Proposed Scheme & Syllabus

For

Bachelor of Technology

Electrical and Electronics Engineering Department

National Institute of Technology Delhi

Teaching Scheme

Semester I

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	PHL 100	Electromagnetics and Quantum Physics	3	1	0	4
2.	CSB 101	Problem Solving and Computer Programming	3	0	2	4
3.	MAL 101	Advanced Calculus	3	1	0	4
4.	EEB 100	Introduction to Electrical and Electronics Engineering	3	0	2	4
5.	HMB 100	Professional Communication	3	0	2	4
6.	MEL 101	Environmental Studies	3	0	0	3
7.	PHP 100	Physics Laboratory	0	0	3	2
8.	MEP 103	Product Design and Realization Laboratory I	0	0	2	1
9.	EAP 101	Extra-Academic Activity	0	0	2	1
	Total Credits		18	2	13	27

Semester II

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	CYL 100	Chemical Structures & Reactivity	3	1	0	4
2.	CSB 102	Data Structures	3	0	2	4
3.	MAL 151	Linear Algebra and Complex Analysis	3	1	0	4
4.	MEB 100	Engineering Visualization	3	0	2	4
5.	HMB 101	Human Values and Ethics	3	0	2	4
6.	MEL 102	Engineering Mechanics	3	0	0	3
7.	CYP 100	Chemistry Laboratory	0	0	3	2
8.	MEP 104	Product Design and Realization Laboratory II	0	0	2	1
9.	EAP 102	Extra-Academic Activity	0	0	2	1
	Total Credits		18	2	13	27

Semester III

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEL 201	Network Analysis & Synthesis	3	1	0	4
2.	EEB 202	Electrical & Electronic Measurements	3	0	2	4
3.	EEL 203	Electro Magnetic Field Theory	3	1	0	4
4.	ECB 206	Analog Electronics	3	0	2	4
5.	ECB 204	Signals & Systems	3	0	2	4
6.	MAL 201	Ordinary Differential Equations and Transforms	3	1	0	4
7.	EEP205	Colloquium/ Industrial Lecture/ Seminar	0	0	2	1
	Total Credits		18	03	08	25

Semester IV

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEB 251	Electrical Machines-I	3	0	2	4
2.	EEB 252	Control Systems	3	0	2	4
3.	EEL253	Power Systems	4	0	0	4
4.	CSB 254	Digital Electronics and Logic Design	3	0	2	4
5.	MAL251	Partial Differential Equations and Numerical Analysis	3	1	0	4
6.	EELXXX	Elective-I	3	0	0	3
7.	EEP305	Summer Internship/ Summer Project-I (Credits will be counted in next Semester)	-	-	-	-
	Total Credits		19	01	06	23

Elective-I

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEL 261	Transducers & Signal Conditioning	3	0	0	3
2.	EEL 262	Biomedical Instrumentation	3	0	0	3
3.	EEL 263	Electrical Engineering Materials	3	0	0	3
4.	EEL 264	Electrical Distribution systems	3	0	0	3
5.	EEL 265	Power station Practice	3	0	0	3
6.	EEL 266	Finite Element Methods and Applications	3	0	0	3
7.	EEL 267	Instrumentation & Measurement	3	0	0	3

Semester V

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEB301	Electrical Machines-II	3	0	2	4
2.	EEL302	Power System Analysis	3	1	0	4
3.	EELXXX	Elective-II	3	0	0	3
4.	EEB303	Introduction to Microprocessors and Interfacing	3	0	2	4
5.	ECB304	IC Applications	3	0	2	4
6.	EEP304	Colloquium/ Industrial Lecture/ Seminar	0	0	2	1
7.	EEP305	Summer Internship/ Summer Project-I	-	-	-	1
	Total Credits		15	01	08	21

Elective-II

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEL 311	Digital Image Processing	3	`0	0	3
2.	EEL 312	Distribution System Planning & Automation	3	0	0	3
3.	EEL 313	Micro Electro Mechanical systems	3	0	0	3
4.	EEL 314	Advanced Control Systems	3	0	0	3
5.	EEL 315	Energy Audit & Management	3	0	0	3
6.	EEL 316	Renewable Energy Systems	3	0	0	3
7.	EEL 317	Restructuring in Power Systems	3	0	0	3
8.	EEL 318	Digital Control	3	0	0	3

Semester VI

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	HML351	Engineering Economics and Accountancy	3	0	0	3
2.	EEB351	Power Electronics	3	0	2	4
3.	EEL352	Switchgear & Protection	3	1	0	4
4.	EELXXX	Elective-III	3	0	0	3
5.		Open Elective-I	3	0	0	3
6.	EEP353	Simulation tools for Electrical Engineering	0	0	3	2
7.	EEP405	Summer Internship-II (Credits will be counted in next Semester)	-	-	-	-
8.	EEP354	Minor Project Work	0	0	4	2
9.	HMP352	Technical Communications	0	0	2	1
	Total Credits		15	01	11	22

Elective-III

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEL 361	Integrated Circuits & Applied Instrumentation(ICAI)	3	0	0	3
2.	EEL 362	Real Time Control in Power System	3	0	0	3
3.	EEL 363	Process Control	3	0	0	3
4.	EEL 364	High Voltage Engineering	3	0	0	3
5.	EEL 365	Power System Planning and Automation	3	0	0	3
6.	EEL 368	Electro-Magnetics for Electrical Machines	3	0	0	3
7.	EEL 369	Special Electrical Machines-I	3	0	0	3

Semester VII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEB401	Electrical Drives	3	0	2	4
2.	EEL4XX	Elective-IV	3	0	0	3
3.		Open Elective-II	3	0	0	3
4.	EEP402	Power System Lab	0	0	2	1
5.	EEP403	Project Work	0	0	6	4
6.	EEP405	Summer Internship-II	0	0	2	1
	Total Credits		09	0	12	16

Elective-IV

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEL 411	Utilization of Electrical Energy	3	0	0	3
2.	EEL 412	DSP and its Application to Power Electronics	3	0	0	3
3.	EEL 413	Power System Operation & Control	3	0	0	3
4.	EEL 414	Switched Mode Power Conversion	3	0	0	3
5.	EEL 415	Special Electrical Machines-II	3	0	0	3

Semester VIII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEL451	HVDC & Flexible AC Transmission Systems	3	1	0	4
2.	EEL4XX	Elective-V	3	0	0	3
3.	EEL4XX	Elective-VI	3	0	0	3
4.	EEL4XX	Elective-VII	3	0	0	3
5.	EEP452	Project Work	0	0	15	10
	Total Credits		12	1	15	23

Elective-V/ Elective-VI / Elective-VII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEL 461	Computer Applications in Power Systems	3	0	0	3
2.	EEL 462	Power Quality	3	0	0	3
3.	EEL 463	Wind Energy Conversion Systems	3	0	0	3
4.	EEL 464	Logic and Distributed Control System	3	0	0	3
5.	EEL 465	Optimal Control	3	0	0	3
6.	EEL 466	CAD for Electrical Machines	3	0	0	3
7.	EEL 467	Intelligent Control	3	0	0	3
8.	EEL 468	System Identification and Adaptive Control	3	0	0	3
9.	EEL 469	Power Electronics For Renewable Energy Systems	3	0	0	3
10.	EEL 470	Electrical Machine Modeling and Analysis	3	0	0	3
11.	EEL 471	Basics of Robotics	3	0	0	3
12.	EEL 472	Inverters and Resonant Pulse Converters	3	0	0	3
13.	EEL 473	Cycloconverters and AC voltage controllers	3	0	0	3
14.	EEL 474	Solid State Power Controllers	3	0	0	3
15.	EEL 475	Power System Stability & Control	3	0	0	3
16.	EEL 476	EHV AC/DC Transmission	3	0	0	3

	Required	Offered
Basic Sciences	**≥ 24**	**28**
Departmental Core	**≥ 60**	**61**
Other Engg Core	**≥ 30**	**33**
Humanities and Social Sciences	**≥ 10**	**12**
Elective	**≥ 15**	**21**
Open Elective	**≥ 3**	**6**
Project	**≥ 14**	**14**
Mandatory Courses	**9**	**9**

Minimum Credits Required for Award of Degree = 175

Mandatory Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1	MEL 101	Environmental Studies	3	0	0	3
2	EAP 101	Extra Academic Activity	0	0	2	1
3	EAP 102	Extra Academic Activity	0	0	2	1
4	EEP305	Summer Internship/ Summer Project – I	0	0	2	1
5	EEP405	Summer Internship– II	0	0	2	1
6	EEP 205	Colloquium/ Industrial Lecture/ Seminar	0	0	2	1
7	EEP 304	Colloquium/ Industrial Lecture/ Seminar	0	0	2	1
	Total Credits					09

Basic Science Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	PHL 100	Electromagnetics and Quantum Physics	3	1	0	4
2.	CYL 100	Chemical Structures & Reactivity	3	1	0	4
3.	MAL 101	Advanced Calculus	3	1	0	4
4.	PHP 100	Physics Laboratory	0	0	3	2
5.	CYP 100	Chemistry Laboratory	0	0	3	2
6.	MAL 151	Linear Algebra and Complex Analysis	3	1	0	4
7.	MAL 201	Ordinary Differential Equations and Transforms	3	1	0	4
8.	MAL251	Partial Differential Equations and Numerical Methods	3	1	0	4
	Total Credits					28

Humanities and social Science Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	HMB 100	Professional Communication	3	0	2	4
2.	HMB 101	Human Values and Ethics	3	0	2	4
3.	HML351	Engineering Economics and Accountancy	3	0	0	3
4.	HMP352	Technical Communication	0	0	2	1
	Total Credits					12

Other Engineering Core:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MEB 100	Engineering Visualization	3	0	2	4
2.	CSB 101	Problem Solving and Computer Programming	3	0	2	4
3.	CSB 102	Data Structures	3	0	2	4
4.	MEL 102	Engineering Mechanics	3	0	0	3
5.	MEP 103	Product Design and Realization Laboratory I	0	0	2	1
6.	MEP 104	Product Design and Realization Laboratory II	0	0	2	1
7.	ECB 206	Analog Electronics	3	0	2	4
8.	ECB 204	Signals & Systems	3	0	2	4
9.	CSB 254	Digital Electronics and Logic Design	3	0	2	4
10.	ECB 304	IC Applications	3	0	2	4
	Total Credits					33

Departmental Core:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEB 100	Introduction to Electrical and Electronics Engineering	3	0	2	4
2.	EEB 202	Electrical and Electronic Measurements	3	0	2	4
3.	EEL 201	Network Analysis and Synthesis	3	1	0	4
4.	EEL 203	Electromagnetic Field Theory	3	1	0	4
5.	EEB 251	Electrical Machines-I	3	0	2	4
6.	EEB252	Control Systems	3	0	2	4
7.	EEL253	Power Systems	4	0	0	4
8.	EEB 301	Electrical Machines-II	3	0	2	4
9.	EEL302	Power System Analysis	3	1	0	4
10.	EEB303	Introduction to Microprocessors and Interfacing	3	0	2	4
11.	EEB 351	Power Electronics	3	0	2	4
12.	EEL352	Switchgear & Protection	3	1	0	4
13.	EEP353	Simulation Tools for Electrical Engineering	0	0	3	2
	EEP354	Minor Project Work	0	0	4	2
14.	EEB401	Electrical Drives	3	0	2	4
15.	EEP402	Power System Lab	0	0	2	1
16.	EEL451	HVDC & Flexible AC Transmission Systems	3	1	0	4
	Total Credits					61

CURRICULUM

Course no: PHL 100	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of Course	Theory			
Course Title	**ELECTROMAGNETICS AND QUANTUM MECHANICS**			
Course Coordinator	DR ANUJ KUMAR SHARMA			
Course objectives:	To understand the basic concepts of electromagnetic theory through vector analysis. To understand the fundamentals of optics (interference, diffraction, and polarization), lasers, and fiber optics. To understand the origin, evolution of quantum physics (mainly particle properties of light and wave properties of particles) and solid state physics In the end, the course will briefly convey some important topics of nanotechnology and instrumentation.			
POs				
Semester	**Autumn: yes**		**Spring: Yes**	

Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				

Text Books:		
1.	Title	Introduction to Electrodynamics
	Author	D. J. Griffiths
	Publisher	Addison Wesley
	Edition	3rd ed. (1999)
2.	Title	Optics
	Author	A. K. Ghatak
	Publisher	Tata McGraw-Hill Education
Reference Books:		
3.	Title	An introduction to fiber optics
	Author	A. Ghatak and K. Thyagarajan
	Publisher	Cambridge University Press
	Edition	1998
4.	Title	Concepts of Modern Physics
	Author	A. Beiser
	Publisher	Tata McGraw-Hill Education
	Edition	6th ed. (2008)
Content	**Unit I:** **08** Vector analysis and Electrmagnetic Theory: Brief review of vector algebra, Electrostatics and magnetostatics, Maxwell's equations in	

	differential and integral forms and their interpretation, EM wave equation, transverse nature and speed of EM waves, EM energy density, Poynting vector. **Unit II: 12** Interference, Diffraction, and Polarization**:** Interference of EM waves**;** Division of amplitude: Uniform and wedge-shaped films; interferometers; Fresnel and Fraunhofer diffractions of EM waves; Diffraction grating; Polarization by transmission; Polarization by reflection; Double refraction. **Unit III: 08** Lasers and FiberOptics:Lasers: Basic principle, Types and applications. Fiber optics: Optical wave guiding, types of optical fibers, transmission losses, fiber optic communication. **Unit IV: 14** Quantum Physics:Dual nature of light; Compton Effect; De-Broglie waves; Davisson-Germer Experiment; Phase and group velocities; Uncertainty principle; Wave-function; Schrodinger wave equation; Particle in a finite and infinite potential well; Tunnel effect. Superposition Principle, Continuity Equation for probability density; Stationary states, Bound states, Free-particle solution, 1-D infinite potential well, Expectation values and uncertainty relations; 1-D finite potential well, Quantum mechanical tunneling and alpha-decay, Kronig-Penny model and emergence of bands. **Unit V: 06** Nanotechnology and Instrumentation**:** Introduction to Nanotechnology; carbon nanotubes, Optical Microscope, Biomedical Instrumentation, Holography.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSB 101	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	NO	NO	NO
Type of course	Theory			
Course Title	**PROBLEM SOLVING AND COMPUTER PROGRAMMING**			
Course Coordinator				
Course objectives:	This course aims to provide the students with a foundation in computer programming. The goals of the course are to develop the basic programming skills in students, and to improve their proficiency in applying the basic knowledge of programming to solve problems related to their field of engineering.			
POs				

Semester	**Autumn: Yes**		**Spring:**		
I	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Programming in ANSI C
	Author	E. Balagurusamy
	Publisher	TATA McGraw Hill
	Edition	6th edition, 2012
Reference Book:		
1	Title	Let Us C
	Author	YashavantKanetkar
	Publisher	Infinity Science Press
	Edition	13th edition, 2012
2	Title	The C Programming Language
	Author	Brian Kernighan & Dennis Ritchie
	Publisher	Prentice Hall
	Edition	2nd Edition, 1988
3	Title	Schaum's Outline of Programming with C

		Author	Byron S Gottfried
		Publisher	TATA Mc Graw Hill
		Edition	2nd edition, 1996
Content	**Unit I:** **05** Introduction to Computers: Hardware and Software. Basic Model of Computation, Notion of Algorithms, Flowcharts, Top down design, Bottom up approaches of problem solving, Number system. **Unit II:** **09** Introduction to programming language, Basics of C, Basic Data types – integer, float, double, char, Boolean, Void. Arithmetic and logical operators: precedence and associativity. Flow of Control- Conditional statements- If-else, Switch-case constructs, Loops- While, do-while, for. **Unit III:** **07** Function – User defined functions, library functions, Parameter passing – call by value, call by reference, recursion. **Unit IV:** **07** Arrays- Advantages and drawbacks, One dimensional, Multi-Dimensional Arrays and strings: Declaration, Initialization, Accessing, Passing arrays and strings as parameters to functions. Pointers, Dynamic memory allocation, Dynamic arrays – One dimensional, Multidimensional dynamic array. **Unit V:** **08** Structure: Declaration, Initialization, passing structure to function, Use of pointers in structure. Preprocessors, Macros, File management in C I/O – Opening, closing and editing files. Correctness & Efficiency Issues in Programming, Time & Space measures.		
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%		

Course no: MAL 101	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	**N**	**N**	**N**
Type of Course	Theory			
Course Title	**ADVANCED CALCULUS**			
Course Coordinator	DR. SUNIL KUMAR			
Course objectives:	This course is aimed to cover differential, integral and vector calculus for functions of one and more than one variable. These mathematical tools and methods are used extensively in physical sciences, engineering, and computer graphics.			
POs				
Semester	**Autumn: Yes**		**Spring:**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite Credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1.	Title	Thomas' Calculus
	Author	G. Thomas, M. Weir, J. Hass
	Publisher	Pearson Pub.
	Edition	2010
2.	Title	Introduction to Real Analysis
	Author	R.G. Bartle, D.R. Sherbert
	Publisher	John Wiley and Sons
	Edition	2011
3.	Title	

	Author	
	Publisher	
	Edition	
Reference Books:		
1.	Title	Advanced Engineering Mathematics
	Author	E. Kreyszig
	Publisher	Jon Wiley and Sons
	Edition	2008
2.	Title	
	Author	
	Publisher	
	Edition	
Content	**Unit I:** **18** Differential Calculus: Limit and Continuity of functions; differentiability; Jacobian, Rolle's theorem; Mean value theorem; Taylor's and Maclaurin's theorems with remainders, Expansions; Convergence of sequences and series of real numbers; Power series; Functions of several variables, limit and continuity, Partial Derivatives and Differentiability, Maxima & Minima of two variables, Lagrange method of multiplier. **Unit II:** **14** Integral Calculus: Fundamentals theorem of integral calculus, Riemann Integration, Improper Integrals, Double and Triple integrals-computation of surface area and volumes-change of variables in double and triple integrals. (14 hours) **Unit III:** **16** Vector Calculus: Scalar and vector field; Vector differentiation; Level surfaces, Directional Derivatives, Gradient of Scalar field; Divergence and Curl of a vector field; Laplacian, Line and Surface integrals; Green's theorem in plane Gauss Divergence's theorem and Stoke's theorem.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **EEB 100**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**Yes**	**No**
Type of Course	Theory			
Course Title	**INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING**			
Course Coordinator				
Course objectives:	To introduce the fundamentals of Electrical and electronics Engineering including circuit analysis, transformers, machines, analog and digital electronics.			
POs				
Semester	**Autumn:** Yes		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) + 24(P)**
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite Credits	NIL				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Electrical and Electronic Technology
	Author	E Hughes
	Publisher	Pearson
	Edition	
2.	Title	Fundementals of Electrical and Electronics Engineering
	Author	Smarajit Ghosh
	Publisher	PHI
	Edition	Second

3.	Title	Text book of Basic Electrical and Electronics Engineering
	Author	J.B.Gupta
	Publisher	S.K.Kataria
	Edition	
Reference Books:		
1.	Title	Electrical Engineering Fundamentals
	Author	V. D. Toro
	Publisher	Prentice Hall
	Edition	
2.	Title	Electrical Machinery
	Author	P.S. Bimbhara
	Publisher	Khanna
	Edition	
3.	Title	Principles of Electrical Engineering and Electronics
	Author	V.K.Mehta
	Publisher	S.Chand Publications
	Edition	
4.	Title	Basic Electrical Engineering
	Author	V.K.Garg
	Publisher	Wiley India
	Edition	
Content	**Unit I:** **08** Electrical Circuit Analysis: Voltage & Current sources: dependent & independent source, source conversion. Analysis of D.C. circuits: Mesh & Loop analysis, Nodal analysis. Network Theorems: Thevenin's, Norton's, superposition theorem etc. Star- Delta circuits. 1-Φ ac Circuits: Review of 1-Φ phase ac circuits under sinusoidal steady state conditions, Resonance, Active, Reactive and Apparent power, Power factor. 3-Φ ac circuits: Balanced and Unbalanced supply, Star and Delta connections, power measurement. **Unit II:** **06** Transformers: Magnetic Circuits: Review of laws of electromagnetism, Flux, MMF and their relation, analysis of magnetic and electric circuit. Single phase transformer: Basic concepts, constructional features, EMF equation, voltage, current and impedance transformation, Equivalent circuits. **Unit III:** **08** Electrical Machines: DC Machines: Constructional features, working principle, emf equation, types of dc machines and their characteristics. Induction Machines: Constructional features, working principle, emf equation, concept of slip and torque–slip characteristics. Synchronous Machines: Constructional features, working principle and emf equation. **Unit IV:** **08** Digital electronics: Number systems: decimal, binary, octal, hexadecimal, their complements, operation and conversion, floating point and signed numbers. Demorgan's theorem, Logic Gates: Basic and Universal Gates, their representation, truth table and realization, Half and Full adder	

	circuits, Flip-Flops etc. **Unit V: 06** Electronic Devices and Circuits: Introduction to semiconductors, Diodes: types of diodes and their characteristic. Bipolar Junction Transistors: working, configurations (CC, CB & CE) and mode of operation.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory foroverall grading

