the subject.

Text Books :

1. M.S. Naidu and V Kamaraju, High Voltage Engineering, 3Edition, Tata Mc Graw Hill, 1995 Rd

2. C.L.Wadhwa, High Voltage Engineering, 3rd Edition, New Age International, 2010

3. Arrilaga, High voltage direct current, 2nd Edition, New York IEEE, 2002

4. Begamudre, Extra high voltage Ac transmission Engineering, 3rdEdition, New age, 2002

Reference Books:

1. D. Ruber, High voltage circuit breaker and design and application, 2nd Edition, Dakker, 1997.
2. Ray S., An introduction to high voltage engineering, 2nd Edition, PHI, 2004

POWER SYSTEMS DYNAMICS

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-VI												
BEE L331	Power System Dynamics	1	0	0	1	1	10	15	25			50

Course Objectives:-

2.To make students familiar with stability system

3.To study economics operations of power system.

Course Outcomes

CO1: Understand the concept of stability in terms of power system

CO2: Identify the solutions for economic operation of power system

CO3: Understand the need of grounding system

CO4: Power system security analysis

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

Unit I:(08 Hrs) : Stability of Power System- Steady state, Dynamic and Transient stability: definition. Dynamics of synchronous machine, swing equation, swing equation for machines swinging coherently and Non-Coherently. Power angle equation, Steady state stability studies, Basic introduction to Voltage Stability aspects.

Transient stability studies: -Swing curve, Equal Area criterion for transient stability, Application of equal area criterion for different disturbances, Solution of swing equation by point by point method, Methods of improving transient stability.

Unit II : (06 Hrs)

Economic operation of power system: Introduction, Distribution of load between units within the plant Optimum generation scheduling considering transmission losses. Representation of transmission loss using loss formula co-efficient, Derivation of loss formula co-efficient, Lambda iteration method, simulation of co-ordination equation on digital computer, Basic introduction to Power sector restructuring.

Unit III : (06 Hrs)

Grounding of Neutral in power system.

Shunt & series compensation-

Generalized equation, shunt reactor compensation of very long line with intermediate switching station, series capacitor compensation at line center, shunt reactors at both ends and series capacitor in middle of line.

Power system security, contingency analysis and various state of a system

Advanced topic on the subject

Text Books:

1. Power System Dynamics- K.R. Padiyar, B.S. Publications
2. Power System Dynamics Control – Prabha S. Kundur, IEEE Press, New York

Reference Books:

1. Power System Stability – E.W. Kimbark, IEEE press, N.Y, Vol.
2. Power System Control and Stability – Vol. – I – Anderson & Foud, IEEE Press, New York.
3. Power System Voltage Stability – C. W. Taylor., McGraw Hill International student edition.
4. Distributed Generation Islanding – implication on power system dynamics performance. – R.A. Walling, N. W. Miller, Power Engineering Society, Summer Meeting, 2002, IEEE Publication, 25 July 2002, Vol. I, PP 92-96.

SWITCHGEAR & PROTECTION

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
Sem VI												
BEEL328 / BEEP328	Switch Gear &Protection	2	0	2	4	3	10	15	25	25		75

Course Objectives:-

1.To introduce the construction, working and applications of different relays & protective schemes like distance protection, differential, over current & overvoltage protection .

2. To study different types of circuit breaker used and practical application

3.Introduction to static and numerical relays

Course Outcomes

CO1: Understand different types of protective relays

CO2:Identify different types of overcurrent relays for protection of transmission line

CO3: Apply different protective schemes for transformer generator and busbar

CO4: provide solution for abnormal condition in the system

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	2.0	2.0	3.0	2	1	1	2	1	2	2	2	2	2	2	3
CO2	2.0	2.0	3.0	2	1	1	2	1	2	2	2	2	2	2	3
CO3	2.0	2.0	3.0	2	1	1	2	1	2	2	2	2	2	2	3
CO4	2.0	2.0	3.0	2	1	1	2	1	2	2	2	2	2	2	3
CO5	2.0	2.0	3.0	2	1	1	2	1	2	2	2	2	2	2	3
CO6	2.0	2.0	3.0	2	1	1	2	1	2	2	2	2	2	2	3

Syllabus:-

Unit I (7Hrs)

General philosophy of Protective Relaying , Medium voltage Line Protection: Over current relaying, directional- over current relay.