Course no: HMB 100	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**Yes**	**No**	**No**
Type of Course	Theory			
Course Title	**PROFESSIONAL COMMUNICATION**			
Course Coordinator				
Course objectives:	To inculcate linguistic skills in students.			
POs				
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	60
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite Credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Technical Communication: Principles and Practice
	Author	Raman, Meenakshi and Sharma, Sangeeta,
	Publisher	Delhi: Oxford University Press
	Edition	2004
2.	Title	Technical Writing and Professional Communication,
	Author	Thomas N Huckin and Leslie &Oslen,
	Publisher	McGrow Hills
	Edition	2004
3.	Title	
	Author	
	Publisher	
	Edition	
Reference Books:		
1.	Title	
	Author	
	Publisher	

	Edition	
2.	Title	
	Author	
	Publisher	
	Edition	
Content	**Unit I:** **15** Theory of communication, Cycle of communication, Types of communication, Verbal and Non-verbal Communication, Oral communication, Written Communication, Body language, Paralanguage, Proxemics, Chronemics, Haptics, Flow of communication, 7Cs of communication, Barriers to communication. **Unit II:** **15** Reading Skills: Practice in reading a wide range of texts with a view to improving their reading comprehension, and also grammar and vocabulary. Reading Comprehension, Reading a Novel, Note Making, Interpretation of Non Verbal Data. **Unit III:** **15** Writing Skills: Practice in Written Communication with a view to enabling independent, original and creative writing. Construction of Sentences and Paragraphs Writing for Correspondence (letters, memos, emails, and fax) Professional Writing (Process Writing, Technical Description and Report Writing), Tips for making presentation, Curriculum Vitae etc. **Unit IV:** **15** Speaking and Listening Skills (Laboratory Work) Practice in Speaking and Listening Activities with a view to improving their oral and listening skills. Individual speech sounds, Stress and Intonation patterns, Personality Development Questionnaires, Role Play, Extempore, Group Discussions, Facing Interviews, Presentation Skills.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **MEL 101**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory			
Course Title	**ENVIORNMENTAL STUDIES**			
Course Coordinator	DR. KAPIL SHARMA			
Course objectives:	Recognize major concepts in environmental sciences and demonstrate in-depth understanding of the environment. Develop analytical skills, critical thinking, and demonstrate problem-solving skills using scientific techniques.			
POs				
Semester	**Autumn: NO**		**Spring: YES**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite Credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	MEL 101	Nil			
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Environmental Science and Engineering
	Author	J.G. Henry and G.W. Heinke
	Publisher	Pearson Education
	Edition	2004
2.	Title	
	Author	
	Publisher	
	Edition	

3.	Title	
	Author	
	Publisher	
	Edition	
Reference Books:		
1.	Title	Introduction to Environmental Engineering and Science
	Author	G.B. Masters
	Publisher	Pearson Education
	Edition	2004
Content	**Unit I:** **06** Multidisciplinary nature of environmental studies**:** Definition, scope and importance, need for public awareness **Unit II:** **06** Ecosystems - Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystems: - a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems, Biogeochemical cycles **Unit III:** **06** Natural Resources: Concept of Renewable and non-renewable resources, Natural resources and associated problems. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Bioenergy and biofuels **Unit IV:** **06** Bio diversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. Inida as a mega-diversity nation, Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity **Unit V:** **06** Environmental pollution: Definition, Cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards, Causes, effects and control measures of urban and industrial wastes. Pollution case	

	studies. Solid waste Management **Unit VI:** **06** Social Issues and Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Climate change, global warming, acid rain, ozone layer depletion and Eutrophication, Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

<table>
<tr><td>Course no:
PHP 100</td><td>Open course (YES/NO)</td><td>HM Course (Y/N)</td><td>DC (Y/N)</td><td>DE (Y/N)</td></tr>
<tr><td></td><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>Type of course</td><td>Practical</td><td></td><td></td><td></td></tr>
<tr><td>Course Title</td><td colspan="4">PHYSICS LABORATORY</td></tr>
<tr><td>Course Coordinator</td><td colspan="4">DR GYANENDRA SHEORAN</td></tr>
<tr><td>Course objectives:</td><td colspan="4">The course is aimed at providing the practical knowledge of:
i. Basic optics experiments (Interference, diffraction, and polarization)
ii. Basic semiconductor devices experiments (diode, LED etc.)
Modern physics experiments (Hall effect, Planck’s constant, bandgap measurement, Thompson experiment)</td></tr>
<tr><td>Text Books:</td><td colspan="4"></td></tr>
<tr><td rowspan="4">1.</td><td colspan="2">Title</td><td colspan="3"></td></tr>
<tr><td>Author</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Publisher</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Edition</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Reference Books:</td></tr>
<tr><td rowspan="4">1.</td><td colspan="2">Title</td><td colspan="2"></td></tr>
<tr><td colspan="2">Author</td><td colspan="2"></td></tr>
<tr><td colspan="2">Publisher</td><td colspan="2"></td></tr>
<tr><td colspan="2">Edition</td><td colspan="2"></td></tr>
<tr><td>Content</td><td colspan="4">1. To study the Hall Effect and determination of hall coefficient, and charge carrier concentration.
2. To study interference and diffraction of light by slits (single, double, and/or multiple).
3. To find out wavelength of light by using plane transmission diffraction grating.
4. To study the interference of light by Fresnel’s biprism.
5. To determine the wavelength of light by Newton’s rings method.
6. To determine specific rotation of sugar using half shade polarimeter.
7. To study the polarization of light and verify Malus’ law.
8. To determine the energy bandgap of a semiconductor by resistivity measurement.
9. To determine the e/m ratio by Thomson’s method.
10. To study photoelectric effect and to determine the Planck’s constant.</td></tr>
</table>

	11. To determine Planck's constant with LED. 12. To determine the refractive index and Cauchy's constants using prism and spectrometer. 13. To find out the Resolving power of diffraction grating using spectrometer. 14. To determine the fill factor and efficiency of solar cell (in series and parallel). 15. To study LCR circuit and to find out the resonance frequency. 16. To study the V-I characteristics of silicon, germanium, and Zener diodes in forward and reverse bias. (**Note:** Any 8-10 experiments may be performed)
Course Assessment	Continuous Evaluation 50% End Semester 50%

Course no: **MEP 103**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of Course	Laboratory			
Course Title	**PRODUCT DESIGN & REALIZATION LABORATORY- I**			
Course Coordinator	ABHISHEK GANDHI			
Course objectives:	This course is to introduce the basic principles 3D modeling of products. At the end of this course, the students could develop 3D models and their engineering drawings using softwares such as Solidworks, etc.			
POs				
Semester	**Autumn: YES**		**Spring: NO**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total TeachingHours**
Contact Hours	0	0	24	1	24
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite Credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	MEP 103	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:

1.	Title	Solidworks 2015 For Engineers And Designers
	Author	Sham Tickoo
	Publisher	Dreamtech Press
	Edition	2016
2.	Title	
	Author	
	Publisher	
	Edition	

3.	Title	
	Author	
	Publisher	
	Edition	
Reference Books:		
1.	Title	Exploring Solidworks 2011: A Project Based Approach
	Author	Prof. Sham Tickoo and Sandeep Prem
	Publisher	Dreamtech Press
	Edition	2011
2.	Title	
	Author	
	Publisher	
	Edition	
Content	**UNIT I: 02** SolidWorks Basics and the User Interface:Design Intent, File References, Opening Files, The Solid Works User Interface **UNIT II: 02** Introduction to Sketching**:** 2D Sketching, Stages in the Process, Saving Files, What are We Going to Sketch, Sketching, Sketch Entities, Basic Sketching, Rules That Govern Sketches, Design Intent, Sketch Relations, Dimensions, Extrude, Sketching Guidelines **UNIT III: 03** Basic Part Modeling:BasicModeling, Terminology, Choosing the Best ProfileChoosing the Sketch Plane, Details of the Part, Boss Feature Sketching on a Planar Face, Cut Feature, Using the Hole Wizard, View Options, Filleting, Detailing Basics, Drawing Views, Center Marks, Dimensioning, Changing Parameters **UNIT IV: 02** Modeling a Casting or Forging:Case Study: Ratchet, Design Intent, Boss Feature with Draft, Symmetry in the Sketch Sketching Inside the Model, View Options, Using Model Edges in a Sketch, Creating Trimmed Sketch Geometry, Using Copy and Paste **UNIT V: 02** Patterning: Why Use Patterns?, Reference Geometry, Linear Pattern, Circular Patterns, Mirror Patterns, Using Pattern Seed Only, Sketch Driven Patterns **UNIT VI: 02** Revolved Features**:** Case Study: Handwheel, Design Intent, Revolved Features, Building the Rim, Building the Spoke, Edit Material, Mass Properties, File Properties, SolidWorks SimulationXpress, Using SolidWorks SimulationXpress, **UNIT VII: 02** Shelling and Ribs: Shelling and Ribs, Analyzing and Adding Draft, Other Options for Draft, Shelling, Ribs, Full Round Fillets, Thin Features **UNIT VIII: 02** Editing: repairs: Part Editing, Editing Topics, Sketch Issues, FilletXpert, DraftXpert **UNIT IX: 02** Editing: Design Changes: Part Editing, Design Changes, Information From a	

	Model, Rebuilding Tools, Sketch Contours, Editing with Instant 3D **UNIT X: 02** Configurations: Configurations, Using Configurations, Creating Configurations, Link ValuesEquations, Configure Dimension / Feature, Modeling Strategies for Configurations, Editing Parts that Have Configurations, Design Library. **UNIT XI: 02** Design Drawings: More About Making Drawings, Section View, Model Views, Broken View, Detail Views, Drawing Sheets and Sheet Formats, Projected Views, Annotations **UNIT XII: 02** Bottom up assemble modeling: Case Study: Universal Joint, Bottom-Up Assembly, Creating a New Assembly, Position of the First Component, FeatureManager Design Tree and Symbols, Adding Components, Using Part Configurations in Assemblies, Sub-assemblies, Smart Mates Using Assemblies, Analyzing the Assembly, Checking for Clearances, Changing the Values of Dimensions, Exploded Assemblies, Explode Line Sketch, Bill of Materials, Assembly DrawingsInserting Sub-assemblies, Pack and Go.
Course Assessment	Continuous Evaluation 50% End Semester 50%

Course no: CYL-100	Open Course (YES/NO) YES	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	No
Type of course	Theory			
Course Title	**Chemical Structure and Reactivity**			
Course Coordinator	Dr. A. P. Singh & Dr. Suman Srivastava			
Course objectives:	By learning this subject, students will be able to understand: i. The basic concept of atomic structure bonding and reactivity. ii. Also this course will also introduce students to basics of electrochemistry, reactions kinetics. iii. This course is design to impart the knowledge of structures of various molecules, their interactions, synthesis route and structural relationship. iv. At the end of this session students will able to understand about the applied chemistry especially about commercial polymer, petroleum products and engineering of materials.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1.	Title	Inorganic Chemistry: Principles of Structure and Reactivity,
	Author	J. E. Huheey
	Publisher	Pearson India
	Edition	4th Edition
2	Title	Concise Inorganic Chemistry,
	Author	J. D. Lee
	Publisher	Wiley
	Edition	5th Edition
3	Title	Elements of Physical Chemistry,
	Author	P. W. Atkins
	Publisher	Oxford Univ Press
	Edition	2nd Edition
4	Title	Organic Chemistry
	Author	R. T. Morrison
	Publisher	Pearson
	Edition	6th Edition
5	Title	Engineering Chemistry
	Author	Shikha Agarwal
	Publisher	Cambridge University Press
	Edition	1st Edition, 2015

Content	**UNIT 1: Fundamentals of Inorganic Chemistry 12** Periodic table, atomic and ionic radii, ionization energy, electron affinity, electronegativity and periodicity.Properties and chemical behaviour of s, p, d and f block elements. Chemical Bonding: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shall electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, CIF_3, ICl_2 and H_2O. Crystal Field Theory (CFT), comparison of the stability of octahedral and tetrahedral complexes on the basis of crystal field stabilization energy (CFSE), factor affecting the magnitude of CFSE, application of crystal field theory. Jahan-Teller effect definition and example from d^9 and high spin d^4 systems. **UNIT 2: Fundamentals of Organic Chemistry 08** Nomenclature of organic molecules. Aromaticity: Benzenoid and non-benzenoid compounds generation and reactions. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Important name reactions and rearrangements. **UNIT 3: Electrochemistry and Chemical Kinetics 08** **Electrochemistry:** Introduction, Types of Conductors, Conductance in Electrolytic Solutions, Factor Affecting Conductance, Kohlrausch' law of Independent Migration of Ion. Conductometric titration, Electro Chemical Cell, Electrode Potential and EMF of a Galvanic Cell, Electrochemical Series., Types of Electrode, Batteries. **Chemical Kinetics:** Introduction, Rate of Reaction, Average Rate and Instantaneous Rate, Rate Law Expression, Rate Constant, Factor Influencing Rate of the Reaction. Order and Molecularity of the Reaction, Zero order, First Order Chemical Kinetics, Half-life of a reaction. **UNIT 4: Analytical Techniques in Chemistry 08** Types of Analysis. Separation Techniques, Potentiometry, pH metry, Spectroscopic techniques: UV-Visible spectroscopy, Lambert Beer's Law, principles and applications of UV-Visible spectroscopy, Infrared spectroscopy, Nuclear Magnetic Resonance Spectroscopy. **UNIT 5: Applied Chemistry 12** (i) **Petroleum Products and Technologies:** Petroleum and petrochemicals, Petroleum cracking, reforming, synthetic petrol, knocking in petrol and diesel engines. (ii) **Industrial Polymers:** Classification of Polymers, Polymer reaction and mechanism of polymerization. Polymerization Techniques, molecular weight of polymers. Commercially important polymers: fibbers, elastomers, adhesives, plastics, vinylic and phenolics, polyesters, polyamide. (iii) **Engineering Materials:** Cement, Gypsum ($CaSO_4.2H_2O$), Plaster of Paris ($2CaSO_4.H_2O$ or $CaSO_4.1/2H_2O$), Lime, Glass, Refractories, Insulating Material.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSB 102	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	NO	NO	NO
Type of course	**Core**			
Course Title	**DATA STRUCTURES**			
Course Coordinator				
Course objectives:	This course aims to provide the students with a foundation in computer programming. The goals of the course are to develop the basic programming skills in students, and to improve their proficiency in applying the basic knowledge of programming to solve problems related to their field of engineering.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
I	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1.	Title	Fundamentals of Data Structures
	Author	E. Horowitz, S. Sahni
	Publisher	Computer Science Press
	Edition	2nd Edition, 2008
Reference Book:		
1.	Title	Data Structures Using C
	Author	E. Balagurusamy
	Publisher	TATA McGraw Hill
	Edition	2013
2.	Title	Data Structure and Program Design
	Author	R.L. Kruse
	Publisher	Prentice Hall
	Edition	2nd Edition, 1996

3.		Title	Data Structures Using C
		Author	A. M. Tanenbaum, Y. Langsam, M. J. Augenstein
		Publisher	Pearson Education
		Edition	1990
Content	**Unit I:** **05** Introduction: Dynamic aspects of operations on data, Characteristics of data structures, Creation and manipulation of data structures, Operations on data structures, Types of data structures – linear and nonlinear. Introduction to algorithm: Asymptotic notations, Analysis of algorithms: Time and Space complexity. **UnitII:** **07** Arrays: Dynamic memory allocation, one-dimensional arrays, multidimensional arrays, operations on arrays, storage – Row major order, Column major order. Linked lists: types of linked lists – singly, doubly and circularly linked lists, operations on linked lists. **Unit III:** **08** Stacks: Implementation of stacks– array and linked list, operations on stacks, Applications of Stacks, Notations – infix, prefix and postfix, Conversion and evaluation of arithmetic expressions using Stacks. Queues: Implementation of queues– array and linked list, operations on queues, Types of queues – queue, double ended queue and priority queue. **Unit IV:** **08** Trees: Binary tree, Binary search tree, Threaded binary tree, Height balanced trees, Tries, Heaps, Hash tables. Graph traversals: Breadth First Search, Depth First Search, Shortest path: Depth first search in directed and undirected graphs. Union-find data structure and applications. Directed acyclic graphs; topological sort. **Unit V:** **08** Searching: Linear search, Binary search and Hashing. Algorithms and data structures for sorting: Insertion Sort, Bubble sort, Selection Sort, Merge sort, Quick Sort, Heap sort, Radix sort, Bucket sort. Algorithm design techniques: Divide and conquer, Greedy approach, dynamic programming.		
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%		

Course no: MAL 151	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	**N**	**N**	**N**
Type of Course	Theory			
Course Title	**LINEAR ALGEBRA AND COMPLEX ANALYSIS**			
Course Coordinator	DR. AMIT MAHAJAN			
Course objectives:	This course covers matrix theory and linear algebra, emphasizing topics useful in other disciplines. The concepts of linear algebra are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Also, this course covers basic concepts of complex analysis, such as limit, continuity, differentiability and integration, and also related theorems.			
POs				
Semester	**Autumn:**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite Credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:		
1.	Title	Linear Algebra and its Applications
	Author	David C. Lay
	Publisher	Pearson Pub.
	Edition	2011
2.	Title	Complex variables and its applications
	Author	R. V. Churchill
	Publisher	McGraw Hill
	Edition	1960
Reference Books:		
1.	Title	Introduction to Linear Algebra
	Author	Gilbert Strang
	Publisher	Cambridge Press
	Edition	2009

2.	Title	Advanced Engineering Mathematics
	Author	E. Kreyszig
	Publisher	John Wiley and Sons
	Edition	2008
Content	**Unit I:** **24** Linear Algebra: Elementary of row and column operations on a matrix, Rank of a matrix, Normal form, Inverse of matrix, Systems of linear equation and their solutions, Vector space and its subspaces, Spanning sets and linear independence, Determinant properties, Linear transformation, Range space and Rank, Null space and nullity, Eigenvalues and eigenvector, Diagonalization of matrices, Similarity of matrices, Inner product, Gram Schmidt process, Least square approximations. **Unit II:** **24** Complex Analysis: Complex number and elementary properties, Complex functions-Limit, continuity and differentiability, Polar form of Complex number, Cauchy Riemann Equations, Analytic and Harmonic functions, Cauchy's Theorem, Cauchy's Integral formula, Taylor and Laurent's series expansion, Zeros and singularities, Residues, Residue theorem and its applications.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: MEB 100	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of Course	THOERY			
Course Title	**ENGINEERING VISUALIZATION**			
Course Coordinator	DR. ABHISHEK MISHRA			
Course objectives:	1. To impart and inculcate proper understanding of the theory of projection. 2. To improve the visualization skills. 3.To enable the students with various concepts like dimensioning, conventions andstandards related to working drawings in order to become professionally efficient. 4. To impart the knowledge on understanding and drawing of simple residential/officebuildings.			
POs	1. Students will be able to understand the theory of projection. 2. Students will be able to know and understand the conventions and the methods of engineering drawing. 3. Students will be able to improve their visualization skills so that they can apply theseskills in developing new products. 4. Students will be able to prepare simple layout of factory buildings.			
Semester	**Autumn:**		**Spring:**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	60
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite Credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per	NIL				

proposed course numbers					
Text Books:					
1.	Title	Engineering Drawing			
	Author	N. D. Bhatt			
	Publisher	CharotarPublishing House Pvt. Ltd.			
	Edition	Fifty Third 2014			
2.	Title				
	Author				
	Publisher				
	Edition				
3.	Title				
	Author				
	Publisher				
	Edition				
Reference Books:					
1.	Title	AutoCAD 2007 Bible			
	Author	E. Finkelstein			
	Publisher	Wiley Publishing Inc.			
	Edition	2007			
2.	Title				
	Author				
	Publisher				
	Edition				
Content	**OVERVIEW:** Sketching concepts. Orthographic Projections and views: Principles of Axonometric projections and Development of Isometric, Dimensioning of Orthographic Views, Sectioning in Orthographic views and assembly drawings. Introduction: Overview of the course, Examination and Evaluation patterns. **Unit I**: **09** Lines Lettering and Dimensioning: Types of lines, Lettering, Dimensioning, Geometrical Constructions, Polygons. Scales: Plain scales, Diagonal scales, Scale of chords. **Unit II**: **09** Curves used in Engineering Practice: Ellipse, Parabola, Hyperbola, normal and tangents to these curves, Involute, Cycloid, Epi-cycloid, Hypo-cycloid, Spiral, Helix on cone and cylinder. **Unit III**: **09** Orthographic projection of points: Principles of Orthographic projection, Projections of points.Projections of Lines: Projections of a line parallel to one of the reference planes and inclined to the other, line inclined to both the reference planes, Traces **Unit IV**: **09** Projections of Planes: Projections of a plane perpendicular to one of the				

	reference planes and inclined to the other, Oblique planes. **Unit V**: **08** Projections of Solids: Projections of solids whose axis is parallel to one of the reference planes and inclined to the other, axis inclined to both the planes. **Unit VI:** **08** Section of Solids: Sectional planes, Sectional views - Prism, pyramid, cylinder and cone, true shape of the section. **Unit VII:** **08** Isometric views: Isometric axis, Isometric Planes, Isometric View, Isometric projection, Isometric views – simple objects.Assembly drawings of the machine parts. **NOTE:** Interpretation of drawings: Introduction of CAD package to construct a simple solid model, Using a CAD package to construct solid models and generating orthographic, isometric, sectional views with dimensioning, Assembly of components and generation of corresponding drawings. Animation of single of machines in CAD.
Course Assessment	Theory (60%): Continuous Evaluation 25%, Mid Semester 25% End Semester 50% Laboratory (40%): Continuous Evaluation 50%

Course no: **HMB 101**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of Course	Practical			
Course Title	**HUMAN VALUES AND ETHICS**			
Course Coordinator				
Course objectives:	To inculcate ethical understanding in students.			
POs				
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	60
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite Credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				

Text Books:		
1.	Title	Organizational Behaviour: Text and Cases
	Author	Chitale, et.al.
	Publisher	PHI Learning Private Limited.
	Edition	
2.	Title	
	Author	
	Publisher	
	Edition	
3.	Title	

	Author	
	Publisher	
	Edition	
Reference Books:		
1.	Title	Ethics in Engineering
	Author	Mike W. Martin & Roland Schinzinger
	Publisher	McGrow Hills
	Edition	
2.	Title	
	Author	
	Publisher	
	Edition	
Content	**Unit I:** **15** Introduction: Organizational Systems and Resources Personality, Types of Personality, Determinants of Personality. Biographical and Personal factors. Environmental Factors. Psychological Factors. Big Five Personality traits. **Unit II:** **15** Feelings, Classification of Feelings. Dimensions of Emotions. Emotions and External Constraints. Emotional Intelligence. Spiritual Intelligence. Authority, Responsibility and Accountability: Meaning of Authority, Responsibility and Accountability. Balance between Authority, Responsibility and Accountability. **Unit III:** **15** Human Resource Policies& Procedures. Introduction, Importance of Policies, Policy formation, Human resources planning. Decision-making &Ethics. **Unit IV:** **15** Concept of moral Relativism and Moral Imperialism. Cognitive Moral Development. Encouragement to Ethical Behaviour. Approaches to Fostering Ethical Behaviour.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **MEL 102**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of Course	Theory			
Course Title	**ENGINEERING MECHANICS**			
Course Coordinator	ABHISHEK GANDHI			
Course objectives:	This course is to introduce the basic principles of engineering mechanics with emphasis on their analysis and application to practical engineering problems.			
POs				
Semester	**Autumn: YES**		**Spring YES**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite Credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	MEL 102	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:		
1.	Title	Engineering Mechanics
	Author	Timoshenko, Young, Rao &Pati
	Publisher	McGraw Hill Education India
	Edition	5 (2013)
2.	Title	
	Author	
	Publisher	

	Edition	
3.	Title	
	Author	
	Publisher	
	Edition	
Reference Books:		
1.	Title	Engineering Mechanics
	Author	J.L. Meriam & L.G. Kraige
	Publisher	Wiley
	Edition	7 (2011)
2.	Title	
	Author	
	Publisher	
	Edition	

Content

UNIT I: **03**

System of Coplanar forces: Introduction to coplanar & non-coplanar force system. Forces and their components. Moment of the force about a point, couple. Resultant of coplanar force system - concurrent forces, parallel forces, non-concurrent non-parallel system of forces.

UNIT II: **03**

Equilibrium of coplanar force system: Meaning of equilibrium, free body diagrams, equilibrium of concurrent, parallel and non-concurrent non-parallel (general) system of forces. Types of supports, determination of reactions at supports for various types of determinate beams.

UNIT III: **03**

Forces in Space: Rectangular components of forces in space, Resultant of concurrent forces, moment of a force about a point, moment of a force about a given axis, resultant of general force system, Equilibrium of a particle in space.

UNIT IV: **03**

Analysis of pin jointed frame/ truss: Perfect truss, Imperfect truss, Analysis of truss by method of joints and method of section.

UNIT V: **03**

Friction: Laws of friction, angle of friction, angle of repose, cone of friction, Equilibrium of bodies on rough horizontal and inclined plane, application to problems involving wedges, ladder. Belt friction, flat belts on the flat pulleys.

UNIT VI: **03**

Centroid of Plane Areas: Concept of Centroid of plane areas. Centroid of areas by integration. Centroid of composite areas.

UNIT VII: **03**

	Moment of Inertia: Moment of inertia of plane areas, parallel axis theorem. Introduction to polar moment of inertia, product of inertia and mass moment of inertia. **UNIT VIII: 03** Kinematics of Particle: Velocity and acceleration in terms of rectangular coordinate system, rectilinear motion, motion along plane curved path, tangential and normal component of acceleration, acceleration - time, velocity- time, graphs and their use, relative velocity, projectile motion, simple harmonic motion. **UNIT IX: 03** Kinematics of rigid bodies: Translation, pure rotation and plane motion of rigid bodies, instantaneous, centre of rotation for velocity for bodies in plane motion, link mechanisms (upto two links) **UNIT X: 03** Kinetics of Particles: Newton's laws of motion, D'Alembert's principle, equation of dynamic equilibrium, linear motion, curvilinear motion. **UNIT XI: 03** Energy and Momentum Principles: Work done by a force, potential and kinetic energy, power, work energy equation, principle of conservation of energy, momentum, impulse and momentum principle, principle of conservation of momentum, impact of solid bodies, elastic impact, semi-elastic impact and plastic impact. **UNIT XII: 03** Kinetics of rigid bodies: D'Alembert's principle for bodies under translational motion, rotational motion about a fixed axis and plane motion. Application to motion of bars, cylinders, spheres.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CYP-100	Open Course (YES/NO) YES	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	No
Type of course	Practical			
Course Title	**Chemistry Laboratory**			
Course Coordinator	Dr. A. P. Singh & Dr. Suman Srivastava			
Course objectives:	This course will provide the practical knowledge to the students on: i) Various types of Titrations ii) Synthesis and characterization of various organic and inorganic compounds. iii) Identification of unknown compounds iv) Hand on experience on various analytical equipments.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Laboratory hours**
Contact Hours	0	0	3	2	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1.	Title	Essentials of Experimental Engineering Chemistry,
	Author	Shashi Chawla
	Publisher	Dhanpat Rai and Co Pvt Ltd
	Edition	4^{th} Edition
2.	Title	Vogel's Quantitative Inorganic Analysis
	Author	G. Svehla
	Publisher	Prentice Hall
	Edition	7^{th} Edition

Content

1. To find the strength in grams per liter of the given solution of sodium hydroxide with the help of stander oxalic acid solution.

2. Estimation of water hardness by EDTA method.
   a. To determine the strength of calcium ion in given $CaCO_3$ solution by complexometric titrations.
   b. To determine the strength of magnesium ion in given $MgSO_4$ solution by complexometric titrations.
   c. To determine the total hardness of given water sample by complexometric titrations.

3. To determination the strength of ferrous ammonium sulphate with the help of $K_2Cr_2O_7$ solution.

4. To Preparation of a nickel complex $[Ni(NH_3)_6]Cl_2$ and estimation of nickel by complexometric titration.

5. Preparation of benzimidazole.

6. Identification of functional group present in an organic compound- unknown sample

7. Measurement of physical properties: Surface tension and viscosity.

8. Chemical kinetics- Acid hydrolysis of ethyl acetate.

9. Acid-base titration using pH meter.

10. Acid-base titration by conductometry.

Course Assessment	Continuous Evaluation 50% End Semester 50%

Course no: MEP 104	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Laboratory			
Course Title	**PRODUCT DESIGN & REALIZATION LABORATORY - II**			
Course Coordinator	ABHISHEK GANDHI			
Course objectives:	The student will be able to identify the manufacturing processes required to manufacture an engineering product. The student will have a brief exposure of basic manufacturing machineries and processes, which are widely utilized in industries to manufacture products.			
POs				
Semester	**Autumn: NO**		**Spring: YES**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	0	0	24	1	24
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite Credits	NIL				
Equivalent course codes as per proposed course and old course	MEP 104				
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Introduction to Basic Manufacturing Processes and Workshop Technology
	Author	Rajendra Singh
	Publisher	New Age International Publishers, India
	Edition	2006
2.	Title	
	Author	
	Publisher	
	Edition	
Reference Books:		
1.	Title	A Textbook of Workshop Technology : Manufacturing Processes
	Author	R. S. Khurmi& J K Gupta
	Publisher	S. Chand Publications
	Edition	16/e
2.	Title	
	Author	

	Publisher	
	Edition	
Content	**UNIT I:** **04** Fitting trade: Preparation of T-Shape Work piece as per the given specifications. Preparation of U-Shape Work piece that contains: Filing, Sawing, Drilling, Grinding. Practice marking operations **UNIT II:** **04** Machine Shop: Study of machine tools in particular Lathe machine (different parts, different operations, study of cutting tools). Demonstration of different operations on Lathe machine. Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting. Study of Quick return mechanism of Shaper. **UNIT III:** **04** Carpentry: Study of Carpentry Tools, Equipment and different joints. Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint **UNIT IV:** **04** Foundry trade: Introduction to foundry, Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes. Demo of mould preparation. Practice – Preparation of mould by using split pattern. **UNIT V:** **04** Welding: Introduction: Study of Tools and welding Equipment (Gas and Arc welding), Selection of welding electrode and current, Bead practice, Practice of Butt Joint, Lap Joint. **UNIT VI:** **04** Forging: Introduction, upsetting, drawing down, punching, bending, swaging and fullering.	
Course Assessment	Continuous Evaluation 50% End Semester 50%	

Course no: EEL 201	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Core			
Course Title	**Network Analysis & Synthesis**			
Course Coordinator				
Course objectives:	To introduce the fundamentals of network analysis using matrices, two-port, and network synthesis.			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**1**	**0**	**4**	**36(L) + 12(T)**
Prerequisite course code as per proposed course numbers	NA				
Prerequisite credits	NA				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	Network Analysis
	Author	M.E. Van Valkenburg
	Publisher	Prentice Hall
	Edition	3rd Ed.
2.	Title	Network Analysis and Synthesis
	Author	Franklin F. Kuo
	Publisher	Wiley
	Edition	2nd Ed.
3.	Title	Engineering Circuit Analysis
	Author	W. H. Hayt and J E Kemmerly
	Publisher	TMH
	Edition	8th Ed.

Content

Unit I: Introduction6
KCL, KVL, Network theorems and its application in the analysis of networks.

Unit II: Network Functions and Response Analysis 8
Concept of complex frequency, driving point and transfer functions for one port and two port network, poles & zeros of network functions, Restriction on Pole and Zero locations of network function, Impulse response and complete response, Time domain behavior form pole-zero plot.

Unit III: Poly-Phase Circuits7
Introduction to polyphase system, Generation of three-phase voltages, Interconnection of 3 phase sources and loads, Star-to-Delta and Delta-to-Star transformation, Voltage, current and power in a star and delta

	connected system, Three phase balanced and unbalanced circuits. **Unit IV: Two-Port Networks7** Two Port networks: Two port parameters, relationships among different network parameters, interconnections of networks. **Unit V: Network Synthesis8** Network Synthesis: Realizability concept, Hurwitz property, positive realness, properties of positive real functions, properties of one port immittance functions and their synthesis, Foster and Cauer forms, RLC synthesis, Introduction to two-port network synthesis.
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEB 202	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Core			
Course Title	**Electrical and Electronic Measurements**			
Course Coordinator				
Course objectives:	To impart knowledge of principles of measurement of electrical quantities, construction and operating principles of electrical instruments, their static and dynamic characteristics, and errors in measurement.			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) + 24(P)**
Prerequisite course code as per proposed course numbers	NA				
Prerequisite credits	NA				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	lectronic Instrumentation and Measurement Techniques
	Author	W.D. Cooper & A.D. Helfrick
	Publisher	Prentice-Hall India
	Edition	
2.	Title	Electrical Measurement & Measuring Instruments
	Author	E.W. Golding
	Publisher	Wheeler Publishing
	Edition	
3.	Title	A Course in Electrical & Electronic Measurements and Instrumentation
	Author	A.K.Sawhney
	Publisher	Dhanpat Rai
	Edition	19th

Content

Unit I: Errors and Accuracy **4**

Static error, static calibration, error calibration curve, limiting errors, relative limiting errors, types of errors- gross errors, systematic errors, random (residual) errors, accuracy and precision, static sensitivity, linearity, hysteresis, threshold, dead time, resolution of instrument, loading effects, introduction to measurement standards.

Unit II: Electrical and Magnetic Measurements **7**

Introduction, D'Arsonval galvanometer, moving iron & moving coil instruments, electrodynamometer, electrostatic instruments, induction type energy-meter, wattmeter.

	Unit III: Resistance Measurements **7** Methods of measurement of low, medium and high resistance, measurement of earth resistance, localization of cable faults by Murray and Varley loop test. **Unit IV: Inductance and Capacitance Measurements** **5** Measurement of inductance and capacitance by A.C. Bridge methods, Q-factor and dissipation factor, sources of errors in bridge circuits, methods of reducing bridge errors, Wagner Earthing Device. **Unit V: Measurement of Power Factor and Frequency** **4** Single phase, three phase Electrodynamometer type power factor meter, moving iron power factor meters, types of frequency meter, mechanical resonance type, electrical resonance type, ratio meter type and Weston frequency meter. **Unit VI: Potentiometers** **4** Basic D.C. potentiometer circuit, modern form of D.C. potentiometer, measurement of voltage, current, resistance and calibration of voltmeter & ammeter using D.C. potentiometer, volt ratio box, A.C. potentiometers and their applications. **Unit VII: Instrument Transformers** **5** Introduction, use of Instrument transformers, ratios, basic constructional features of C.T. and P.T., ratio and phase angle errors, reduction of errors.
Curse Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory foroverall grading

Course no: EEL 203	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	N	Y	N
Type of course	Core			
Course Title	**Electromagnetic Field Theory**			
Course Coordinator				
Course objectives:	To learn the fundamental concepts applied in Electrostatics, Magnetostatics, Time-varying fields and Electromagnetic Waves			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**1**	**0**	**4**	**36(L) + 12(T)**
Prerequisite course code as per proposed course numbers	NA				
Prerequisite credits	NA				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Principles of Electromagnetics
	Author	Mathew N. O. Sadiku
	Publisher	Oxford University Press Inc.
	Edition	
2.	Title	Electromagnetism – Theory and Applications
	Author	AshutoshPramanik
	Publisher	PHI.
	Edition	
3.	Title	Engineering Electromagnetics
	Author	W H Hayt, J A Buck
	Publisher	McGraw Hill Education
	Edition	
Reference Book:		
1.	Title	Theory and Problems of Electromagnetics
	Author	Joseph. A.Edminister
	Publisher	Tata McGraw Hill
	Edition	Second edition
2.	Title	Electromagnetics with Applications
	Author	Kraus and Fleish
	Publisher	
	Edition	McGraw Hill International Editions, Fifth Edition, 1999

Content	**Unit I: Introduction** **5** Sources and Effects of Electro-Magnetic Fields – Vector Fields – Different Co-ordinate Systems – Vector Calculus – Gradient, Divergence and Curl – Divergence Theory – Stoke's Theorem. **Unit II: Electrostatics** **10** Coulomb's Law – Electric field intensity – Field due to point and continuous charges – Gauss's lawand application – Electric potential – Electric field and equipotential plots – Electric field in freespace, conductors, dielectric -Dielectric polarization - Dielectric strength - Electric field in multipledielectrics – Boundary conditions, Poisson's and Laplace's equations – Capacitance- Energy **Unit III: Magnetostatics** **11** Lorentz Law of force, magnetic field intensity – Biot–savart Law - Ampere's Law – Magnetic field dueto straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in freespace, conductor, magnetic materials – Magnetization – Magnetic field in multiple media –Boundaryconditions – Scalar and vector potential – Magnetic force – Torque – Inductance – Energy density –Magnetic circuits. **Unit IV: Electro-Magnetic Waves** **10** Generation – Electro Magnetic Wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors-skin depth, Skin Effect, Proximity Effect,Poynting vector – Plane wave reflection and refraction – Transmission lines–Line equations – Inputimpedances – Standing wave ratio and power, Smith's Chart.
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECB 206	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Other Engg. Core			
Course Title	**Analog Electronics**			
Course Coordinator				
Course objectives:	To make the Students i. familiar with the structure of basic electronic devices. ii. exposed to the operation and applications of electronic devices.			
POs				

Semester	**Autumn:** Yes		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) + 24(P)**
Prerequisite course code as per proposed course numbers	NA				
Prerequisite credits	NA				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Electronic Devices and Circuits
	Author	David A. Bell
	Publisher	Prentice Hall of India
	Edition	
2.	Title	Microelectronic Circuits
	Author	Sedra and smith
	Publisher	Oxford University Press
	Edition	2004
3.	Title	Electronic Devices and Circuit theory
	Author	Robert L.Boylestad
	Publisher	Pearson Education
	Edition	11 edition (2015)
4.	Title	Integrated Electronics
	Author	Millman&Halkias
	Publisher	McGraw Hill Education
	Edition	3 edition (2010)

Reference Book:

1.	Title	Electronic Devices
	Author	Floyd
	Publisher	Pearson Asia
	Edition	9th Edition, 2012.

Content	**UNIT I Diodes** **4** Review of semiconductors, p-n junction, forward and reverse biased junction, equivalent circuits; Applications - rectifier, clipper, clamper, voltage doubler, transfer characteristics; Zener diode; Power supply, filter, zener regulator; Special purpose diodes.

	UNIT II Bipolar Junction transistors **9** npn and pnp transistors, input and output characteristics - cut-off, saturation and active regions; CE, CB and CC configurations, small signal model, BJT as amplifier; Biasing circuits; Stability analysis, DC and AC equivalent circuits. Small-signal Analysis:h-parameter model of BJT, analysis of BJT amplifier circuits, cascaded amplifiers, frequency response of RC coupled amplifier. **UNIT III Power Amplifiers** **3** DC and AC load lines; Class A operation; Class B operation, push-pull circuit; Biasing circuits, Class C amplifier; Current source **UNIT IV Field Effect Transistors** **4** Operating characteristic, transductance, JFET as amplifier, biasing circuits; Applications. **UNIT V Operational Amplifier** **9** Differential amplifier, level shifter, output stage and parameters of OPAMP; Applications of OPAMP: inverting and non inverting amplifier, active filters- low pass, high pass, band pass, active diode, active full wave rectifier, clipper, clamper, waveform generator circuits – square, triangular and sine wave generator. **UNIT VI Oscillators** **4** Barkhausen criterion, damped oscillation in LC circuits; Harmonic oscillators- RC-phase shift oscillator, transistor phase shift oscillator, Wein's bridge oscillator; Tuned oscillator- Colpitts oscillator, Hartley oscillator; Crystal oscillator **UNIT VII Voltage Regulators** **3** Zener voltage regulator, emitter follower regulator, series voltage regulator, IC regulator **Laboratory Experiments:** 1. Ripple And Regulation Characteristics Of Full Wave And Half Wave With Filters (C,L,Lc,Clc) 2. Clippers And Clampers 3. Half Wave And Full Wave Voltage Doubler, Tripler. 4. BJT Characteristics NPN & PNP (CB, CC And CE). 5. Biasing Circuits Of BJT 6. Amplifier Class A,B,AB By Using BJT 7. FET Characteristics (N & P Channel) 8. MOSFET Characteristics (N & P Channel) 9. Op Amp Inverting And Non-Inverting Amplifiers. 10. Active Filters (Low Pass , High Pass And Band Pass) Using Op –Amp 11. Wein-Bridge Oscillator Using Op- Amp 12. RC Phase Shift Oscillators By Using BJT 13. Zener Diode & IC Voltage Regulator 14. Series & Emitter Follower Voltage Regulator
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory foroverall grading

Course no: **ECB 204**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**SIGNALS AND SYSTEMS**			
Course Coordinator	DR. RAJIV KUMAR TRIPATHI			
Course objectives:	Coverage of continuous and discrete-time signals and systems, their properties and representations and methods those are necessary for the analysis of continuous and discrete-time signals and systems. Knowledge of time-domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc. Knowledge of frequency-domain representation and analysis concepts using Fourier Analysis tools, Z-transform. Mathematical and computational skills needed in application areas like communication, signal processing and control, which will be taught in other courses			
POs				
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	
Prerequisite course code as per proposed course numbers	None				
Prerequisite Credits	None				
Equivalent course codes as per proposed course and old course	None				
Overlap course codes as per proposed course numbers	None				

Text Books:		
1.	Title	Signals and Systems
	Author	Alan V. Oppenheim, Alan S. Willsky with S. Hamid

		Nawab
	Publisher	PHI Publications
	Edition	
2.	Title	Principles of Linear Systems and Signals
	Author	B.P. Lathi
	Publisher	Oxford University Press Publications
	Edition	
3.	Title	Signals and Systems
	Author	Simon Haykin
	Publisher	John Wiley and Sons Publications
	Edition	

Content

Unit I: **06**

What is Signal and System Theory? The black-box approach. Formal definition of 'signal' and 'system'. The domain and range variables, continuous and discrete signals and cont. and discrete systems. Signal operations: folding, Shifting, scaling for Continuous and Discrete Time Signal. Characterization of systems: memory, linearity, causality, time-invariance, stability and Invertibilty. Condition on Impulse response of a system for an LTI system for memory, linearity, causality, time-invariance, stability, Invertibilty.