Unit II (7Hrs)

High Voltage Line Protection: Distance relays, carrier distance Schemes. Unit carrier schemes, numerical relays

Unit III (8 Hrs)

Equipment Protection: Principles of differential relaying, protection of generators, transformers and bus Bars by differential relaying and other relays. Protection Induction Motors against overloads, short circuits. Thermal relays.

Unit IV (6 Hrs)

Switchgear: Circuit breakers. Arc interruption theory, recovery and restricting voltages, RRRV, breaking of inductive and capacitive currents, C.B, ratings, different media of arc

interruption overview of oil circuit breakers, construction and operation of Air blast, SF6 and vacuum breakers, Advances in industrial power system protection

Text Books:

1. Power System Dynamics- K.R. Padiyar, B.S. Publications

2. Power System Dynamics Control – Prabha S. Kundur, IEEE Press, New York

Reference Books:

1. Power System Stability – E.W. Kimbark, IEEE press, N.Y, Vol.

2. Power System Control and Stability – Vol. – I – Anderson & Foud, IEEE Press, New York.

3. Power System Voltage Stability – C. W. Taylor., McGraw Hill International student edition.

4. Distributed Generation Islanding – implication on power system dynamics performance. – R.A. Walling, N. W. Miller, Power Engineering Society, Summer Meeting, 2002, IEEE Publication, 25 July 2002, Vol. I, PP 92-96.

Power Station Practice

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-VI												
BEEL 326	Power Station Practice	2	0	0	2	2	10	15	25			50

Course Objectives:

1) To introduce conventional as well as nonconventional methods of generation of electricity.
2) To study parameters related to site selection, awareness about important components of the systems.
3) To study the procedure to calculate the cost of generation.
4) Course Outcomes

Course Outcomes

1. CO1: Understand various sources of energy that can be converted into electrical energy
2. CO2: To study thermal and hydro power plant components and their operation.
3. CO3 To compare Nuclear power reactors in power station
4. CO4 To investigate the roles of various renewable energy sources

Syllabus:-

Unit-1: (08 Hrs) Sources of Electrical Energy: - Coal oil and natural gas water power, nuclear fission and fusion. Their scope and potentialities for energy conversion. Generation different factors connected with a generating station, connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity and utilization factor, load curve, load duration curve, load survey base load and peak load station, advantages of interconnection.

Unit-II: (10 Hrs) Thermal Stations: - Choice of site, location, size and number of units, general layout, major equipment, essential and non-essential auxiliaries, electric supply to auxiliaries, cost of generation, effect of different factors costs.

Hydro Station: - Hydrology, stream flow, flow duration curve, , mass curve reservoir capacity, type of hydroplants and their field of use, pumped storages plants and their utility, surge tanks, governing characteristics of turbine and hydro generators.

Unit III : (06Hrs) Nuclear Station: - Principle of Nuclear energy, materials, types of nuclear reactors, breeder reactors, location, material for moderator and control rods, cost economics.

Unit IV : Renewable energy resources

Solar Energy: - Introduction, Solar energy collectors, solar energy storage, electrical power generation and other Miscellaneous applications of solar energy. ii) **Wind Energy: -** Introduction, Basic principles of wind energy conversion, site selection. Basic component of wind energy conversion system, wind turbines and their analysis, wind Electrical generation, stand-alone and grid connected wind electrical power systems, Basic principle of Tidal power ,site selection ,storage and plant layout for Tidal power plant, Introduction to wave energy and its Energy plants, Wave energy based power plants layout, Estimation of carbon credits.

1. V K Mehta, Principals of Power system, 2nd Edition, S Chand & Company Ltd., 1990
2. G R Nagpal, Power plant Engineering, 5th Edition, Khanna Publishers, 2008
3. G.D Rai, Non conventional Energy Sources, 4 th Edition, Khanna Publishers, 2010
4. M.V. Deshpande, Elements of electrical power station design, 3rd Edition, A.H.Wheelar, 1986

Reference Books:

1. Chakraborty, Sony, Power System Engineering, 15th Edition, Dhanpatrai & sons, 2002
2. Skrotzki W.A., Power Station Engineering Economics, 2nd Edition, Tata Mc-Graw Hill, 1972

SEMESTER VII

PROJECT PHASE-I (4 Credit)

Course Objective:

1. To Provide opportunity for working on a real time project, prepare a prototype and present conclusions in the form of reports.
2. To Provide opportunity for selection of Projects considering their usability to the industry snd society without endangering the environmental aspects.