Unit II: **08**

Periodic signals: definition, periodicity of the sum of two signals, Orthogonal functions, Sinusoidal Fourier Series, Derivation of Fourier coefficient of sinusoidal series, continuous-time complex exponential Fourier Series. Relationship between Fourier coefficient of Sinusoidal and Exponential Fourier Series, Signal approximation using truncated Fourier series. Brief discussion of convergence issues and conditions for existence of the CTFS. Aperiodic signals and their representation: the transition from the CTFS to the Continuous Time Fourier Transform (CTFT). Finite power and finite energy signals. Brief discussion of convergence issues and conditions for existence of the FT. Extension of the FT for finite power signals: frequency domain Dirac impulses. Properties of the FS and FT: particular emphasis on convolution.

Unit III: **08**

A discussion of the discrete-time complex exponential. Discrete time systems and complex exponentials. Periodic discrete signals: sampling periodic continuous time signals. Periodic signal as a sum of complex exponentials. The discrete-time Fourier series: analysis and synthesis equations. The DFT: N-point DFT of an M-point signal. Aperiodic signals and their representation: the transition from the DTFS to the discrete-time Fourier Transform. Finite power and finite energy signals. Brief discussion of convergence issues and conditions for existence of the DTFT. Extension of the DTFT for finite power signals: frequency domain Dirac impulses. Properties of the DTFS and DTFT: particular emphasis on convolution.

Unit IV: **08**

The principle of cont. signal sampling. The primary objective: perfect reconstruction. Ideal sampling and the sampling theorem: over- and under-sampling. Reconstruction theory: finite order interpolators and reconstruction distortion; ideal reconstruction. Non-ideal sampling and

	reconstruction. Sampling of discrete-time signals. **Unit V:** **06** Laplace Transform as a generalization of the FT. The region of convergence and its properties. Pole-zero plots. Inverse transformation: role of the ROC in ensuring uniqueness. Properties of the LT. Inference of the FT from the LT. System characterization from the pole-zero plots. One-sided LT. The z-Transform as a generalization of the DTFT. The region of convergence and its properties. Pole-zero plots. Inverse transformation: role of the ROC in ensuring uniqueness. Properties of the ZT. Inference of the DTFT from the LT. System characterization from the pole-zero plot. Cont. to discrete system transformations. One-sided ZT. **Tentative List of Experiments:** 1. Matlab Basics, Independent and dependent variable and function generation 2. Signal Generation: Such as unit impulse, unit step, Sinusoidal, exponential and others. 3. To create user function for performing signal operations: folding, Shifting, scaling, addition for continuous and discrete time signal. 4. Convolution and its properties for continuous and discrete time signal. 5.Implementation of Continuous Time Fourier Series (CTFS) of continuous periodic time signals. 6. Properties of CTFS and mplementation of Discrete Time Fourier Series (DTFS) of Discrete periodic time signals. 7.Properties of DTFS. 8. mplementation of Discrete Time Fourier Transform (DTFT) of discrete time aperiodic signals. 9. Properties of DTFT. 10. Implementation of Discrete Fourier Transform (DFT) of discrete time signals.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: MAL201	Open course (YES/NO) :	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	N	N	N
Type of course	Regular			
Course Title	Ordinary Differential Equations and Transforms			
Course Coordinator	DrAmitMahajan			
Course objectives:	This course provides an introduction to topics involving ordinary differential equations. Emphasis is placed on the development of abstract concepts and applications for first-order and linear higher-order differential equations, systems of differential equations, series solutions, special functions, Laplace and Fourier transforms.			
POs				

Semester: 3rd	Autumn: Yes		Spring:		
	Lecture	Tutorial	Practical	Credits	Total Teaching Load
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:		
1.	Title	An Introduction to Ordinary Differential Equations,
	Author	E.A. Codington,
	Publisher	Dover Publications,
	Edition	1989.
2.	Title	Advanced Engineering Mathematics
	Author	E. Kreyszig,
	Publisher	John Wiley and Sons
	Edition	8th Edition, 2008.
Reference Book:		
1.	Title	Advanced Engineering Mathematics,
	Author	R. K. Jain and S. R. K. Iyengar
	Publisher	Narosa Pub. House
	Edition	2008.

Content	**Unit I: Ordinary Differential Equations:** 14 Formation of differential equations; Separable equations; Equations reducible to separable form; Exact solutions, Exact equations, Integrating factors, Linear first order equations; Bernoulli's equation; Orthogonal trajectories. Homogeneous linear equations of arbitrary order with constant coefficients; Non-homogeneous linear equations with constant coefficients; Euler and Cauchy's equations; Method of variation of parameters; System of linear differential equations. **Unit II: Special Functions:** 14 Classification of singularities of an ordinary differential equation, series solution, Method of Frobenius, Indicial equation; Examples of Bessel and Legendre functions; Bessel of first kind-recurrence formulae-generating functions-orthogonality of Bessel functions; Legendre polynomial-Rodrigue's formula- generating function-recurrence formula- orthogonality of Legendre polynomials. **Unit III: Laplace Transform:** 6 Laplace transform– Inverse Laplace transform–properties of Laplace transforms, Convolution theorem–Solution ODE by Laplace transform. Laplace transform of periodic function, Dirac-Delta function, Unit Step function. **Unit IV: Fourier Series and Transform:** 14 Fourier Series-Expansion of a function in Fourier series for a given range – Half range sine and cosine expansions. Fourier transformation and inverse transforms – sine, cosine transformations and inverse transforms–simple illustrations.
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEB 251	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Core			
Course Title	**Electrical Machines-I**			
Course Coordinator				
Course objectives:	To develop basic concepts of Transformers and DC machines. Understand their constructional details, working principles, operating characteristics, operational issues and practical applications. Understand the fundamental concepts of electro-mechanical energy conversion			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) + 24(P)**
Prerequisite course code as per proposed course numbers	NA				
Prerequisite credits	NA				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	Electrical Machines
	Author	Nagrath and Kothari
	Publisher	Tata McGraw Hill
	Edition	
2.	Title	Electrical Machinery
	Author	P. S. Bimbhra
	Publisher	Khanna Publisher
	Edition	Seventh

Reference Book:

1.	Title	Theory of AC Machinery
	Author	A.S.Langsdorf
	Publisher	Tata McGraw Hill
	Edition	
2.	Title	Electric Machinery
	Author	A.E.Fitzerald, C.Kingsley and S.D.Umans
	Publisher	Tata McGraw Hill
	Edition	

Content	**Unit I: Transformers 14** Construction, theory and operation, E.M.F. equation, phasor diagram, ideal transformer, equivalent circuit, open and short circuit tests, back to back test, voltage regulation and efficiency, per-unit transformer values, application, auto-transformers, three winding transformer, parallel operation of single phase and three phase transformers, three phase

	transformer connections, phasor groups, three phase to two phase and six phase conversion. **Unit II: Basic Concepts of Rotating Electrical Machines 8** Constructional details of various rotating machines, introduction to lap and wave windings, EMF generation, effect of chording and distribution of winding on EMF, Harmonics in generated emf, MMF produced by distributed winding. **Unit III: DC Machines 14** Construction, types of dc machine, EMF equation, armature reaction, commutation, interpoles and compensating windings, characteristics of dc generators, voltage build up, DC motor: principle, torque of dc machine, types of dc motors, characteristics of dc motor, speed control of dc motor, three point starter, four point starter, Ward-Leonard system, Swinburne's test, Hopkinson's test, braking of dc motor, losses and efficiency, applications of DC motors. **Electrical Machines – I Laboratory:** Determination of open circuit characteristic of D.C. machine, determination of load characteristics of D.C. generators, speed control of D.C. motors using armature control and field control methods, brake test on D.C. shunt motor & Swinburne's test, fields test on two identical D.C. series machines, retardation test on D.C. machines to determine moment of Inertia, Hopkinson test on two identical D.C. machines, O.C. and S.C. tests on single phase transformer, load test on single phase transformer, Sumpners test on two single phase transformers, Scott connection of single phase transformers, separation of no load losses of a single phase transformer.
Curse Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory foroverall grading

Course no: EEB 252	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Core			
Course Title	**Control Systems**			
Course Coordinator				
Course objectives:	This is a first course on feedback control of dynamic systems. It provides basic concepts and principles of modeling, analysis and controller design for continuous linear time-invariant systems with techniques including roots locus and frequency response methods. Laboratory experiments are designed so that the theory learnt in the class can be applied to real physical systems.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) + 24(P)**
Prerequisite course code as per proposed course numbers	NA				
Prerequisite credits	NA				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Control Systems Engineering
	Author	I.J. Nagarath& M. Gopal
	Publisher	New Age Pub. Company
	Edition	
2.	Title	Automatic Control Systems
	Author	B.C. Kuo
	Publisher	PHI
	Edition	
3.	Title	Modern Control Engineering
	Author	Kotsuhiko Ogata
	Publisher	Prentice Hall of India
	Edition	

Content

Unit I: Introduction **3**

Concepts of control systems, open loop and closed loop control systems and their differences, different examples of control systems.

Unit II: Mathematical Modeling and Transfer Function of Physical Systems5

Mathematical modeling of electrical and mechanical systems, transfer function of DC servo motor, AC servo motor, block diagram representation of systems considering electrical systems as examples, block diagram reduction technique and signal flow graph, mason's gain formula.

	Unit III: Time Response Analysis **6** Standard test signals, time response of first order systems, characteristic equation of feedback control systems, transient response of second order systems, time domain specifications, steady state response, steady state errors and error constants, effects of proportional derivative, proportional integral systems. **Unit IV: Stability Analysis in S-Domain** **5** The concept of stability- Routh's stability criterion, absolute, relative, conditional and bounded input, bounded output stability, limitations of Routh's stability. **Unit V: Root Locus Technique** **5** The root locus concept, construction of root loci, effects of adding poles and zeros to G(s)H(s) on the root loci. **Unit VI: Frequency Response Analysis** **6** Introduction, frequency domain specifications, bode diagrams-determination of frequency domain specifications and transfer function from the bode diagram, phase margin and gain margin, stability analysis from bode plots, polar plot, nyquist plots, stability analysis. **Unit VII: Classical Control Design Techniques** **6** Compensation techniques – Lag, Lead, Lead-Lag controllers design in frequency domain, PID controllers.
Curse Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory foroverall grading

Course no: EEL253	Open course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Core			
Course Title	**Power Systems**			
Course Coordinator				
Course objectives:	To familiarize students with the infrastructure of power systems and to introduce the design aspects of power system generation, distribution and transmission and utilization.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**4**	**0**	**0**	**4**	46
Prerequisite course code as per proposed course numbers	NA				
Prerequisite credits	NA				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Elements of Power System Analysis
	Author	J. J. Grainger and W.D. Stevenson
	Publisher	Tata McGraw-Hill Publishing Company Limited,
	Edition	2008
2.	Title	Power System Engineering
	Author	D.P.Kothari, I. J. Nagarath
	Publisher	Tata McGraw Hill
	Edition	
3.	Title	Electrical Power Systems
	Author	C.L.Wadhwa
	Publisher	New age international
	Edition	

Reference Book:

1.	Title	Electrical Power System- Concepts, Theory and Practices
	Author	Roy S.
	Publisher	Prentice Hall of India Private Limited
	Edition	2007
2.	Title	Electric Power Systems
	Author	B.M. Weedy and B.J.Cory
	Publisher	Wiley India.
	Edition	4th Ed.

Content	**Unit I: Introduction 9** General Structure of Electrical Power System- Introduction to Power System, Generation, Transmission, Distribution and Utilization- Overview Single Line Diagram (SLD) Representation. Different Types of Transmission Substations, Idea About Substation and Equipments in Substation, Radial and Grid Systems. Overhead vs. underground systems. Comparison of AC and DC systems and choice of working voltages for transmission and distribution. **Unit II: Transmission Lines 10** Line resistance, inductance and capacitance calculations, effect of earth on capacitance of overhead transmission lines, representation of lines: short transmission lines, medium length lines, nominal T and PI-representations, long transmission lines. The equivalent circuit representation of a long line, A, B, C, D constants, Ferranti Effect, Power flow through a transmission line, receiving end power circle diagram. **Unit III: Travelling Waves10** Production of travelling waves, open circuited line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at T-junction line terminated through a capacitance, capacitor connection at a T-junction, Attenuation of travelling waves. corona loss, Factors affecting corona loss and methods of reducing corona loss. **Unit IV: Overhead Line Insulators and Insulated Cables 10** *Overhead line Insulators:* Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential. *Insulated Cables:* Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables. **Unit V: Economics of Generation 9** Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer.
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSB 254	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	NO	NO	NO
Type of course	**Other Engineering Courses**			
Course Title	**DIGITAL ELECTRONICS & LOGIC DESIGN**			
Course Coordinator				
Course objectives:	This course is aimed to provide an introduction to digital logic design and its ability to understand number system representations, binary codes, binary arithmetic and Boolean algebra, its axioms and theorems, and its relevance to digital logic design. It also introduces combinational circuits, synchronous sequential logic and Asynchronous sequential logic.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
IV	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Digital Design
	Author	Mano, M. Morris
	Publisher	Pearson Education
	Edition	Third Edition, 2002
Reference Book:		
1	Title	Digital Fundamentals
	Author	Floyd, Thomas L.
	Publisher	Pearson Education, Singapore
	Edition	Seventh Edition, 2002
2	Title	Digital Electronics
	Author	Gothmann, William H.
	Publisher	PHI, New Delhi
	Edition	Second Edition 2000
3	Title	Jain, R.P.
	Author	Modern Digital Electronics
	Publisher	TMH, New Delhi
	Edition	Third Edition 2003

4	Title	Digital Logic Design
	Author	B Holdsworth
	Publisher	TMH, New Delhi
	Edition	Second Edition 1991
5	Title	Logic Design Theory
	Author	Nripendran N. Biswas
	Publisher	PHI, New Delhi
	Edition	1993
6	Title	Leach, D. P., Albert P. Malvino
	Author	Digital Principles and Applications
	Publisher	TMH, New Delhi
	Edition	Fifth Edition 1995

Content	**Unit** I (5 Hours) Binary systems: Digital Systems, Binary Numbers, Number Base Conversions, Octal And Hexadecimal Numbers, Complements, Signed Binary Numbers, Binary Codes, Binary Storage Registers And Binary Logic. **Unit** II (7 Hours) Basic Theorems And Properties Of Boolean Algebra , Boolean Functions, Canonical And Standard Forms, Other Logical Operations , Digital Logic Gates, Integrated Circuits. **Unit** III (8 Hours) Gate level minimization: The Karnaugh-Map Method, Four-Variable Map, Five-Variable Map, prime cubes, Minimum sum of Products and Product Of Sums Simplification, Don't –Care Conditions, NAND And NOR Implementation, prime implicant chart, cyclic prime implicant chart. LOGICFAMILIES **Unit IV** (8 Hours) Combinational Logic: Combinational Circuits, Analysis Procedure, Design Procedure, Binary Adder-Subtractor, Decimal Adder, Binary Multiplier, parallel adders and look-ahead adders, Magnitude Comparator, Decoders, Encoders, multiplexers and demultiplexers, parity generators and checkers. **Unit** V (8 Hours) Programmable Logic Devices, Introduction to sequential circuits, memory elements, latches. Flip-flops, analysis of sequential circuits, state tables, state diagrams, design of sequential circuits, excitation tables, registers, shift registers, counters.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course no: **MAL 251**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**Yes**	**No**
Type of Course	Theory			
Course Title	**PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL ANALYSIS**			
Course Coordinator	DR. PRASHANT KUMAR			
Course objectives:	This course provides an introduction to topics involving partial differential equations and numerical methods. Firstly, emphasis is placed on the development of abstract concepts and applications of linear and nonlinear first order partial differential equations, solution of wave, heat and Laplace's equations. Secondly, this course focuses on computational methods since mathematical models describing physical phenomena are rarely analytically solvable.			
POs				
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite Credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1.	Title	Numerical Analysis: Mathematics of Scientific computing
	Author	D. Kincaid and W Cheney,

	Publisher	AMS
	Edition	3rd edition 2002
2.	Title	Advanced Engineering Mathematics
	Author	E. Kreyszig,
	Publisher	John Wiley and Sons
	Edition	8th Edition, 2008.
3.	Title	
	Author	
	Publisher	
	Edition	
Reference Books:		
1.	Title	An Introduction to Numerical Analysis
	Author	K. E. Atkinson
	Publisher	John Wiley and Sons
	Edition	2nd Edition 1989
Content	**Unit I:** **24** Partial Differential Equations: Formation and solutions of partial differential equations, Lagrange's linear equation of the first order, Non-linear equations, Charpit's method, Homogeneous linear equations with constant co-efficient, Non-homogeneous linear equations. Solutions of Wave equation, Heat equation and Laplace's equation by the method of separation of variables. **Unit II:** **24** Numerical Analysis: Principles of floating point computations and rounding errors. Solutions of nonlinear equations: Bisection method, Newton's method and its variants, fixed point iterations, convergence analysis; Newton's method for non-linear systems. Interpolation: Polynomial interpolation, Hermite interpolation, spline interpolation, error estimates. Numerical differentiation: Based on interpolation, the method of undetermined coefficients, Richardson extrapolation, Error estimates. Numerical integration: Based on interpolation, quadrature methods, Gaussian quadrature, Error estimates. Initial value problems: Taylor series method, Euler and modified Euler methods, Runge-Kutta methods, multistep methods, stability and convergence analysis.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: EEL 261	Open course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course				YES
Course Title	**Transducers & Signal Conditioning**			
Course Coordinator				
Course objectives:	To impart knowledge of the principles, working and characteristics of transducers and the associated signal conditioning circuits for industrial applications.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Transducers and Instrumentation
	Author	D. V. S. Murty
	Publisher	Prentice-Hall of India Private Limited
	Edition	2nd
2.	Title	Instrumentation Devices & Systems
	Author	C.S. Rangan, G.R. Sarma and V. S.V. Mani
	Publisher	Tata Mc-Graw Hill
	Edition	2nd
3.	Title	A course in Electrical & Electronic Measurements & Instrumentation
	Author	A. K. Sawhney
	Publisher	Dhanpat Rai & Sons
	Edition	

Content

Unit I: Transducers **10**

Introduction, classification, mechanical devices as primary detectors, basic requirements of a transducer, electrical transducers, type of transducers for measuring displacement, strain, vibration, pressure, flow, temperature, force, torque, liquid level, humidity, P. H. value, velocity (angular & linear), acceleration, basic principles of resistive transducers, inductive transducers, capacitive transducers, thermoelectric transducers, piezoelectric transducers, hall effect transducers, electromechanical transducers, photoelectric transducers, digital transducers.

Unit II: Signal Processing Circuits **8**

Introduction, ideal op-amp, operational amplifier specifications, zero

	crossing detector, zero crossing detector with hysteresis, inverting and non-inverting amplifiers, voltage-follower, adder, subtractor, multiplier, divider, integrator, differentiator, voltage to current converter, current to voltage converter, phase shifter circuit, absolute-value circuit, peak detector, ac to dc converter, logarithmic converter, differential-amplifier, instrumentation amplifier, analog modulators & demodulators. **Unit III: Data Display and Recording Systems 5** Introduction to analog and digital display methods, analog recorders, C.R.O., magnetic tape recorders, digital input-output devices, digital frequency meter, digital voltmeter. **Unit IV: Data Transmission and Telemetry 6** Introduction, characteristics of frequency division multiplexing, time-division multiplexing, transmission channels and media. **Unit V: Data Acquisition and Conversion 7** Introduction, signal conditioning of the inputs, single channel D A S, Multi-channel D A S, data conversion, multiplexer, S/H circuit, A/D converter.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 262	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course				YES
Course Title	**Biomedical Instrumentation**			
Course Coordinator				
Course objectives:	To familiarize students with various types of biomedical instrumentation systems.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	EEL202				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Biomedical Instrumentation and Measurements
	Author	Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer
	Publisher	Prentice-Hall of India Private Limited
	Edition	2nd
2.	Title	Hand- book of Biomedical Instrumentation
	Author	R.S. Khandpur
	Publisher	Tata Mc-Graw Hill
	Edition	2nd
3.	Title	Biomedical Instruments: Theory and Design
	Author	Walter Welkowitz, Sid Deutsch and MetinAkay
	Publisher	Academic Press
	Edition	2nd

Content

Unit I: Introduction **4**

Development of biomedical instrumentation, components, physiological systems of the body and problems in measuring a living system.

Unit II: Transducers and Electrodes **5**

The transducers & transduction principles, active transducers, passive transducers, transducer for biomedical applications, pulse sensors, respiration sensors, bioelectric potentials, biopotential electrodes.

Unit III: Biomedical Recorders and Display Systems **4**

Block diagrams of electro cardiograph, phonocardiograph, electroencephalograph and electro-myograph.

Unit IV: Patient Care and Monitoring **4**

Elements of intensive care monitoring, patient monitoring displays,

	diagnosis, calibration &repairability of patient monitoring equipment, pacemakers, defibrillators. **Unit V: Shock Hazards and Prevention 7** Physiological effects of electric current, electric shock hazards from electrical equipment, methods of accident prevention. **Unit VI: Bio-Telemetry 5** Introduction, components of biotelemetry and applications of telemetry in patient care. **Unit VII: Diagnostic Techniques 7** X-ray machine and X-ray computed tomography, basic magnetic resonance imaging components, basic ultrasonic imaging system, computer applications in biomedical instrumentation.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL263	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course				YES
Course Title	**Electrical Engineering Materials**			
Course Coordinator				
Course objectives:	To familiarize students with the properties of various types of electrical engineering materials			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	EEL203				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Materials for Electrical Engineering
	Author	B.M.Tareev
	Publisher	Higher School Pubishing House
	Edition	1st
2.	Title	Electronic Properties
	Author	R. Rose, L.A. Shepard and J. Wulff
	Publisher	Wiley Eastern Pvt. Ltd
	Edition	1st

Content

Unit I: Magnetic Materials **9**

Dia, Para, Ferro, anti ferro and Ferri magnetic materials, soft and hard magnetic materials, tapes and films, magnetic anisotropy magnetostriction, effect of impurities, losses in magnetic materials.

Unit II: Semiconductors **9**

Silicon wafer preparation, different fabrication techniques involved in electronic chip in VLSI technology, conductivity of materials electrical and thermal conductivity of materials, bimetals high temperature materials, thermocouples, free electron theory of metals, factors affecting electric conductivity of metals, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, super conductivity.

Unit III: Dielectric Materials **9**

Field vectors, polarization, Ferro electricity and Piezo electrics, behavior of polarization under impulse and frequency switching, dielectric loss, spontaneous polarization.

Unit IV: Insulating Materials **9**

	Electrical, mechanical and thermal properties of liquid, solid, fibrous insulating materials, glass, ceramic, mineral and plastic materials,relationships between structure and electrical, mechanical, thermal, chemical properties.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL264	Open course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course				YES
Course Title	Electrical Distribution systems			
Course Coordinator				
Course objectives:	To impart knowledge about power distribution system and study of automation- SCADA.			
POs				

Semester	Autumn:		Spring: Yes		
	Lecture	Tutorial	Practical	Credits	Teaching Hours
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Electric Power Distribution
	Author	A.S. Pabla
	Publisher	Tata McGraw Hill Publishing Co. Ltd
	Edition	4th
2.	Title	Learning Material for Electrical Power Distribution
	Author	M.K. Khedkar, G.M. Dhole
	Publisher	Laxmi Publications Ltd
	Edition	

Content

Unit I: Load and Energy Forecasting 9

Distribution of power, Management, Power Loads, Load Forecasting, Power System Loading, Technological Forecasting. Need Based Energy Management (NBEM) – Objectives:, Advantages, Distribution Management System (D.M.S.)

Unit II: Distribution Automation 9

Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints. Interconnection of Distribution, Control & Communication Systems.

Unit III: SCADA 8

Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

Unit IV: Switch Placement, maintenance and managements 10

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems,

	Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Maintenance of Automated Distribution Systems, Difficulties in implementing Distribution. Automation in Actual Practice, Urban/Rural Distribution, Energy Management.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 265	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course				YES
Course Title	**Power station Practice**			
Course Coordinator				
Course objectives:	To learn the operations of various power plants.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Elements of Electrical Power Station Design
	Author	M.V. Deshpande
	Publisher	Prentice-Hall of India Private Limited
	Edition	
2.	Title	Generation of Electrical Energy
	Author	B.R. Gupta
	Publisher	Eurasia Publishing house
	Edition	4th
3.	Title	Power Plant Technology
	Author	M.M. El-Wakil
	Publisher	McGraw- Hill
	Edition	
4.	Title	A Course in Power Plant Engineering
	Author	Arora and Domkundwar
	Publisher	Dhanpat Rai and Sons
	Edition	3rd

Content

Unit I: Conventional Sources of Electrical Energy 6

Steam, Hydro, Nuclear, Diesel and Gas; Their Scope and Potentialities for Energy Conversion

Unit II : Generation 4

Different Factors Connected With a Generating Station; Load Curve, Load Duration Curve, Energy Load Curve; Base Load and Peak Load Plants.

Unit III: Thermal Stations 6

Selection of Site, Size and Number of Units, General Layout, Major Parts, Auxiliaries, Generation Costs Of Steam Stations.

	Unit IV: Hydro Stations **6** Selection of Site, Mass Curve, Flow Duration Curve, Hydrograph, Classification of Hydro Plants, Types of Hydro Turbines, Pumped Storage Plants. **Unit V: Nuclear Stations** **6** Main Parts, Location, Principle of Nuclear Energy, Types of Nuclear Reactors, Reactor Control, Nuclear Waste Disposal. **Unit VI: Power Station Control and Interconnection** **8** Excitation Systems, Excitation Control, Automatic Voltage Regulator Action; Advantage of interconnection , Alternate Energy Sources Overview
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 266	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course				YES
Course Title	**Finite Element Methods and Applications**			
Course Coordinator				
Course objectives:	To introduce finite element methods and their applications in engineering.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	An Introduction to the Finite Element Method
	Author	J.N. Reddy
	Publisher	McGraw Hill
	Edition	3rd
2.	Title	Electrical Machine analysis using Finite Elements
	Author	Nicola Biyanchi
	Publisher	Taylor and Francis Group, CRC Publishers
	Edition	
3.	Title	Finite Element Analysis of Electrical Machines
	Author	S.J. Salon
	Publisher	Kluwer Academic Publishers
	Edition	
4.	Title	Applied Finite Element Analysis
	Author	L.J. Segerlind
	Publisher	John Wiley
	Edition	2nd
Reference Book:		
1.	Title	Finite Element Method in Engineering
	Author	S.S. Rao
	Publisher	Pergamon Press
	Edition	2nd
2.	Title	Finite Elements in Engineering
	Author	Chandrupatla&Belagundu
	Publisher	Prentice Hall of India Private Ltd.
	Edition	
3.	Title	Finite Elements and Applications to

		Electromagnetics
	Author	Chary
	Publisher	John Wiley and Sons
	Edition	

Content	**Unit I: Introduction** **9** Basic Concepts of FEM – Variational Formulation B. V. P – Ritz method – Finite Element Modeling – Element Equations – Linear and Quadratic shape functions. **Unit II: Finite Element Analysis of 2D problems** **9** Basic Boundary Value Problems in 2 Dimensions - Triangular, quadrilateral, higher order elements -Poisson's and Laplace Equations - Weak Formulation - Elements Matrices and Vectors. **Unit III: ISO Parametric Formulation** **9** Natural Co-ordinate System - Lagrangian Interpolation Polynomials - Iso-parametric Elements -Formulation - Numerical Integration - 1D -2D Triangular elements - rectangular elements. **Unit IV: Applications** **9** Introduction, magnetic circuits, reviews of electromagnetic theory, application of finite element method to magnetic circuit design. CAD tools - SPEED™, MAXWELL™ and applications to magnetic circuit design.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 267	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course				YES
Course Title	**Instrumentation & Measurement**			
Course Coordinator				
Course objectives:	After learning this course students should have: 1. Sound knowledge on Displacement and Strain measuring techniques. 2. Sound knowledge on thermocouples, pyrometer and other temperature measuring techniques. 3. Familiar with the operation and usage of various waveform analysing instruments			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	EEB 100 & EEL 202				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Transducers and Instrumentation
	Author	D. V. S Murty
	Publisher	Prentice–Hall of India Private Limited
	Edition	
2.	Title	Principles of Industrial Instrumentation
	Author	D Patranabis
	Publisher	Tata McGraw Hill
	Edition	2nd
3.	Title	A course in Electrical & Electronic Measurements & Instrumentation
	Author	K. Sawhney
	Publisher	Dhanpat Rai & Sons
	Edition	

Content

UnitI: Introduction to instrumentation 4

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, Statistical analysis of measurement data. Standards and Calibration.

Unit II: Measurement of Displacement and Strain 8

Resistive, inductive and capacitive transducers for displacement; Wire, metal film and semiconductor strain gauges; LVDT; Synchros, eddy current transducers, proximity detectors, Wheatstone-bridge circuit with one, two and four active elements, temperature compensation.

	Measurement of Speed and Torque:Electro-magnetic and photoelectric tachometers; Torque shaft, strain-gauge, electromagnetic and radio type torque meters. Measurement of Force and Pressure: Column, ring and cantilever-beam type load cells; Elastic elements for pressure sensing; Using displacement sensors and strain gauges with elastic elements. **Unit III: Measurement of Temperature 7** Resistance temperature detector (RTD), principle and types, construction requirements for industry, measuring circuits. NTC and PTC Thermistors, principle and types, manufacturing techniques, measuring circuits, linearization methods and applications. Seebeck effect, thermocouple and thermopile. Pyrometers, integrated circuit sensors, diode type sensors, ultrasonic thermometers, Johnson noise thermometer, fluidic sensors, spectroscopic temperature measurements, thermograph, temperature switches and thermostats. Radiation measurement: Radiation thermometers, introduction, definition of terms, general form of radiation measurement system, radiation thermometer types, photo electric radiation thermometers, signal conditioning for radiation thermometers, remote reading thermometers. Temperature sensor selection and applications. **Unit IV: Flow measurement 7** Introduction, definitions and units, classification of flow meters, pitot tubes, orifice meters, venture tubes, flow tubes, flow nozzles, positive displacement liquid meters and provers, positive displacement gas flow meters, variable area flow meters. Anemometers: Hot wire/hot film anemometer, laser doppler anemometer (LDA), electromagnetic flow meter, turbine and other rotary element flow meters, ultrasonic flow meters, doppler flow meters, cross correlation flow meters, vortex flow meters. Measurement of mass flow rate: Radiation, angular momentum, impeller, turbine, constant torque hysteresis clutch, twin turbine coriolis, gyroscopic and heat transfer type mass flow meters. **Unit V: Analog Electronic Instrumentation 5** Tuned and sampling voltmeters; AC and DC current probes; Wave analyser, harmonic distortion meter, harmonic analyser, spectrum analyser. **Unit VI: Digital Electronic Instrumentation 5** Digital counter-timer and frequency meter, time standards, digital voltmeter and multimeter, accuracy and resolution considerations, comparison with analog electronic instruments.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEB 301	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**Yes**	**No**
Type of Course	Theory and Practical			
Course Title	**Electrical Machines - II**			
Course Coordinator				
Course objectives:	To develop the basic understanding of ac rotating electrical machines. Familiarize with constructional details, working principles, operating characteristics, operational issues and practical applications of single-phase &three-phase Induction Machines and Synchronous Machines.			
POs				
Semester	**Autumn:** YES		**Spring:** NO	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) + 24(P)**
Prerequisite course code as per proposed course numbers	**EEB 251**				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

1.	Title	Electric Machinery
	Author	A.E.Fitzerald, C.Kingsley and S.D.Umans
	Publisher	Tata McGraw Hill
	Edition	
2.	Title	Theory of AC Machinery
	Author	A.S.Langsdorf
	Publisher	Tata McGraw Hill
	Edition	

Content	**Unit I: Polyphase Induction Machines** Theory of three phase induction motors, principle of operation, slip, equivalent circuits, expression for torque, full load torque, maximum torque, starting torque and output power, torque-slip and torque-speed characteristics, circle diagram, no load and blocked rotor test, deep bar cage and double cage induction motor, starting of induction motors, speed control of induction motor, cogging &crawling, induction generators. **Unit II: Single Phase Induction Motors** Principle of operation on the basis of double revolving field theory, equivalent circuit **Unit III: Synchronous Machines** Types of exciters for synchronous machines, flux and MMF phasor diagrams for cylindrical rotor synchronous machines, armature reaction, open and short circuit characteristics, leakage reactance, synchronous reactance, phasor diagram under loaded conditions, operating characteristics of alternators and their ratings, predetermination of regulation by EMF and potier triangle methods for non-salient pole alternators, steady state power flow equations, power angle characteristics, constant excitation and constant power output, circle diagram for synchronous machines, two reaction theory for salient pole alternators and pre-determination for regulation, slip test, V curves, hunting and its suppression, starting of synchronous motor, synchronous condenser. **Unit IV: Parallel Operation of Alternators** Synchronization of alternators by dark lamp method, parallel operation of alternators, alternator on infinite bus bar, effect of change of excitation and prime mover inputs. **Electrical Machines – II Laboratory** Determination of equivalent circuit parameters of three phase induction motor, Brake test on 3-phase induction motor, circle diagram of 3-phase induction motor, speed control of 3-phase induction motor, single phase operation of 3-phase induction motor, regulation of 3-phase alternator by Z.P.F. method, parallel operation of alternators, determination of V and inverted V curves of 3-phase synchronous machine, characteristics of 3-phase Schrage motor, no load and load characteristics of an amplidyne, determination of equivalent circuit parameters of single phase induction motor.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory for overall grading

Course no: EEL 302	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Theory			
Course Title	**Power System Analysis**			
Course Coordinator				
Course objectives:	To provide in-depth knowledge of power system analysis under normal conditions and on fault, and the concepts of power system and voltage stability.			
POs				

Semester	**Autumn:** Yes		**Spring:** No		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**1**	**0**	**4**	**36(L) + 12(T)**
Prerequisite course code as per proposed course numbers	EEL 253				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Power System Analysis
	Author	H.Saadat
	Publisher	Tata McGraw-Hill Publishing Company Limited
	Edition	2008
2.	Title	Computer Techniques in Power System Analysis
	Author	M. A.Pai
	Publisher	Tata McGraw-Hill Publishing Company Limited
	Edition	2nd Ed.,2008
3.	Title	Reactive Power Control in Electric Systems
	Author	T. J. E.Miller
	Publisher	John Wiley and Sons
	Edition	2010
4.	Title	Power System Analysis
	Author	J. J. Grainger and W. D.Stevenson
	Publisher	McGraw-Hill International Book Company
	Edition	2008
5.	Title	Power System Analysis and Design
	Author	J. D. Glover and M. S.Sarma
	Publisher	Cengage Learning
	Edition	4th Ed.

Content	**Unit I: Formation of Network Matrices** Formation of admittance matrix with and without mutual impedances, Z-bus

	building algorithm with and without mutual impedances. **Unit II: load flow analysis** Formation of static load flow equations, solution of load flow problem by Gauss-Seidel, Newton-Raphson (polar and rectangular) and fast decoupled techniques. **Unit III: Short circuit Analysis** Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks, fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase fault, faults on power systems, faults with fault impedance, reactors and their location, short circuit capacity of a bus. **Unit IV: Power System stability** Swing equation, power angle equation, synchronizing power coefficient, basic concepts of steady state, dynamic and transient stability, equal area criterion, solution of the swing equation, multi-machine transient stability studies with classical machine representation. **Unit V: Voltage stability** Introduction, comparison of angle and voltage stability, reactive power flow and voltage collapse, mathematical formulation of voltage stability problem, voltage stability analysis, prevention of voltage collapse, trends and challenges
Curse Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEB 303	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)		DE (Y/N)
	No	**No**	**Yes**		**No**
Type of Course	Theory and Practical				
Course Title	**Introduction to Microprocessors and Interfacing**				
Course Coordinator					
Course objectives:	To introduce the 8085 and 8086 microprocessors and their interfacing				
POs					
Semester	**Autumn:** Yes		**Spring:** No		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) + 24(P)**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				
Text Books:					
1.	Title	Microprocessors and Interfacing			
	Author	Douglas V. Hall, SSSP Rao			
	Publisher	Mc Graw Hill			
	Edition	3rd Edition, 2012			

Content

Unit I : 8085 and 8086 Microprocessor Architectures

The 8085 Microprocessor Family Overview, Registers in 8085, 8085 Machine Instructions, Main features of 8086, Important 8086 pin diagram/Description, The 8086 Microprocessor family-An overview, 8086 Internal Architecture, The BIU, Introduction to programming 8086, a basic 8086 microcomputer system

Unit II : 8086 Family Assembly Language programming

Constructing machine codes for 8086 instructions, Introduction to assembler EMU8086, 8086 instruction descriptions and assembler directives, assembly level programs using assembler EMU8086

Unit III : Input and output modes and interfacing

Peripheral Devices, Input/output Devices, I/O modes in computer systems, Programmed I/O mode, Interrupt Mode of I/O, 8086 Interrupts and Interrupt Responses, Hardware Interrupt Applications, 8254 Software programmable timer/counter, 8259A Priority Interrupt Controller, Software Interrupt Applications, Direct Memory Access (DMA) Mode I/O, I/O

	Channels **Laboratory:** Experiments follow the contents of the course covered during the lectures.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory foroverall grading

Course no: ECB 304	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)		DE (Y/N)
	NO	**N**	**N**		**N**
Type of Course	Theory				
Course Title	**IC Applications**				
Course Coordinator					
Course objectives:	This course is aimed to cover OP AMP basic characteristics, AC and DC parameters. It also covers OP AMP linear as well as non linear applications.				
POs					
Semester	**Autumn: Yes**		**Spring:**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Load**
Contact Hours	3	0	2	4	48
Prerequisite course code as per proposed course numbers	Analog Electronics				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	OP-AMP and linear integrated circuits
	Author	Ramakant A. Gayakwad.
	Publisher	Pearson Pub.
	Edition	2nd
2.	Title	Design with operation amplifiers and Analog Integrated circuits
	Author	Sergei Franco
	Publisher	John Wiley and Sons
	Edition	2011
Reference Books:		
1.	Title	Integrated Electronics: Analog and Digital circuits & system
	Author	Millman & Halkias
	Publisher	TMH
	Edition	2008

Content	**Unit I: INTRODUCTION TO OPERATIONAL AMPLIFIERS**: The basic operational amplifier & its schematic Bsymbol, Block diagram representation of OP-AMP, Power supply requirements of an OP-AMP, Evolution of OP-AMP., Specification of a typical OP-AMP (741). **Unit II: THE PRACTICAL OP-AMP**: Input offset voltage, input bias current, input offset current. total output offset voltage, thermal drift, error voltage, variation of OP-AMP parameter with temperature & supply voltage. Supply voltage rejection ration (SVRR), CMRR-Measurement of OP-AMP parameters.Frequency response compensator networks. Frequency response of internally compensated OP-AMP & non-compensated OP-AMP. High frequency OP-AMP equivalent circuit, open loop voltage gain as a function of frequency. Slew rate, causes of slew rates and its effects in application. **Unit III: OPERATIONAL AMPLIFIER CONFIGURATIONS & LINEAR APPLICATION:** Open loop OP-AMP configurations- The differential amplifier, inverting amplifier, noninverting amplifier, negative feed back configurations - inverting and non inverting amplifiers, voltage followers & high input impedance configuration, differential amplifiers, closed loop frequency response & circuit stability, single supply operation of OP-AMP, summing, scaling and averaging amplifier, voltage to current & current to voltage converters, integrators & differentiators, logarithmic & anti logarithmic amplifiers. **Unit IV: ACTIVE FILTERS & OSCILLATORS:** Advantages of active filters, classification of filters, response characteristics of butter worth, chebyshev, causal filters, first order and second order butter worth filters- low pass and high pass types. Band pass & band reject filters. Oscillator principles, types of oscillators - phase shift, wein bridge & quadrature. square wave, triangular wave and saw tooth wave generators, voltage controlled oscillator. **Unit V: COMPARATORS & CONVERTERS:** Basic comparator & its characteristics, zero crossing detector, voltage limiters, clippers & clampers, small signal half wave & full wave rectifiers, absolute value detectors, sample and hold circuit.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Elective - II

Course no: EEL 311	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of course	Elective			
Course Title	**Digital Image Processing**			
Course Coordinator				
Course objectives:	To learn the basics of Image Analysis			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:,

1.	Title	Digital Image Processing
	Author	R. Gonzalez and R. E. Wood
	Publisher	Pearson Education
	Edition	3rd Edition, 2016
2.	Title	Introductory Computer Vision and Image Processing
	Author	Adrian Low
	Publisher	McGraw Hill
	Edition	
3.	Title	Fundamentals of Digital Image Processing
	Author	A. K. Jain
	Publisher	Pearson Education
	Edition	2015
4.	Title	Pattern Recognition
	Author	William Gibson
	Publisher	Berkley
	Edition	2005

Content	**Unit I: Introduction** Digital image representation, fundamental steps in image processing, elements of digital image processing systems, elements of visual perception, image model, sampling and quantization, relationship between pixels, imaging geometry. **Unit II: Image Enhancement**

	Enhancement by point processing, sample intensity transformation, histogram processing, image subtraction, image averaging, spatial filtering, smoothing filters, sharpening filters, frequency domain: low-pass, high-pass, homomorphic filtering. **Unit III: Image Transformations** *Geometric transformations*: Translation, rotation, scaling and shearing. *Frequency transformation*: Discrete Fourier transform (DFT), fast Fourier transform (FFT), short-time Fourier transform (STFT), *Multi-resolution Expansions*: Wavelet Transforms in 1-D and 2-D., Wavelet Packets Transform. **Unit IV: Image Compression** Coding redundancy, Inter-pixel redundancy, fidelity criteria, image compression models, error-free compression, variable length coding, bit-plane coding, loss-less predicative coding, lossy compression, image compression standards, Real-Time image transmission, JPEG and MPEG. **Unit V: Image Segmentation** Detection of discontinuities, edge linking and boundary detection, thresholding, region oriented segmentation, use of motion in segmentation, spatial techniques, frequency domain techniques.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 312	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Distribution System Planning &Automation**			
Course Coordinator				
Course objectives:	To provide in-depth knowledge of distribution system components, planning and protection.			
POs				
Semester	**Autumn:** YES		**Spring:** NO	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL253 EEL265				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Electric Power Distribution Engg
	Author	Turan Gonen
	Publisher	Mc Graw Hill
	Edition	

Content

Unit I: Distribution System Planning

Planning and forecasting techniques, load characteristics- definitions, load forecasting, load management, tariffs.