Course Outcomes :

Upon successful completion of the course, students shall be able to

1. Hands-on experience on real time systems
2. Boost of confidence

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

INDUSTRY INTERNSHIP(12 Credit)

Course Objectives:

1. To expose students to industry environment
2. To get practical orientation relevant to subjects
3. To provide solutions to industrial and social need

Course Outcome:

At the end of the course the student shall be able to:

CO1:Understand the working culture of industry
CO2: Identify and solve industrial problem with analytical approach
CO3:-Provide solution in specific domain
CO4:-Work in a multidisciplinary group
CO5:-Provide hands on experience on real time systems
CO6:-Boost technical confidence

· A group of 04 student (Maximum) should identify an industry of good standing on their own in consultation with guide.

· Students are expected to complete topic identification and synopsis during this project seminar.

· All formalities related to industry Identification, topic identification and synopsis must be completed during 1st month of phase1.

· Period of industrial project will be of 24 week starting from last date of even semester exam every year.

· Student must report to his project guide every month.

· Student will be required to present from time to time (minimum.4 times during project); their progress report for project evaluation in person.. Under exceptional circumstances: the student may be allowed to present through video-conferencing. However this is not applicable to final Seminar

· Evaluation of the project will be according to the sheet

3. Ability to work in a multidisciplinary group.
4. Ability to consider the industry, social and environmental requirement
5. Present conclusions effectively before the

SEMESTER-VIII

EHVAC & HVDC TRANSMISSION

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-VIII												
	EHVAC & HVDC TRANSMISSION Elective-II	2	0	0	2	2	10	15	25			50

Course Objectives:

1. Understand the effect of electrostatic and electromagnetic field on EHVAC lines,
2. Understand Comparison between AC and DC Transmission.
3. Understand Control of power in HVDC lines, filters, circuit breakers and HVDC substations

Course Outcomes

CO1: Understand the power handling capabilities of EHVAC lines
CO2: Analyse the effect of electrostatic and electromagnetic field on EHVAC lines
CO3: Compare between AC and DC Transmission station

CO4: Design circuit breaker and substation model

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	1.0	1.0	2.0	3	3	1	2	1	0	0	0	1	3	2	3
CO2	1.0	1.0	2.0	3	3	1	2	1	0	0	0	1	3	2	3
CO3	1.0	1.0	2.0	3	3	1	2	1	0	0	0	1	3	2	3
CO4	1.0	1.0	2.0	3	3	1	2	1	0	0	0	1	3	2	3
CO5	1.0	1.0	2.0	3	3	1	2	1	0	0	0	1	3	2	3
CO6	1.0	1.0	2.0	3	3	1	2	1	0	0	0	1	3	2	3

Syllabus:-

Unit I

Power handing capacities of EHV AC Transmission lines. Voltage gradients : Electric field of point charge . sphere gap-line charge, single and three phase lines and bounded conductors-Maxwell‘s potential co-efficient , Mangolelt Formula

Unit II

Electrostatic and electromagnetic fields of EHV Lines, Electric shock and threshold current :Capacitance of long object , calculation of electromagnetic field of A.C. Lines (3-ph Single and double circuit line only) Effect of high electrostatics field , measurement of electrostatic ground wires, electrostatic interference Corona : Types critical disruptive voltages : Factor affecting corona , Methods for reducing corona power loss, corona current wave form charge voltage diagram audible noise and radio interference.

Unit III

Comparison of EHV AC and HVDC Systems Conversion from AC to DC Rectifiers, conveters conversion from AC to DC Invertors Kinds ofDC Link. Earth electrode and earth returns : Introduction OBJECTIVE, location and configuration, resistance of electrodes means of reducing earth electrode resistance troubles caused by earth electrode resistance trouble caused by earth

Current and remedies.Multiterminal HVDC System : Introduction 2 pole transmission. MTDC System with series and parallel connected convertors advantages and parallel connected converters, Advantages and applications configurations and types.