Unit II: Distribution Transformers

Types, three phase and single phase transformers, connections, dry type and self protected type transformers, regulation and efficiency.

Unit III: Distribution Sub-Stations

Introduction to distribution substations, bus schemes, substation location and rating, primary systems, voltage drop and power loss calculations, location of capacitors in distribution systems.

	Unit IV: Distribution System Protection Distribution system automation, Grounding-necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 313	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Micro Electro Mechanical systems**			
Course Coordinator				
Course objectives:	To understand the working and operation principle of various MEMS Devices			
POs				
Semester	**Autumn:** YES		**Spring:** NO	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	D. H. Modeling MEMS and NEMS
	Author	Pelesko, J. A. and Bernstein
	Publisher	Chapman and Hall/CRC, 2003
	Edition	
2.	Title	On Variational Approaches to Plate Models
	Author	Teresi, L. and Tiero, A., 1997
	Publisher	Meccanica, 32, 143-156
	Edition	
3.	Title	Review of modeling electrostatically actuate microelectromechanical systems
	Author	Batra, R. C., Porfiri, M., Spinello, D.
	Publisher	Smart Materials and Structures, 16(6), R23-R31.
	Edition	

Content	**Unit I:** Non-dimensionalization and single degree of freedom systems, Elastic MEMS and kinematics of continua. Equilibrium equations, constitutive equations in linear elasticity, and Naviers's equations**.** **Unit II:** Strings and Membranes, Beam Theory. Variation Calculus: Lagrange's equations and an alternative way to look at strings, membranes and plates.

	Unit III: Plate Theory, Plate Problems. Fundamentals of electrodynamics and small is different. Analysis of single degree of freedom models for electrostatically actuated MEMS. **Unit IV:** Modelling electrostatically actuated micro membranes, Modelling and numerical analysis of electrostatically actuated micro beams and micro plates.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 314	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Advanced Control Systems**			
Course Coordinator				
Course objectives:	To familiarize students with classical and modern control systems including non-linear systems.			
POs				
Semester	**Autumn:** YES		**Spring:** NO	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 252				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Control System Engineering
	Author	Nagrath I. J. and Gopal M.
	Publisher	New Age International Private Ltd. Publishers.
	Edition	5th Ed.
2.	Title	Automatic Control System
	Author	Kuo B.C.
	Publisher	Wiley India
	Edition	8th Ed.
3.	Title	Modern Control Engineering
	Author	Ogata K.
	Publisher	Pearson Education
	Edition	4th Ed.

Content	**Unit I: State Variable Approach:** Derivation of state model of linear time invariant (LTI) continuous systems, transfer function from ordinary differential equations, canonical variable diagonalization, system analysis by transfer function and state space methods for continuous, Systems convolution integral; State transition matrices and solution of state equations for continuous and discrete time system. **Unit II: Discrete Data Systems:**

	Introduction to discrete time systems, sample and hold circuits, pulse transfer function, representation by difference equations and its solution using z-transform and inverse z transforms, analysis of LTI systems, unit circle concepts; Stability **Unit III: Controllability and Observability:** Concept of controllability and observability, definitions, state and output controllability and observability tests for continuous and discrete systems, controllability and observability of time varying systems. **Unit IV: Modern Control:** Introduction, effect of state feedback on controllability and observability, design via state feedback full order observer, reduced order observers design of state observers and controllers. **Unit V: Non Linear Systems:** Types of non linearity, limit cycles, jump resonance, linearization techniques; Perturbation methods: phase plane and describing function analysis; Stability concepts, Lyapunov functions for linear and non linear systems.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 315	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Energy Audit &Management**			
Course Coordinator				
Course objectives:	To impart knowledge to the students about current energy scenario, energy management, auditing and assessment.			
POs				
Semester	**Autumn:** YES		**Spring:** NO	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL-253, EEB - 251				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Industrial Energy Management: Principles Applications
	Author	Giovanni and Petrecca
	Publisher	The Kluwer International Series-207, 1999
	Edition	
2.	Title	Handbook of Energy Audits
	Author	Albert Thumann
	Publisher	Fairmont press
	Edition	5th edition 1998
3.	Title	Energy Efficient Electric Motors and Applications
	Author	H.E. Jordan
	Publisher	Plenum Pub. Corp
	Edition	second edition 1994
4.	Title	Energy Management Handbook
	Author	W.C. Turner
	Publisher	John Wiley and Sons
	Edition	
5.	Title	Energy Management
	Author	W. R. Murphy, G. Mckay
	Publisher	Butterworths
	Edition	

Content

Unit I: Energy Audit and Management

Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach understanding energy costs, Bench marking, Energy

	performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit Instruments energy management, Roles and responsibilities of energy Manager and Accountability, Financial analysis techniques, Financing options, Energy performance contracts and role of ESCOs. Defining monitoring &targeting, Elements of monitoring&targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences. **Unit II: Energy Efficiency in Electrical Systems** Electricity billing, Electrical load management and maximum demand Control, Maximum demand controllers; Power factor improvement, Automatic power factor controllers, efficient operation of transformers, Energy efficient transformers; Induction motors efficiency, motor retrofitting, energy efficient motors, Soft starters, Variable speed drives; Performance evaluation of fans and pumps, Flow control strategies and energy conservation opportunities in fans and pumps, Energy efficiency measures in lighting system, Electronic ballast, Occupancy sensors, Energy efficient lighting controls Factors affecting selection of DG system, Energy performance assessment of diesel conservation avenues. **Unit III: Energy Conversion in Thermal systems** Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler, Properties of steam, Assessment of steam distribution losses,Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery. Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria. **Unit IV: Energy Performance &Assessment** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, Fans and pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio(ILER) method Financial Analysis: simple payback period, NPV, IRR, Case studies of few selected industries, analysis of results and inference.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 316	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Renewable Energy Systems**			
Course Coordinator				
Course objectives:	To learn the principles of generating Heat Energy and Electrical energy from Non-conventional / Renewable Energy Sources.			
POs				
Semester	**Autumn:** Yes	**Spring:** No		

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 251				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Wind power generation
	Author	Nick Jackinse
	Publisher	IET
	Edition	
2.	Title	Analysis of electrical machinery
	Author	P. C. Krause
	Publisher	Wiley-IEEE Press
	Edition	

Content

Unit I: Solar Energy &Wind energy

Introduction, Brief history about wind turbine, installed wind turbine worldwide, their usage and electricity generation capability.

Unit II: Wind turbines

Construction, working, principle, different types turbine blades, their structure, horizontal and vertical wind turbine system, power in the wind, various factors affecting the power in the wind, impact of tower height, Betz experiment, coefficient of performance, tip speed ratio, Weibull distribution function, Rayleigh probability distribution function, cumulative distribution function, average wind speed, capacity factor, wake effect.

	Unit III: Generator system Squirrel cage induction generator, principle and working, equivalent circuit and derivation of circuit parameters, wound rotor induction generator, equivalent circuit and parameter derivation, Doubly fed induction machine – power injected from network in to rotor and from rotor to network, equivalent circuit, induction machine – dynamic modelling.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 317	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Restructuring in Power Systems**			
Course Coordinator				
Course objectives:	To understand the electricity power business and technical issues in a restructured power system in both Indian and world scenario.			
POs				
Semester	**Autumn:** YES		**Spring:** NO	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL 253				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Operation of Restructured Power Systems
	Author	K. Bhattacharya, MHT Bollen and J.C Doolder
	Publisher	Kluwer Academic Publishers, USA, 2001
	Edition	
2.	Title	Power System restructuring and deregulation
	Author	Lei Lee Lai
	Publisher	John Wiley and Sons
	Edition	UK. 2001

Content

Unit I: Deregulation of the Electricity Supply Industry

Deregulation, Reconfiguring Power systems, unbundling of electric utilities, Background to deregulation and the current situation around the world, benefits from a competitive electricity market, after-effects of deregulation.

Unit II: Power System Operation in Competitive Environment

Role of the independent system operator, Operational planning activities of ISO: ISO in Pool markets, ISO in Bilateral markets, Operational planning activities of a GENCO: Genco in Pool and Bilateral markets, market participation issues, competitive bidding

Unit III: Transmission/Distribution Open Access and Pricing Issues

	Power wheeling, Transmission open access, pricing of power transactions, security management in deregulated environment, and congestion management in deregulation **Unit IV: Ancillary Services Management** General description of some ancillary services, ancillary services management in various countries, and reactive power management in some deregulated electricity markets **Unit V: Reliability and Deregulation** Reliability analysis: interruption criterion, stochastic components, component models, calculation methods, Network model: stochastic networks, series and parallel connections, minimum cut sets, reliability costs, Generation, transmission and distribution reliability, Reliability and deregulation: conflict, reliability analysis, effects on the actual reliability, regulation of the market.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 318	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Digital Control**			
Course Coordinator				
Course objectives:	To study the stability analysis of digital control system. To introduce student to fundamental concepts of digital control components and systems.			
POs				
Semester	**Autumn:** YES		**Spring:** NO	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 252				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Digital Control Systems
	Author	B. C. Kuo
	Publisher	Oxford University Press
	Edition	2/e, Indian Edition, 2007
2.	Title	Discrete Time Control Systems
	Author	K. Ogata
	Publisher	Prentice Hall
	Edition	2/e, 1995
3.	Title	Digital Control and State Variable Methods
	Author	M. Gopal
	Publisher	Tata Mcgraw Hill
	Edition	2/e, 2003
4.	Title	J. D. Powell and M. L. Workman, Digital Control of Dynamic Systems
	Author	G. F. Franklin
	Publisher	Addison Wesley, 1998, Pearson Education, Asia
	Edition	3/e, 2000

Content

Unit I: Introduction to digital control

Introduction- Discrete time system representation, mathematical modelling of sampling process, data reconstruction.

Unit II: Modelling Discrete-time Systems by Pulse Transfer Function

Revisiting Z-transform, mapping of s-plane to z-plane, pulse transfer function,

	Pulse transfer function of closed loop, Sampled signal flow graph. **Unit III: Stability analysis of discrete time systems** Jury stability test, Stability analysis using bi-linear transformation, Time response of discrete systems, Transient and steady state responses, Time response parameters of a prototype second order system. **Unit IV: Design of sampled data control systems** Root locus method, controller design using root locus, root locus based controller design using MATLAB, nyquist stability criteria, bode plot, lead compensator design using bode plot, lag compensator design using bode plot, lag-lead compensator design in frequency domain. **UNIT V: Deadbeat response design** Design of digital control system with deadbeatresponse, Practical issues with deadbeat response design, sampled data control systems with deadbeat response. **Unit VI: Discrete state space model** Introduction to state variable model, various canonical forms, characteristic equation, state transition matrix, solution to discrete state equation. **Unit VII: Controllability, observability and stability of discrete state space models** Controllability and observability, stability, Lyapunov stability theorem. **Unit VIII: State feedback design** Pole placement by state feedback, set point tracking controller, full order observer, reduced order observer, output feedback design-Theory, examples. **Unit IX: Introduction to optimal control** Basics of optimal control, performance indices, linear quadratic regulator (LQR) design.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEB 351	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**Yes**	**No**
Type of Course	Theory and Practical			
Course Title	**Power Electronics**			
Course Coordinator				
Course objectives:	The course aims at familiarizing the students with the operating characteristics of semiconductor devices, triggering circuits and their applications for power control. The course also deals with the detailed analysis and operation of power controllers.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) + 24(P)**
Prerequisite course code as per proposed course numbers	EEB 100				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Modern Power Electronics
	Author	B. K. Bose
	Publisher	IEEE Press
	Edition	
2.	Title	Power Electronics-Circuits, Devices & Applications
	Author	M.H. Rashid
	Publisher	Pearson Education
	Edition	

Content	**Unit I: Characteristics of Various Solid State Devices** Introduction, power semiconductor devices: power diode, power transistor, MOSFET, Thyristor & its two transistor model, Triac, Gate turn off thyristor (GTO), insulated gate bipolar transistor (IGBT), comparison of switching power devices, turn on & turn off characteristics, driver circuits. **Unit II: AC to DC Converters** Commutation, single phase and three phase bridge rectifiers, semicontrolled & fully controlled rectifiers, dual converters, effect of load and source inductance. **Unit III: DC to DC Converters** Principle of operation, control strategies, step-up, step-down choppers, types of chopper circuits, steady state analysis, multiphase chopper. **Unit IV: DC to AC Inverters** Voltage source inverters, single phase inverter, three phase inverter, harmonic reduction techniques and PWM techniques, current source inverter. **Unit V: AC to AC Converters** Single phase & 3-phase AC voltage controllers using thyristors , phase control and integral cycle control, AC choppers, single phase cyclo-converters, applications, effects of harmonics. **<u>Power Electronics Laboratory:</u>** Study of characteristics of power semiconductor switching devices (SCR, Triac, MOSFET, IGBT), Study of two-pulse fully controlled rectifier, feeding R, RL and RLC (DC-motor) loads, Study of a six-pulse half controlled rectifier feeding R, RL and RLE loads, Study of a six-pulse fully controlled rectifier feeding R and RL loads- Closed-loop control of a six-pulse fully controlled rectifier, Study of a 1-phase inverter with square wave, quasi-square wave and SPWM control, Speed control of induction motor with V/f control method using 3-phase inverter, Open –loop control of a separately excited DC motor drive with a 6-phase fully controlled rectifier, Study of characteristics of a class –D commutated thyristorized step-down chopper, Study of AC chopper with R and RL loads to achieve power control, Study of performance of a PWM controlled AC-DC converter, Study of performance of a 1-phase cyclo-converter.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory for overall grading

Course no: EEL 352	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	No	**No**	**Yes**		**No**
Type of Course	Theory				
Course Title	**Switch Gear and Protection**				
Course Coordinator					
Course objectives:	To introduce the concept and necessity of protection in generation and transmission, and applications of switchgears including internal operation of different types of circuit breakers.				
POs					
Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**1**	**0**	**4**	**36(L) + 12(T)**
Prerequisite course code as per proposed course numbers	EEL 302				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Fundamentals of power system protection
	Author	Y. G. Paithankar and S. R. Bhide
	Publisher	Prentice Hall
	Edition	
2.	Title	Switchgear and Power System Protection
	Author	Ravindra P.Singh
	Publisher	PHI Learning Private Ltd
	Edition	
3.	Title	Power System Protection and Switchgear
	Author	Badri Ram, D N Vishwakarma
	Publisher	TMH
	Edition	

Content	**Unit I: Protection Schemes** Principles and need for protective schemes, nature and causes of faults, types of faults, methods of neutral grounding, zones of protection and essential qualities of protection **Unit II: Electromagnetic Relays**

	Operating principles of relays, universal relay, torque equation, R-X diagram, electromagnetic relays, over current, directional, distance, differential, negative sequence, thermal and under frequency relays, distance protection- impedance relay, reactance relay, mho relay, input quantities for various types of distance relays, effect of arc resistance, power swings, line length and source impedance on the performance of distance relays, selection of distance relays. **Unit III: Apparatus Protection** Current transformers and potential transformers and their applications in protection schemes protection of transformer, generator, motor, busbars and transmission line. **Unit IV: Static Relays and Numerical Protection** Static relays, phase, amplitude comparators, synthesis of various relays using static comparators, block diagram of numerical relays–overcurrent protection, transformer differential protection, distant protection of transmission lines. **Unit V: Circuit Breakers** Physics of arcing phenomenon and arc interruption, DC and AC circuit breaking, re-striking voltage and recovery voltage, rate of rise of recovery voltage, resistance switching, current chopping, interruption of capacitive current, types of circuit breakers – air blast, air break, oil, SF6 and vacuum circuit breaker, comparison of different circuit breakers, rating and selection of circuit breakers.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEP 353	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	No	No	Yes		No
Type of Course	Laboratory				
Course Title	**Simulation Tools for Electrical Engineering**				
Course Coordinator					
Course objectives:	The student will be able to use various simulation tools available for Electrical Engineering				
POs					
Semester	**Autumn: NO**		**Spring: YES**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	0	0	3	2	36
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
Content	This lab is designed to introduce various simulation software available for electrical engineering				
Course Assessment	Lab: Continuous Evaluation 50% and End Semester 50%				

Course no: HML351	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No			
Type of course	Theory			
Course Title	Engineering Economics and Accountancy			
Course Coordinator	Dr. Shakira Khan			
Course objectives:	The subject will provide the knowledge of economics, finance and accountancy for the better decision making of the economic alternatives and investment alternatives in the field of engineering and anywhere else.			
POs				

Semester	**Autumn:**		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				

Text Books:		
1.	Title	Engineering Economics Principles,
	Author	Henry Malcom Steiner
	Publisher	McGraw Hill Publications
	Edition	
2.	Title	Dewett K.K.,

	Author	Modern Economic Theory
	Publisher	Sultan Chand & Co.
	Edition	
1. 3	Title	Indian Economy
	Author	Agrawal AN
	Publisher	Wiley Estern Ltd, New Delhi
	Edition	
4	Title	Accounting Part-1
	Author	Jain and Narang
	Publisher	Kalyani Publisher
	Edition	
5	Title	Fundamentals of Engineering Economics
	Author	Kumar P.
	Publisher	Wiley India Pvt. Ltd. New Delhi.
	Edition	2012
Reference Book:		
1	Title	Engineering Economics
	Author	Panneerselvam R
	Publisher	PHI Learning Pvt. Ltd., New Delhi.
	Edition	2013
2	Title	Financial Management
	Author	Tulsian P.C.
	Publisher	S. Chand and Company Pvt. Ltd.
	Edition	2009
Content	**Unit I: Engineering Economics** Introduction to Engineering Economics – Fundamental concepts-Time value of money – Cash flow and Time Diagrams – Choosing between alternative investment proposals. (6 hours)	

	Unit II: Capital Budgeting Methods of Economic analysis (Pay back, ARR, NPV, IRR and B/C ratio). Depreciation and methods of calculating depreciation (Straight line, Sum of the years digit method, Declining Balance Method, Annuity Method, Sinking Fund method.) (7 hours) **Unit III: Indian economy and Economic Development** National Income Accounting – Methods of Estimation – Various Concepts of National Income – Significance of National Income Estimation and its limitations. Inflation: Definition- Measures to Control (Monetary and Fiscal policy). New Economic Policy 1991 Breakeven Analysis – Meaning and its application, Limitation. (8 hours) **Unit IV: Financial Accounting**: Accounting Principles, procedure-Double entry system – Journal, ledger, Trial balance – Cash Book – Preparation of Trading and Profit and Loss account – Balance Sheet. Cost Accounting - Introduction-Classification of costs – Methods of Costing-Techniques of Costing. E-commerce: Importance and Need. (8 hours) **Unit V: Managerial Economics** Scope of Managerial Economics: Theory of Demand and Theory of Supply. Law of demand and Law of Supply. Techniques of Managerial Economics; Theory of firm, Theory of Market Structure. Applications of Managerial Economics. (7 hours)
Curse Assessment	Continuous Evaluation: 20% Mid Semester: 30% End Semester: 50%

Course no: HMP 352	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	**YES**	**NO**	**NO**
Type of Course	Practical			
Course Title	**TECHNICAL COMMUNICATION**			
Course Coordinator				
Course objectives:	The course aims to inculcate soft skills and technical writing in students. The practical sessions will prepare students to face job interviews and Group Discussion.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**0**	**0**	**2**		24
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	New International Business English,
	Author	Jones, L &R. Alexander
	Publisher	UK: CUP
	Edition	2006
2.	Title	Effective Technical Communication
	Author	Rizvi, M. A.
	Publisher	New Delhi: McGraw Hills Education
	Edition	2005

Content

Unit I: WRITTEN COMMUNICATION

Writing Resume, Curriculum Vitae, and Bio-data (Design, Style); Writing Cover letter, Job Applications, Statement of Purpose (SoPs), Life Essay etc.

Writing Technical Correspondences: Report Writing, Process Writing, Technical Description: Instructions, manuals etc.Proposals writing, Journal Articles and Conference Papers, Review and Research Articles. (Focus would be given to Grammar, Foreign Words &Phrases, Appropriate use of Prepositions and other aspects).