Unit IV

Power flow control in HVDC System: constant current constant voltage, constant ignition and excitation angle control, control characteristic. Parallel operation of AC and DC links (Synchronous and Asynchronous links)

Text Books:

1. S. Rao., EHV AC and HVDC transmission Engineering and practice, 3rdEdition, Khanna publications, 1999

2. C. L. Wadhwa, Electrical power systems, 4thEdition, CBS publication, 2005

Reference Books:

1. Begamudre, EHV AC Transmission, 2ndEdition, New Age publications, 1990

2. K.R. Padiyar,―HVDC Power TransmissionSystems‖, 2ndEdition, New Age publications, 2010

Advanced Power Electronics
(2 Credit) [30 Hrs]

Course Objectives:

1. This subject deals with the modern power semiconductor switches, converters, their control and application in residential, commercial & industrial etc
2. To study DC to DC switch mode converter.
3. To introduce resonant converter

Course Outcomes:

Upon successful completion of the course, students shall be able to-

CO1 Study overview and Protection of semiconductor devices

CO2 Study Single phase and Three phase line commutated convertors.

CO3 Design three phase Inverter and also study harmonic analysis

CO4 Study Close loop control of DC-DC convertor

CO5 Study comparison between PWM and resonant convertor

CO6 Study Role of FACTS devices in Power electronics along with designing UPS and intelligent Controllers

Unit I Static Controllable Switches (5 Hrs)

Overview of power semiconductor device structure, characteristics, rating and protection (Thyristor, BJT, MOSFET, IGBT, MOS

controlled Thyristor etc.) comparison of controlled switches .

Unit II Line Commutated Converters (5 Hrs)
Single phase and three phase line commutated converters – fully controlled, semi controlled, and dual phase cycloconverters. Performance with resistive and inductive loads. Converters with improved performance. Single phase Cycloconverters. Three phase cycloconverters. Reduction of output harmonics.

Unit III Soft Switch Inverters (5 Hrs)
Inverters, type (Hard/soft switch inverter, Voltage source inverter current source inverter). Operation with different types of loads, Performance parameters Harmonic elimination, control of output, voltage using different switching techniques.

Unit IV DC to DC Switch Mode Converters (5 Hrs)
Basic concepts, analysis of switch on and Off transients types, DC to DC converters comparison, soft switching, close loop control .

Unit V Resonant Converters (5 Hrs)
Comparison of PWM and resonant converters, classification, Basic resonant circuit concepts , Analysis and design of SRC (series), PRC (parallel), SPRC(series - parallel) resonant converters , DC-DC as well as AC-DC resonant converter, application for induction heating and reduction in THD and P.F. improvement .

Unit VI Power Modulators (5 Hrs)
Different methods to control the output voltage. Electric utility application, various types of SVCs (static var compensator), Power conditioners and uninterruptible power supplies, protection of supply, Introduction to recent intelligent controllers. Advanced topic on the subject

Text Books:
1. Ned Mohan Tora M. Undeland, William P.Robbins, Power Electronics, 2nd Edition, John Wiley & Sons, 1995
2. M.H. Rashid, Power Electronics Circuits and Application, 7th Edition, Prentice Hall of India, 2009

Reference Books:
1. C.V. Lander, Power Electronics, 3rd International Edition, Mc-Graw Hills, 2002
2. P.C. Sen, Modern Power Electronics, 3rd Edition, A.H.Wheeler Publication Co., 2009
3. M. D Singh, K B. Kanchandani, Power Electronics, Tata McGraw Hill International

Advanced Drives (2 Credit) [30 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	Marks
SEMESTER-VIII												
	Advanced Drives	2	0	0	2	2	10	15	25			50

Course Objectives
1. This Subject deals with modern drives controls techniques such as vector & scalar.
2. To study V/F control.
3. To study DTC control for industrial application

Course Outcomes
Upon successful completion of the course, students shall be able to-
CO1 Understand dynamics of drives.
CO2 Understand variable frequency control of drives.
CO3 Understand synchronous servomotor drive in industries.
CO4 Understand modern control techniques for ac drives.
CO5 Understand digital control of AC/DC drives and special motors used in industries.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:
Unit I Dynamics of Electrical Drives (05 Hrs)
Classification of electric drives – Basic elements of an electric drive. Dynamic condition of electric System. Stability consideration of electric drives.

Unit II AC Drives (05 Hrs)
Variable frequency control of AC motor. Cycloconverter control of slip frequency, Forced

commutated inverter drive, analysis.Performance and stability of synchronous and asynchronous drives.

Unit III Synchronous Motor Drives (07 Hrs)
Synchronous servomotor drives with sinusoidal waveform, with sinusoidal waveforms, with trapezoidal waveforms, Load commutated inverter drives.