Unit II: ORGANISATIONAL COMMUNICATION

Samples of technical letters (Letter of Inquiry, Replies to Inquiry Letters, Letters Placing Orders, Instruction Letters, Letters Urging Action, Complaint

	Letters, and Adjustment Letters) E-mail Correspondences: Format, Standard Practices and Strategies **Unit III: PRESENTATION SKILLS** Oral presentation Skills: How to make presentation (Focus on Paralinguistic features of speech: Pause, Voice, Stress, and Intonation etc. and Non-verbal cues: Body-languageetc.). Preparing the Presentation: Develop the central idea, main ideas and supporting materials, visual aids. Rehearsing the presentation: Improving Delivery and handling stage Fright **Unit IV: Group Discussion Skills** Techniques for Group Discussion Subject Knowledge, Communication Skills, Leadership Skills, Group Behaviour Group Contribution: Contributing Systematically; Creating Cooperative Environment, Optimal Participation, Handling Conflict, Effective Closure Individual Contribution: Topic analysis; Discussing Opinion, Problems, Case Studies Exchanging Opinions, Suggestions and Proposals **Unit V: Job Interviews** Pre-interview Presentation Techniques Self-Analysis, Research the Organisation Job Analysis, Revise your Subject Knowledge, Develop your Interview file. Interview questions: types, Answering Strategies **Good manners and Positive Behaviour**
Course Assessment	Labortatory: Continuous Evaluation 50% End Semester 50%

Elective - III

Course no: EEL 361	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Integrated Circuits & Applied Instrumentation(ICAI)**			
Course Coordinator				
Course objectives:	To learn about signal conditioning circuits and design and applications of Operational amplifiers			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	ECB 304				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Operational Amplifiers and Linear Integrated Circuits
	Author	R.F. Coughlin
	Publisher	Pearson Education (P) Ltd.
	Edition	
2.	Title	Op-Amp and Linear Integrated Circuits
	Author	R.A. Gayakwad,
	Publisher	Pearson Education
	Edition	
3.	Title	Linear Integrated Circuits
	Author	D.R. Choudhary
	Publisher	New Age International (P) Limited
	Edition	

Content

Unit I: Design and Applications of Op-Amps

Operational amplifiers, its transfer characteristics, characterization of Op-amp parameters (Slew rate, offset error, CMRR) comparator characteristics, limitation of Op-amp as comparator, Voltage limiters, zero crossing detector, precision rectifier, peak detector, window detector. Inverting and non-inverting configuration amplifiers, analog integrator and differentiator, logarithmic amplifier, instrumentation amplifier AD 620, isolation amplifiers.

Unit II: Signal Conditioning Circuits

	Basic bridge amplifier and its use with strain gauge and temperature sensors, filters in instrumentation circuits, universal trigonometric function generator AD639, Phase-sensitive detectors, Phase-locked loops, signal converters A/D and D/A techniques and chips (ADC 0804, 0808/9 DAC 800, AD558 etc.), sample and hold circuits, 555-Timers, linear IC voltage regulators, Opto-isolators and their use in instrumentation system, keypad and LCD interfacing techniques. **Unit III: Case Studies** Case Studies on Op-Amp based design circuits.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 362	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Real Time Control in Power System**			
Course Coordinator				
Course objectives:	To impart knowledge to the students about real time security monitoring and control (computer and operator) of power system for economic and reliable operation.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL 253				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Power System control – Technology
	Author	Torsten Cegrell
	Publisher	Prentice Hall International Ltd
	Edition	
2.	Title	Power Generation operation and control
	Author	Allen J. Wood and Bruce F. Wollenberg
	Publisher	John Wiley & Sons
	Edition	
3.	Title	Computer Aided Power Systems Operation and Analysis
	Author	R. N. Dhar
	Publisher	Tata McGraw Hill
	Edition	

Content

Unit I: Computer Control of Power Systems

Need for real time and computer control of power systems, operating states of a power system, introduction to SCADA- grid operation & control, need and advantages of SCADA- SCADA - Supervisory control and Data Acquisition systems implementation considerations, energy control centers, software requirements for implementing the above functions, RTU- SCADA functions, control Functions.

Unit II: State Estimation

	Different types of State Estimations, theory of WLS state estimation, sequential and non-sequential methods to process measurements, bad data observability, bad data detection, identification and elimination. **Unit III: Security and Contingency Evaluation** Security concept, security analysis and monitoring, contingency analysis for generator and line outages by iterative linear power flow method, fast decoupled model, and network sensitivity methods. **Unit IV: Man – Machine Communication** Operator's Console, VDU display and its use, operator dialogs, mimic diagram functions, printing facilities, remote terminal unit (RTU) & communication practices, major components: RTU Panel, Interface Panel, D20M main processor, analog card, status card, control card, modems-types of communications- types of network elements in LAN & WAN. **Unit V: Sub-load Dispatch Center (Sub-LDC)** Elements of SLDC- workstations- front end processor- routers- function of SLDC- introduction to SCADA PROTOCOLS and communication standards for electrical power systems. **Unit VI: Real Time Software** Classification, structure, tools, language requirements of RTS computer control of electrical power systems, state load dispatch center (SLDC): inter Connectivity of Sub-LDCs & SLDCs, hierarchy of data transfer, functions & responsibilities of SLDC, real time operation carried at SLDC. Southern regional load dispatch center (SRLDC), Functions & responsibilities of SRLDC, operations carried at SRLDC.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 363	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Process Control**			
Course Coordinator				
Course objectives:	To introduce the basic principles & importance of process control in industrial process plants.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 252				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Chemical Process Control
	Author	Stephanopoulis, G
	Publisher	Prentice Hall of India
	Edition	New Delhi, 1990
2.	Title	Automatic Process Control,
	Author	Eckman. D.P
	Publisher	Wiley Eastern Ltd.
	Edition	New Delhi, 1993
3.	Title	Process Control
	Author	Pollard A
	Publisher	Heinemann educational books
	Edition	London, 1971
4.	Title	Process Control
	Author	Harriott. P
	Publisher	Tata Mc - Graw hill
	Edition	

Content	**Unit I: Introduction** Need for process control – mathematical model of first order level, pressure and thermal processes– higher order process – interacting and non-interacting systems – continuous and batch processes– self-regulation – servo and regulator operations. **Unit II: Control Actions and Controllers** Basic control actions – characteristics of on-off, proportional, single-speed floating, integral and derivative control modes – P+I, P+D and P+I+D control modes – pneumatic and electronic controllers to realize various control actions. **Unit III: Optimum Controller Settings** Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – determination of optimum settings for mathematically described processes using time response and frequency response – Tuning –Process reaction curve method – Ziegler Nichols method – Damped oscillation method. **Unit IV: Multi loop Control** Feed-forward control – ratio control- cascade control – inferential control – split-range control – introduction to multivariable control – examplesfrom distillation column and boiler systems. **Unit V: Final Control Element** I/P converter – pneumatic and electric actuators – valve positioner – control valves –characteristics of control valves – inherent and installed characteristics – valve body – commercial valve bodies–control valve sizing – cavitation and flashing – selection criteria.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 364	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**High Voltage Engineering**			
Course Coordinator				
Course objectives:	The course primarily aims to give the student a deeper physical understanding of high voltage technologies, generation and measurement of high voltage, as well as ageing and breakdown mechanisms are dealt with.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	PHL 100, EEL 203				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	High voltage Insulation Engineering
	Author	Ravindra Arora & Wolfgang Mosch
	Publisher	New Age International Publishers
	Edition	
2.	Title	High Voltage Engineering
	Author	M.S. Naidu, V. Kamaraju
	Publisher	TMH
	Edition	
3.	Title	High Voltage Technology
	Author	L. L. Alston
	Publisher	BS Publications
	Edition	

Content

Unit I: Introduction

Electro static fields, their control and estimation, electric field intensity, classification of electric fields, control of electric field intensity, generation of high dc and ac voltages. Cockroft, Walton voltage multiplier circuit.

Unit II: Electrostatic Generator

Generation of high ac voltages by cascaded transformers, series resonant circuit, generation of impulse voltages and currents- definitions, impulse

	generator circuits, impulse current generation. **Unit III: Measurement of High Voltages and Currents** Introduction, sphere gap, electrostatic voltmeter, generating voltmeter, Fortescue method, voltage dividers, measurement of high dc, ac and impulse currents. **Unit IV: High Voltage Testing of Electrical Equipment** Testing of insulators, cables, bushings, power capacitors, power transformers and circuit breakers- IEC, ANSI, IEEE and Indian standards for testing electrical equipment, non-destructive test techniques, high voltage Schering bridge, partial discharges measuring techniques, breakdown mechanism of gaseous liquid and solid insulating materials.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 365	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Power System Planning and Automation**			
Course Coordinator				
Course objectives:	To understand the different power system planning and forecasting techniques.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL 253				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Forecasting methods and application
	Author	Makridakis, Spyros
	Publisher	John Wiley
	Edition	1993
2.	Title	Modern Power system planning
	Author	X.Wang& J.R. McDonald
	Publisher	McGraw. Hill
	Edition	1993
3.	Title	Electrical Power system planning
	Author	A.S Pabla
	Publisher	Mac Millan
	Edition	1998
4.	Title	Power system planning
	Author	Sullivan
	Publisher	McGraw. Hill
	Edition	1977
5.	Title	Electricity distribution network design
	Author	Lakervi E, E J Holmes
	Publisher	IEE
	Edition	2nd edition, 2003
Content	**Unit I: Forecasting – Needs and Uses** Current Status Of Forecasting, Fundamentals Of Quantitative Foreca	

	Explanatory And Time Serious Forecasting, Least Square Estimates, Peak Forecasting, Accuracy Of Forecasting Methods, Regression Methods, Box Je Time Serious Methods. **Unit II: Short and Long Term Forecasting Techniques** Problems facing electricity industry, Long term forecasting techniques, Me of long term forecasting, Spatial load forecasting, Multivariate procedures, term forecasting techniques **Unit III: Forecasting and Planning** The role of forecasting in planning, Comparison and selection of foreca methods, The accuracy of forecasting methods, Pattern of the Data and its e on individual forecasting methods, Time horizon effects on forecasting meth **Unit IV: Generation Planning** Fundamental economic analysis, Generation planning optimized accordi generating unit categories, distribution & Transmission system planning.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 368	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Electro-Magnetics for Electrical Machines**			
Course Coordinator				
Course objectives:	To understand the importance of eddy currents and their effects on the design of Poly phase induction motors			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 251, EEB 301				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Electromangetics for Electrical Machines
	Author	Saurabh Kumar Mukerji, Ahmad Shahid Khan, Yatendra Pal Singh
	Publisher	CRC Press
	Edition	
2.	Title	Electromagnetic Field Theory Fundamentals
	Author	Guru, B. H. And Hiziroglu, H.R
	Publisher	PWS Publishing company, Boston
	Edition	
3.	Title	Eddy Currents in Linear and Non-Linear Media
	Author	Subbarao, V
	Publisher	Omega Scientific Publishers, New Delhi, India
	Edition	
4.	Title	Two-Dimensional Fields in Electrical Engineering
	Author	Bewley, L. V
	Publisher	Dover, New York
	Edition	

Content	**Unit I : Eddy currents in Magnetic Cores** Introduction, Eddy current machines (Solid Rotor Induction Machines) – Two-dimensional Model, Eddy currents in large plates due to alternating excitation current – Single phase excitation, poly-phase excitation, Eddy currents in cores with rectangular cross-sections, Eddy currents in cores with Triangular Cross-sections, Eddy currents in cores with regular polygonal cross-sections, Eddy currents in circular cores, Distribution of current density in Circular Conductors, Eddy currents in Laminated rectangular cores **Unit II : Laminated-Rotor Poly-phase Induction Machines** Introduction, Two-Dimensional Fields in Anisotropic Media, Cage or Wound Rotor Induction Machines, Induction Machines with skewed rotor slots – Air-gap Field, Fields in the anisotropic rotor region, Determination of arbitrary constants. **Unit III : Unlaminated Rotor Poly-phase Induction Machines** Introduction, tooth-ripple harmonics in solid-rotor induction machines – Physical Description, Field Distribution in Stator Slots, Field Distribution in the Air-gap, Field Distribution in Solid Rotor, machine performances, Three-dimensional fields in solid-rotor induction machines – Idealized Model, Field Distributions, Effects of Finite Machine Length, Effect of Different rotor and stator lengths, performance parameters
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 369	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Special Electrical Machines-I**			
Course Coordinator				
Course objectives:	To understand and analyse the behaviour and construction of various special purpose machines			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 251, EEB 301				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Special Electrical Machines
	Author	E.G. Janardanan
	Publisher	PHI publication
	Edition	
2.	Title	Electric Machinery and Transformers
	Author	Bhag S. Guru, Huseyin R. Hiziroglu
	Publisher	Oxford
	Edition	

Content

Unit I: Permanent Magnet Synchronous Motor (PMSM)

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

Unit II: Synchronous Reluctance Motor (SyRM)

Construction of SyRM, Working of SyRM, Phasor diagram and Torque Equation of SyRM, control of SyRM, Advantages of SyRM, Applications of SyRM

Unit III: Single phase special Electric machines

AC Series Motor – Construction, Principle of Working, EMF and Torque Equation, Phasor Diagram, Torque-Speed Characteristics, Repulsion Motor

	– Construction and Working, Types of Repulsion motors, Torque Equation of Repulsion Motor, Characteristics, Phasor Diagram, Hysteresis Motor, Single-phase reluctance motor, Universal Motor – Types and Construction, Principle of Operation, Speed Control of Universal Motor **Unit IV: Servo Motors** DC Servo Motors – Construction, Principle of Operation, AC Servo Motors – Construction & Working, Analysis of Two-phase AC Servo Motor, Torque-speed characteristics, Transfer Function **Unit V: Linear Electric Machines** Linear Induction motor, Linear Synchronous Motor, DC Linear Motor, Linear Reluctance and Levitation Machines
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEB 401	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Theory and Practical			
Course Title	**Electrical Drives**			
Course Coordinator				
Course objectives:	To understand basic of DC/AC electrical drives, their speed control and braking techniques			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**2**	**4**	**36(L) 24(P)**
Prerequisite course code as per proposed course numbers	EEB 251 EEB 301 EEB 351				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	Fundamentals of Electrical Drives
	Author	G. K. Dubey
	Publisher	Alpha Science International, Ltd
	Edition	2nd Ed.
2.	Title	Power electronic control of AC motors
	Author	J. M. D. Murphy and F. G. Turnbull
	Publisher	Pergamon press
	Edition	1st Ed. and Revised
3.	Title	Electric Drives
	Author	Ion Boldea and S. A. Nasar
	Publisher	CRC press
	Edition	3rd Ed.

Content

Unit I: Introduction

Electrical drives, advantages of electrical drives, parts of electrical drives – electrical motors, power modulators, sources, control unit.

Unit II: Dynamics of Load System

Fundamental torque equations, speed torque conventions and multiquadrant operation, equivalent values of drive parameters – loads with rotational motion and translational motion, measurement of moment of inertia – reduced voltage and retardation test on induction motor, components of load torques, nature and classification of load torques, calculation of time and energy loss in

	transient operations, steady state stability, load equalisation. **Unit III: Control Aspects and Sensing** Modes of operation, speed control and drives classifications, closed loop control of drives – current limit control, Torque control, speed control, speed sensing, current sensing, phase locked loop control, closed loop position control. **Unit IV: Rating and Heating of Motors** Thermal model, classes of duty, determination of motor rating – continuous duty, short time duty, intermittent duty. **Unit V: DC Motor Drives** DC motor and their performance, starting, braking, transient analysis, speed control, methods of armature voltage control, ward Leonard drives, transformer and uncontrolled rectifier control, 1-phase controlled and semi controlled rectifier fed DC motor, 3- phase half controlled, semi controlled and fully controlled rectifier fed DC motor drive, chopper controlled DC motor drive. **Unit VI: Induction Motor Drive** Three phase induction motor analysis and performance, starting, speed control and braking, stator voltage control, variable frequency control, VSI and CSI control, rotor resistance control, pole amplitude modulation, slip power recovery – Scherbius and Kramer drive. **Laboratory:** Measurement of Moment of Inertia of a 3-phase induction motor using retardation Test, To perform rheostatic braking of a DC Shunt motor and observe the impact of increasing resistance on braking time, To perform counter-current braking of a DC –Shunt type motor and observe the impact of plugging resistance on braking time, To validate armature and flux control of a DC – shunt type motor using rheostats, To validate two-quadrant operation of a DC – shunt type motor using Ward-Leonard Method of speed control, To validate the speed control of a DC-shunt type motor by using DC-DC chopper circuit, To perform DC-dynamic braking of a 3-phase induction motor and observe the impact of DC current on braking time, To perform counter-current braking of a 3-phase induction motor and observe the impact of braking resistance on braking time, To validate V/F control of a 3-phase induction motor using 3-phase Voltage Source Inverter, To perform speed control of a 3-phase slip-ring Induction motor by rotor resistance variation.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory for overall grading

Course no: EEP 402	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of course	Practical			
Course Title	**Power System Lab**			
Course Coordinator				

Course objectives:	To understand basic of Power Systems, operations of the relays, techniques and Principle of Differential Protection.				
POs					
Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**0**	**0**	**2**	**1**	**24 (P)**
Prerequisite course code as per proposed course numbers	EEL253 EEL302				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Power System Analysis
	Author	H. Saadat
	Publisher	Tata McGraw-Hill Publishing Company Limited
	Edition	3rd Ed.
2.	Title	Computer Techniques in Power System Analysis
	Author	M. A. Pai
	Publisher	Tata McGraw-Hill Publishing Company Limited
	Edition	3rd Ed.
3.	Title	Reactive Power Control in Electric Systems
	Author	T. J. E.Miller
	Publisher	John Wiley and Sons
	Edition	1st Ed. (1982)

Content	To study the qualities of a power system protection scheme and protection devices, Apply a relay for phase sequence, phase failure and voltage asymmetry to a three-phase circuit, Apply a max/min voltage relay in a three-phase network, Apply a max/min frequency relay to a power production plant, Apply a maximum current (over current & short circuit) relay to a three-phase line, To use a timer with different time functions to extend the protection relays operation, To use an auxiliary relay as interface for remote optical/acoustic signalling of the protection relays operation, Connection of the voltage transformers with open delta of three-phase lines, Connection diagram of the open delta voltage transformers paired to a maximum voltage and over-current relay for opening the circuit in case of fault to ground and overload/short-circuit, Principle of Differential Protection.
Course Assessment	Lab: Continuous Evaluation 50% End Semester 50%

ELECTIVE - IV

Course no: EEL 411	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of course	Theory			
Course Title	**Utilization of Electrical Energy**			
Course Coordinator				
Course objectives:	This subject gives a comprehensive idea in utilization of electrical power such as drives, electric heating, electric welding and illumination, electric traction.			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	Utilization of Electric Energy
	Author	E. Openshaw Taylor and Orient Longman
	Publisher	Orient Longman Pvt Ltd
	Edition	1st Ed. Reprints
2.	Title	Utilization of Electrical Power including Electric drives and Electric traction
	Author	N. V. Suryanarayana
	Publisher	New Age International (P) Limited
	Edition	1st Revised Ed. Reprints
3.	Title	Electric Drives
	Author	Ion boldea and S. A. Nasar
	Publisher	CRC press
	Edition	3rd Ed.

Content

Unit I: Electrical Heating and Welding

Advantages and methods of electric heating, resistance heating induction heating and dielectric heating, selection of frequency of induction and dielectric heating, welding process, different types of resistance and arc welding.

Unit II: Electrolysis Process

Principle of electrolysis, electroplating, metal extraction and metal processing, electromagnetic stirs.

	Unit III: Illumination Terminology Laws, coefficient of utilization and depreciation factor, polar curves, photometry, integrating sphere, Stroboscopic effect, sources of light, discharge lamps, MV and SV lamps, comparison between tungsten filament lamps and fluorescent tubes, basic principles of light control, types and design of lighting schemes, lighting calculations. **Unit IV: Electric Traction** Systems of electric traction and track electrification, review of existing electric traction systems in India, mechanics of traction movement, speed-time curves for different service, adhesive weight and braking retardation, specific energy consumption for given run, coefficient of adhesion, train lighting, systems of train lighting.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 412	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory			
Course Title	**DSP and its Application to Power Electronics**			
Course Coordinator				
Course objectives:	To realize real time DSP based microcontroller application to Power System and Power Electronic domains			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	ECB 204 EEB 303 EEB 351				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	Discrete Time Signal Processing
	Author	A. V. Oppenheim, R. W. Schafer
	Publisher	PHI.
	Edition	3rd Ed.
2.	Title	Optimum Signal Processing
	Author	S. J. Orfanidis
	Publisher	McGraw-Hill
	Edition	2nd Ed.
3.	Title	Introduction to DSP
	Author	Proakis, Manolakis
	Publisher	PHI/ Pearson.
	Edition	3rd Ed.

Contents

Unit I: Introduction

Fixed and floating-point processors Number formats and operations: Fixed point 16 bit numbers representations of signed integers and fraction, Floating Point Numbers. Review of commonly used DSP processors in power electronics applications, Introductions to TMS320C2000.