Unit IV Advanced Control Strategies (07 Hrs)
Control of AC/DC machines.State variable approach.Scalar control method / Vector control method, comparison, Space vectors, stator space current, stator voltage space vector, stator flux linkages space vector, transformation of space vector coordinates from one reference frame to another.

Unit V Digital control of drives (06 Hrs)
Adoptive control principles. Digital control of drives.Application of microprocessor / computers to Electric AC / DC Drives.Switched reluctance motor control, Study of recent drives controllers. Advanced topic on the subject

Text Books:
1. Vedam Subramanyam, Electrical Drive, 2nd Edition, Tata Mc Graw Hill, 1996
2. Rakosh das Begamudere, Electro Mechanical Energy convection with dynamics of Machines, 2nd Edition, Wiley Eastern, 1998

Reference Books:
1. Paul, C, Krause, Analysis of Electric Machinery, 2nd Edition, IEEE Press, 2002
2. B.K. Bose, Power Electronics and AC Drives, 2nd Edition, Pearson Education, 2002
3. Joseph Vithyathil, Power Electronics, principles and application, 3rd Edition, Mcgraw Hill, 1995
4. Mohan Undeland, Power Electronics, converters, Application and design, 3rd Edition, Robbins John Wiley, 2008
5. G.K. Dubey, Fundamentals of Electrical Drives, 2nd Edition, Narosa Publication, 2002

Electric Vehicle (2 Credit) [30 Hrs]

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-VIII												
	Electric Vehicle	2	0	0	2	2	10	15	25			50

Course Objectives:
1. Electrical Vehicles need strong sources, efficient power-drives & excellent co-ordination within the vehicle.
2. This course introduces modern subsystems for efficient operation of vehicles.

Course Outcome:
Upon successful completion of the course, students shall be able to-
CO1 Understand basics of battery technology.
CO2 Understand scheme of HEV and full electric vehicle.
CO3 Analyse need of different motor drives for electric vehicle.
CO4 Apply new topologies to electric vehicle.
CO5 Evaluate performance parameters of electric vehicle.
CO6 Create improved systems for electric vehicle.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	2.0	1.0	3.0	1	2	3	1	0	0	0	1	2	3	2	3
CO2	3.0	2.0	3.0	1	2	3	1	0	0	0	1	2	3	2	3
CO3	3.0	2.0	3.0	1	2	3	1	0	0	0	1	2	3	2	3
CO4	3.0	2.0	3.0	1	2	3	1	0	0	0	1	2	3	2	3
CO5	3.0	2.0	3.0	1	2	3	1	0	0	0	1	2	3	2	3
CO6	3.0	2.0	3.0	1	2	3	1	0	0	0	1	2	3	2	3

Error! Not a valid link.Syllabus:

Unit I Introduction to Electric Vehicles (04 Hrs)
Electric vehicles (EV) development, past, present and future, comparison with IC engine driven vehicles.

Unit II Storage Units (05 Hrs)
Batteries, fuel cells, ultracapacitors. Power converters in EV. Different types of motors used in EV and their torque-speed characteristics, motor control techniques,

Unit III Vehicle Control (05 Hrs)
High performance and efficiency-optimized control, sensorless control. Electric vehicles modeling and their Characteristics.

Unit IV Electric drive-trains (05 Hrs)

Basic concept of electric traction - introduction to various electric drive-train topologies - power flow control in electric drive-train topologies - fuel efficiency analysis

Unit V Electric propulsion unit (05 Hrs)
Introduction to electric components used in electric vehicles - Configuration and control of DC Motor drives - Configuration and control of Induction Motor drives - Configuration and control of Permanent Magnet Motor drives - Configuration and control of Switched Reluctance Motor drives - Drive system efficiency

Unit VI Hybrid Electric Vehicle (05 Hrs)
Fuel cell Vehicles, Hybrid Electric Vehicles (HEV), series, parallel and series-parallel (split) systems, Recent industrial power electronic applications. Advanced topic on the subject

Text Books:
1. Sandeep Dharmeja, Electric Vehicle Battery Systems, 1st Edition, Newnes, 2001
2. K.T.Chau, Zheng Wang, Chaos in Electrical Drive Systems: Analysis, Control & Applications, 1st Edition, John Wiley and Sons, 2011

Reference Books:
1. Chung Chow Chan, K.T.Chau, Modern Electric Vehicle Technology, 1st Edition, Oxford University Press, 2001
2. Springer Books, Electrical Vehicle Integration into Modern Power Networks
3. A.T.P.So George C.Barney waterstones.com, International Journal of Elevator Engineering, United Kingdom
4. John Lowry, John Wiley and Sons, Electrical Vehicle Technology Explained-James Larminie, 1st Edition, 2003

Modern Digital Control System

First Term													Course Category
A Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						Duration of Paper	
						Theory			Practical		Total Marks		
	Th.	Tu.	Pr.	Total Hours		TAE	CAE	ESE	Int.	Ext.		Hours	
Modern Digital Control System	2	0	0	`2		8	12	30			50	2	Elective

Course Objectives:
1. To familiarize with data sampling
2.To understand basic digital system.
3. To prepare for various engineering applications.

Course Outcomes:
On successful completion of the course, Students shall be able to:
CO1: understand digitisation of analog system
CO2: Demonstrate the knowledge z transform
CO3: analyze discrete time control system
CO4: design discrete time state space equation

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:
UNIT – I SAMPLING AND RECONSTRUCTION Introduction, Examples of Data control systems – Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

UNIT-II THE Z – TRANSFORMS Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms

UNIT-III Z-PLANE ANALYSIS OF DISCRETE-TIME CONTROL SYSTEM Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane.

UNIT – IV STATE SPACE ANALYSIS State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations

Text Books:

Sr.	Title	Author	Publisher	Year	Edi

No.		Name		of Publication	tion
1	Digital Control Engineering,	M. Gopal,	Wiley Eastern,	1988.	
2	Computer Controlled Systems,	K.J Astrom, B Wittenmark,	Prentice - Hall India	1994	2nd edition

Reference Books:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Digital Control	R. Isermann,	Narosa Publications,	1993.	, Vol 1

SMART GRID TECHNOLOGIES AND APPLICATIONS

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
SEMESTER-VIII												
	Smart Grid and Technologies Elective-III	2	0	0	2	2	10	15	25			30

Course objectives:-

1)To ensure the students aware of the current state-of-the-art on design, operation and control of smart grid

2) To acquire knowledge on the components in smart grids and their functions

Course Outcome

CO1:Understand the concept of smart grid, their comparison over conventional grid & international policies

CO2:To implement smart metering & vehicle to grid applications.

CO3:Analyse Smart Substation & PMU's (Phasor Measurement Unit)

CO4:To practice power quality issues & audit.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:

Unit I (07 Hrs)

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid . CDM opportunities in Smart Grid

Unit II (08 Hrs)

Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers. Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

Unit III (08 Hrs)

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

Unit IV (07 Hrs)

Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality

Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.
Advanced topic on the subject

Textbook
Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid (Wiley - IEEE)
by Stephen F. Bush
Smart Grids: Infrastructure, Technology, and Solutions (Electric Power and Energy Engineering)
by Stuart Borlase

ADVANCED POWER SYSTEM STABILITY

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th	Tu	Pr	Total H		TAE	CAE	ESE	Int	Ext	Marks
SEMESTER-VIII												
ADVANCED POWER SYSTEM STABILITY Elective		2	0	0	2	2	10	15	25			30

Course Objectives
1. To introduce fault analysis of large power system
2. To study methods of stability.
3. To study effects of grounding on stability.

Course Outcomes
Upon successful completion of the course, students shall be able to
1. Understand the advanced methods of ensuring power system stability during fault conditions
2. To find the stability under major disturbances.
3. To understand the effect of grounding on stability
4 Understand the behavior of rotor in synchronous generators, the effect of change in load on rotor angular velocity and acceleration.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes		Programme Specific Outcomes	
	PO1….	PO12	PSO1…	PSO3
CO1	1/2/3/-		1/2/3	
CO2…..				
CO6				

Syllabus:
Unit I (07 Hrs)
Fault analysis of large power system, Calculation of three phase balanced and unbalanced faults.Methods of Symmetrical components, Fault levels in a typical system. Power in symmetrical components

Unit II (07 Hrs)
Transient stability : - A) Consideration of rotor angle, b) Consideration of time. Review of classical method, dynamic and transient stability investigations and simulation of single machine infinite bus and multi machine system, Solution by step by step method for swing equation.
Unit III (07 Hrs)
Effects of grounding on stability, effects of various disturbance, parameters and controls on stability, prevention of stability pull out.Role of automatic voltage regulator (AVR) on improving stability
Unit IV (07 Hrs)
Effect of excitation control and turbine Governing, Augmentation of stability of conventional methods, Recent software for power system analysis.Advanced topic on the subject
Test Book
1. Power System Dynamics Control – Prabha S. Kundur, IEEE Press, New York

Reference Book
1. "Power System Dynamics and Stability" by P Sauer and M A Pai
2. "Power System Dynamics, Stability and Control" by K R Padiyar
"Handbook of Electrical Power System Dynamics: Modeling, Stability, and Control" by Mohammad Shahidehpou

Flexible AC Transmission System

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					
							Theory			Practical		Total
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	Marks
SEMESTER-VIII												
Flexible AC Transmission System Elective		2	0	0	2	2	10	15	25			30

Course Objectives

· To introduce various Power Electronics controllers used in the Power Systems for the fast real and reactive power control.

Course outcomes

CO1:-Understand the operation FACTS and transmission interconnections

CO2:-Study the objectives of shunt compensation.

CO3:-Study the objectives of series compensation.

CO4:-Determining IPFC, UPFC and sub-synchronous resonance

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO 1…. 12												PSO1	PSO2	PSO3
CO1	1.0	2.0	2.0	3	3	0	1	0	0	0	0	2	2	3	2
CO2	1.0	2.0	2.0	3	3	0	1	0	0	0	0	2	2	3	2
CO3	1.0	2.0	2.0	3	3	0	1	0	0	0	0	2	2	3	2
CO4	1.0	2.0	2.0	3	3	0	1	0	0	0	0	2	2	3	2
CO5	1.0	2.0	2.0	3	3	0	1	0	0	0	0	2	2	3	2
CO6	1.0	2.0	2.0	3	3	0	1	0	0	0	0	2	2	3	2

Syllabus:

Unit I (7 Hrs)

FACTS Concept and General System Consideration: Transmission Interconnection, Flow of Power in an AC System, factors affecting the Loading Capability, Power Flow and Dynamic Stability Consideration of Transmission interconnection, Importance of controllable, Parameters, FACTS Controller.Voltage-Sourced Converters: Basic Concept of Voltage-Sourced Converters, Single-Phase Full-Wave Bridge Converter Operation, Single-Phase Leg, Operation, Square-Wave Voltage Harmonics for Single Phase Bridge, Three-Phase Full-Wave Bridge Converter, Sequence of Valve Conduction, Process in. Each Phase-Leg, Transformer connection for 12-PluseOperation, Three Level Voltage Sourced Convert, Pulse-Width Modulation Converter, Generalized Technique of Harmonic Elimination and Voltage Control,

Unit II (06 Hrs)

Static Shunt Compensators: SVC and STATCOM: OBJECTIVEs of shunt Compensation, Methods of Controllable Var Generation, Static Var Compensators SVC and STATCOM, Comparison Between STATCOM and SVC, Static Var System.

Unit-III (07 Hrs)

Static Series Compensators: GCSC, TSSC, TCSC and SSSC: OBJECTIVEs of series Compensation, Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators, External (System) Control for Series *Reactive* Compensators.

UNIT IV

Static Voltage and Phase Angle Regulators ; TCVR and TCPAR: OBJECTIVEs of Voltage and Phase Angle regulators, Approaches to Thyristor -Controlled Voltage and Phase Angle Regulators (TCVR and TCP ARS), Switching Converter-Based Voltage and Phase Angle regulator, Hybrid Phase Angle Regulators.

Combine Compensators (UPFC, IPFC): The Unified Power Flow Controller (UPFC}, Interline Power Flow Controllers Generalized and Multifunctional FACTS Controllers, Sub synchronous Resonance, NGH-SSR Damping Scheme,

Books

1. Song, Y.H. and Allan T. Johns, „Flexible ac transmission systems (FACTS)‟,
Institution of Electrical Engineers Press, London, 1999.

2. Hingorani ,L.Gyugyi, „ Concepts and Technology of flexible ac transmission system‟,
IEEE Press New York, 2000 ISBN –078033 4588.

3. R .Mohan Mathur and Rajiv K.Varma , „Thyristor - based FACTS controllers for Electrical transmission systems‟, IEEE press, Wiley Inter science , ISBN no . 0-471-20643-1,2002.

4. K.R.Padiyar, „FACTS controllers for transmission and Distribution systems‟ New Age international Publishers 1st edition -2007.