Unit II: DSP Architecture, peripherals and programming

Introduction to Digital control using DSP, Overview of TMS320XXXXX Digital signal controller family – Features, Architecture, Interrupt and Reset, Memory map - On-chip memories: Flash, RAM, and Boot ROM – External memory Interface. Clock system- Digital I/O -CPU Timers – Analog to Digital Converter (ADC), Pulse Width Modulator (PWM), High Resolution PWM, Capture Module,

	Quadrature Encoder Pulse Module. Controller Area Network, Serial Communication Interface, Serial Peripheral Interface, I2C and Multi-channel Buffered Serial port. Programming: assembler, linker processes, code structure, Code composer studio. **Unit III: Mathematic Tools for Real time DSP implementation** Review of numerical integration: Euler's implicit and explicit method, Heun's Method, Trapezoidal Method. Implementation of low pass filter. Review of reference frame transformation theory. Design of controllers for closed loop applications in power electronics: PI, Type II and Type III controllers. **Unit IV: DSP Applications in Power Electronics and Power systems.** Speed control of Induction motor, BLDC motor, Digital control of DC/DC converter, LED Lighting. Issues of harmonics and unbalanced currents in power systems, Implementation of Active filters in DSP under balanced and unbalanced condition, harmonic oscillator and 3 phase lock loop, Static VAR Compensator, Hardware in Loop simulations. Design of a DSP controlled Solar PV based Converter/Inverter system.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 413	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory			
Course Title	**Power System Operation & Control**			
Course Coordinator				
Course objectives:	To provide students the knowledge of the engineering and economic aspects of planning, operation, security, controlling power generation and transmission systems in electric utilities.			
POs	Upon completion of this course, students will be able to develop generation dispatching schemes, apply control and selection methods on a power system.			

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL 253 EEL 302				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	Power System Analysis
	Author	Grainger J. J. and Stevenson W. D.
	Publisher	McGraw-Hill International Book Company, 2008.
	Edition	1st Ed.
2.	Title	Power System Analysis Operation and Control
	Author	A. Chakrabarti, S. Halder
	Publisher	PHI, 2010.
	Edition	3rd Ed.
3.	Title	Power System operation and Control
	Author	K. Uma Rao
	Publisher	Wiley India.
	Edition	1st Ed.

Contents	**Unit I: Economic Load Dispatch** Economic dispatch of thermal units and methods of solution, Transmission losses, B matrix loss formula, Composite generation production cost function-solution by gradient search techniques, Nonlinear function optimization **Unit II: Automatic generation and Voltage Control** Introduction, load frequency problem-Megawatt frequency (or P-f) control channel, MVAR-voltages (or Q-V) control channel-Dynamic interaction between P-f and Q-V loops. Mathematical model of speed-governing system-Turbine models, division of power system into control areas, P-f control of single control area (the uncontrolled and controlled cases)-P-f control of two area systems (the uncontrolled cases and controlled cases), Economic Dispatch and AGC, EMS, SCADA. **Unit III: Methods of Voltage Control** Reactive power and its relation to voltage control, location of voltage control equipment, methods of voltage control, excitation control, voltage regulators, tap changing transformers, booster transformers, induction regulators, reactive power injection and voltage control by synchronous condenser **Unit IV: Unit Commitment and Hydro Thermal Scheduling** *Unit commitment:* Constraints in Unit commitment, Spinning reserve, Thermal and hydro constraints, Unit commitment solution methods- Priority list methods, Dynamic programming solution, Short and long range hydro-thermal scheduling, hydroelectric plant models, scheduling problems, *Hydro thermal scheduling*; Short range hydro-thermal scheduling: Gradient approach, Pumped storage hydro plants, Dynamic programming solution to the hydrothermal scheduling problems. **Unit V: Power System Security** Factors affecting power system security, Contingency analysis: Detection of network problems, Correcting the generation approach: Sensitivity methods, compensated factors, correcting the generation dispatch using linear programming.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 414	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory			
Course Title	**Switched Mode Power Conversion**			
Course Coordinator				
Course objectives:	To acquaint the students with working, analysis and design of different types of dc to dc converters.			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 351				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	Fundamentals of Power Electronics
	Author	Robert Erickson and Dragon Maksivimovic
	Publisher	Springer Publications
	Edition	2nd Ed.
2.	Title	Power Electronics
	Author	Issa Batarseh
	Publisher	John Willey
	Edition	2nd Ed.
3.	Title	Elements of Power Electronics
	Author	Philip T. Krein
	Publisher	Oxford University Press
	Edition	2nd Ed.

Content

Unit I: Introduction:

Basic concepts of Switched Mode power converters, DC-DC converters Characteristics, constituent elements, operating principles.

Unit II: Steady State Analysis and Isolated Bridge Converters:

Half bridge and full-bridge converters, Power circuit and steady state analysis, utilization of magnetic circuits and comparison with previous topologies. stress and sizing of elements, control methods, duty ratio, current programmed, frequency programmed and sliding mode control.

	Unit III: Single-Switch Isolated Converters: Requirement for isolation in the switch-mode converters, transformer connection, Forward and flyback converters, power circuit and steady-state analysis. Push-Pull Converters-Power circuit and steady-state analysis, utilization of magnetic circuits in single switch and push-pull topologies. **Unit IV: Dynamic Analysis of DC-DC Converters:** Formulation of dynamic equation of buck and boost converters, averaged circuit models, linearization technique, small-signal model and converter transfer functions and frequency domain models. **Unit V: Controller Design:** Review of frequency-domain analysis of linear time-invariant systems, concept of bode plot, phase and gain margins, bandwidth, controller specifications, proportional (P), proportional plus integral (PI), proportional plus integral plus integral controller (PID), selection of controller parameters. **Unit VI: Resonant Converters:** Classification of Resonant converters-Basic resonant circuits- Series resonant circuit-parallel resonant circuits- Resonant switches. Concept of Zero voltage switching, principle of operation, analysis of M-type and L-type Buck or boost Converters. Concept of Zero current switching, principle of operation, analysis of M-type and L-type Buck or boost Converters.
Curse Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 415	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory			
Course Title	**Special Electrical Machines-II**			
Course Coordinator				
Course objectives:	To understand and analyse the behaviour and construction of various special purpose machines			
POs				

Semester	**Autumn:** Yes		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 251 EEB 301				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Special Electrical Machines
	Author	E. G. Janardanan
	Publisher	PHI publication
	Edition	3rd Ed.
2.	Title	Electric Machinery and Transformers
	Author	Bhag S. Guru, Huseyin R. Hiziroglu
	Publisher	Oxford
	Edition	2nd Ed.

Content

Unit I: Permanent Magnet Synchronous Motor (PMSM)

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

Unit II: Synchronous Reluctance Motor (SyRM)

Construction of SyRM, Working of SyRM, Phasor diagram and Torque Equation of SyRM, control of SyRM, Advantages of SyRM, Applications of SyRM

Unit III: Single phase special Electric machines

AC Series Motor – Construction, Principle of Working, EMF and Torque Equation, Phasor Diagram, Torque-Speed Characteristics, Repulsion Motor – Construction and Working, Types of Repulsion motors, Torque Equation of Repulsion Motor, Characteristics, Phasor Diagram, Hysteresis Motor, Single-phase reluctance motor, Universal Motor – Types and Construction, Principle of Operation, Speed Control of Universal Motor

	Unit IV: Servo Motors DC Servo Motors – Construction, Principle of Operation, AC Servo Motors – Construction & Working, Analysis of Two-phase AC Servo Motor, Torque-speed characteristics, Transfer Function **Unit V: Linear Electric Machines** Linear Induction motor, Linear Synchronous Motor, DC Linear Motor, Linear Reluctance and Levitation Machines.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 451	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Theory			
Course Title	**HVDC & Flexible AC Transmission Systems**			
Course Coordinator				
Course objectives:	To provide an in-depth understanding of different aspects of high voltage direct current power transmission system. To familiarize students with FACTS devices, their control techniques and applications.			
POs				

Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**1**	**0**	**4**	**36(L)+ 12(T)**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	HVDC Power Transmission Systems–Technology and System Interactions
	Author	K.R.Padiyar
	Publisher	New Age International Publishers
	Edition	3rd Ed.
2.	Title	Understanding FACTS–Concepts and Technology of Flexible AC Transmission Systems
	Author	Narain G.Honorani, Laszlo Gyugyi
	Publisher	Wiley-IEEE Press
	Edition	2nd Ed.

Content

Unit I: HVDC Transmission

Introduction, comparison of ac and HVDC, economic & terminal equipment of HVDC transmission systems: types of HVDC Links, apparatus required for HVDC System, comparison of AC & DC transmission, application of DC transmission system, planning & modern trends in D. C. transmission.

Unit II: HVDC Transmission Analysis

HVDC converters, pulse number, analysis with and without overlap, converter bridge characteristics, characteristics of 6 Pulse & 12 Pulse converters.

	Unit III: HVDC System Control Principles of dc link control, starting and stopping of dc link, power control, harmonics & filters, introduction- generation of harmonics types, power flow analysis in ac/dc systems. **Unit IV: Flexible AC Transmission Systems (FACTS)** Concept of FACTS, flow of power in an ac system, dynamic stability consideration- basic types of FACTS controllers, shunt compensator: SVC & STATCOM - objectives of shunt compensation- methods of controllable VAR generation- switching converter type VAR generators-basic operating principle and control approaches, static series compensators -GCSC,TSSC,TCSC & SSSC - objectives of series compensator, variable impedance type series compensators- basic operating control schemes- power angle characteristics, control range and VA rating- external control.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

ELECTIVE - V/ ELECTIVE - VI/ELECTIVE - VII

Course no: EEL 461	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	No	**No**	**No**		**Yes**
Type of Course	Theory				
Course Title	**Computer Applications in Power Systems**				
Course Coordinator					
Course objectives:	The course is designed to give students the required knowledge for design, analysis of electric power grids. It also deals with soft computing techniques in power systems contingency analysis for power system.				
POs					
Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL253, EEL302, EEL352.				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Computer methods in power systems analysis
	Author	Stagg and El Abiad
	Publisher	McGraw Hill ISE
	Edition	1968 and Reprints
2.	Title	Computer techniques in power system
	Author	M. A. Pai
	Publisher	Tata McGraw Hill
	Edition	3rd Edition

Content

Unit I: Network Matrix Formation

Incidence and network matrices, graphs, incidence matrices formation of network matrix, Y-bus by singular transformation, algorithms for formation of Z-bus matrix, characteristic and application of Y bus and Z bus, short circuit calculations using Z-bus.

Unit II: Representation of Transformers

Representation of On load tap changing transformer and phase shifting transformer,π representation of off-nominal tap transformers.

	Unit III: Load Flow Techniques Technique in load flow studies, sparsity technique for Y-bus and Gauss-Seidal method- comparison of GS, NR, FDC models- distribution system, introduction to real time control of power system, linear wls state estimation, D.C power flow based wls equations, SCADA transient **Unit IV: Stability Analysis** Representation of power system elements- numerical integration methods- transient stability algorithm using modified Euler's method and fourth order RungeKutta method. **Unit V: Sensitivity and Security Analysis** Sensitivity factors, line outage distribution factor, generation shift distribution factor, compensated shift factor, contingency ranking and analysis, power system security and security levels, application of soft computing techniques in power systems
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 462	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Power Quality**			
Course Coordinator				
Course objectives:	To understand the various power quality phenomenon, their origin and monitoring and mitigation methods. Understand the effects of various power quality phenomenon in various equipment.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL253, EEB 251, EEB301.				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Electrical Power Systems Quality
	Author	Dugan Roger C
	Publisher	Mc Graw Hill
	Edition	3rd Edition
2.	Title	Power Systems Quality Assessment
	Author	J.Arillaga, N.R.Watson, S.Clon
	Publisher	John Wiley
	Edition	2nd Edition
3.	Title	Understanding Power quality Problems: Voltage Sags and Interruptions
	Author	Bollen Math H.J
	Publisher	IEEE Press / Johnwiley& Sons, Inc.,Publication
	Edition	2001and Reprints

Reference Books:		
1.	Title	Power Quality
	Author	Sankaran C.
	Publisher	CRC Press
	Edition	2001 and Reprints

Content	**Unit I: Introduction** Power quality definitions, power quality – voltage quality, power quality evaluation procedure, terms and definitions general classes of power quality problems, sources of pollution, international power quality standards and regulations, transients long duration voltage variations, short-duration voltage variations voltage, imbalance waveform distortion, voltage fluctuation, power quality terms, cbema and iti curves, voltage sags, dips and interruptions sources of sag and interruptions estimating voltage sag performance. **Unit II: Fundamental Principles of Protection** Solution at the end-user level, motor starting sag, transient over voltages, sources of transient over voltages, principles of over voltage, protection devices for over voltage protection, utility capacitor-switching transients, utility system lightning protection, ferro-resonance, switching transient problems with loads computer tools for transients analysis. **Unit III: Fundamentals of Harmonics** Harmonic distortion, voltage versus current distortion, harmonics versus transients, harmonic indexes, harmonic sources from commercial loads, harmonic sources from industrial loads, effects of harmonic distortion, inter-harmonics, evaluations principles for controlling harmonics, harmonic filter design: a case study, long-duration voltage variations, principles of regulating voltage devices for voltage regulation, utility voltage regulator, application of capacitors for voltage regulation, end-users capacitors application, regulating utility voltage with distributed resources, power quality monitoring considerations, historical perspective of power quality measuring instruments, assessment of power quality measurement, data application of intelligent systems. **Unit IV: Power Quality Measurement:** Measuring and solving power quality problems, Power quality measurement device and its measurement, test: location, duration, instrument set-up and its guidelines.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **EEL 463**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	No	**No**	**No**		**Yes**
Type of Course	Theory				
Course Title	**Wind Energy Conversion Systems**				
Course Coordinator					
Course objectives:	To impart knowledge about wind energy resources and application technologies.				
POs					
Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB351				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Wind Energy conversion Systems
	Author	L.L.Freris
	Publisher	Prentice Hall
	Edition	1990 and Reprints
2.	Title	The generation of Electricity by wind power
	Author	E.W.Golding
	Publisher	Redwood burn Ltd., Trowbridge
	Edition	1976 and Reprints
3.	Title	Grid Integration of WECS
	Author	S.Heir
	Publisher	Wiley
	Edition	2014 and Reprints
Reference Books:		
1.	Title	Wind power generation
	Author	Nick Jackinse
	Publisher	IET
	Edition	2009 and Reprints
2.	Title	Analysis of electrical machinery
	Author	P. C. Krause
	Publisher	Wiley-IEEE Press
	Edition	3rd Edition

3.	Title	Variable speed generators
	Author	Ion Boldea
	Publisher	Taylor & Francis group
	Edition	2006 and Reprints
Content	**Unit I: Introduction** Brief history about wind turbine, installed wind turbine worldwide, their usage and electricity generation capability. Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient- Sabinin's theory-Aerodynamics of Wind turbine **Unit II: Wind Turbines** Construction, working, principle, different types turbine blades, their structure, horizontal and vertical wind turbine system, power in the wind, various factors affecting the power in the wind. Impact of tower height, Betz experiment, coefficient of performance, tip speed ratio, Weibull distribution function, Rayleigh probability distribution function, cumulative distribution function, average wind speed, capacity factor, wake effect. HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction. **Unit III: Fixed Speed Systems** Generating Systems- Constant speed constant frequency systems - Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator, principle and working, equivalent circuit and derivation of circuit parameters, Model of Wind Speed, Model wind turbine rotor, Drive Train model, Generator model for Steady state and Transient stability analysis. **Unit IV: Variable Speed Systems** Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator, Doubly fed induction machine (DFIG) – power injected from network in to rotor and from rotor to network, equivalent circuit, induction machine – dynamic modelling. DFIG - PMSG -Variable speed generators modeling - Variable speed variable frequency schemes. **Unit V: Grid Connected Systems**: Stand alone and Grid Connected WECS system- Grid connection Issues-Machine side & Grid side controllers-WECS in various countries.	
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: EEL 464	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Logic and Distributed Control System**			
Course Coordinator				
Course objectives:	To illustrate the concept of programmable logic controllers and distri-buted Control system. Students will have the knowledge of data acquisition System and able to write Programs using ladder diagrams, real time applications of DCS and communication standards.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	Tutorial	Practical	Credits	Teaching Hours
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Programmable Logic Controllers – Principles and Applications
	Author	John. W.Webb Ronald A Reis
	Publisher	Prentice Hall Inc., New Jersey
	Edition	Third edition
2.	Title	Distributed Control Systems
	Author	Lukcas M.P
	Publisher	Van Nostrand Reinhold Co., NewYork, 1986.
	Edition	Second
3.	Title	Elements of Process Control Applications
	Author	Deshpande P.B and Ash R.H
	Publisher	ISAPress, New York, 1995.
	Edition	Second

<table>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Process Control Instrumentation Technology,</td></tr>
<tr><td>Author</td><td>Curtis D. Johnson</td></tr>
<tr><td>Publisher</td><td>Prentice Hall of India, New Delhi, 1999</td></tr>
<tr><td>Edition</td><td>Fourth edition</td></tr>
<tr><td>Content</td><td colspan="2">Unit I:

Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control systems. alarms, interrupts. Characteristics of digital data, controller software, linearization. Digital controller modes: Error, proportional, derivative and composite controller modes.

Unit II:

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions.

Unit III:

PLC intermediate functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions.

Unit IV:

Distributed control systems (DCS): Definition, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept - case studies in DCS.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.</td></tr>
</table>

Course no: EEL 465	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	No	**No**	**No**		**Yes**
Type of Course	Theory				
Course Title	**Optimal Control**				
Course Coordinator					
Course objectives:	To apply the knowledge and tools of optimal theory to Control Systems.				
POs					
Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite Credits	NIL				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Optimal Control Theory
	Author	Donald E.Kirk
	Publisher	Prentice Hall Inc., Englewood Cliffs, New Jersey
	Edition	First
2.	Title	Gopal M
	Author	Modern Control System Theory
	Publisher	Willey Eastern Ltd., New Delhi
	Edition	1995

Content

Unit I: Introduction

Definitions of Optimal Control, Performance Index, constraints, formulation of optimal control problem, selection of a performance index Classification of optimal control problems.

Unit II: Calculus of Variations and Optimal Control

Optimum of a Function and a functional, The Basic Variational Problem, Euler Lagrange's equation for scalar case and its generalization to vector case, Lagrange Multiplier method, Fixed and free end problems, Transversality conditions, Dynamic optimization with equality and inequality constraints.

Unit III: Linear Quadratic Optimal Control Systems

Problem Formulation, Finite-Time Linear Quadratic Regulator, LQR System for General Performance Index, Analytical Solution to the Matrix Differential

	Riccati Equation, Infinite-Time LQR System, Stability Issues of Time-Invariant Regulator, Linear Quadratic Tracking System: Finite-Time Case, LQT System: Infinite-Time Case. **Unit IV: Pontryagin Minimum Principle** Pontryagin Minimum Principle, Dynamic Programming, Principle of Optimality, Optimal Control Using Dynamic Programming, Optimal Control of Discrete-Time Systems, Optimal Control of Continuous-Time Systems, The Hamilton-Jacobi-Bellman Equation, LQR System Using H-J-B Equation. **Unit V: Dynamic Programming** The principle of optimality; Dynamic programming applied to a routing problem; Functional equation of dynamic programming; Recurrence relation of dynamic programming.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.

Course no: EEL 466	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**CAD for Electric Machines**			
Course Coordinator				
Course objectives:	To learn the design of Various three-phase as well as single phase AC machines			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 251, EEB 301,				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Computer Aided Design of Electrical Machinery
	Author	Veinot Cyril G
	Publisher	MIT press London, UK
	Edition	
2.	Title	Performance Design of AC Machinery
	Author	Say M.G.
	Publisher	CBS
	Edition	3rd Edition
3.	Title	Design of Electrical Machines
	Author	Deshpandey M.V.
	Publisher	PHI Learning
	Edition	

Content	**Unit – I Design of Synchronous Machine** Features of construction of low speed and medium speed machine, design consideration of turbo and water wheel alternators, output co-efficient and choice of main dimensions, design of stator winding, and design of field systems, regulation, losses and efficiency, cooling systems. **Unit – II Design of 3-phase induction motor** Design consideration of ac motors, calculation of main dimensions, design of stator winding, effect of air-gap on performance. Rotor Design: Design of slip ring and squirrel cage rotor, components of leakage reactance, calculation of leakage reactance and its effect on its performance **Unit – III Design of Single phase induction motor** Calculation of main dimensions of stator, complete design of stator with its punching details, design of main and auxiliary winding, design of rotor, performance calculation of designed rotor and performance by equivalent circuit approach. **Unit – IV Computer Aided Design** Philosophy and economics of computer aided design, advantages, limitations, Analysis and Synthesis Methods, and Selection of input data and design variables, flow-charts for design of induction motor and synchronous machines, Optimization of design constrained and unconstrained optimization problem.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 467	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	No	**No**	**No**		**Yes**
Type of Course	Theory				
Course Title	**Intelligent Control**				
Course Coordinator					
Course objectives:	To introduce the basic concepts of intelligent controllers and its applications in Control.				
POs					
Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 252				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Introduction to Artificial Neural Systems
	Author	Jacek.M.Zurada
	Publisher	Jaico Publishing House
	Edition	1999 and Reprints
2.	Title	Neural Networks And Fuzzy Systems
	Author	Kasko B
	Publisher	Prentice-Hall of India Pvt. Ltd.
	Edition	1994 and Reprints
3.	Title	Fuzzy sets, uncertainty and Information
	Author	Klir G.J. & Folger T.A.
	Publisher	Prentice-Hall ofIndiaPvt. Ltd.
	Edition	1993 and Reprints
Reference Books:		
1.	Title	Genetic algorithms in Search, Optimization and Machinelearning
	Author	Goldberg D.E.
	Publisher	Addison Wesley
	Edition	1989 and Reprints

Content	**Unit-I: I INTRODUCTION** Approaches to intelligent control, Architecture for intelligent control, Symbolic reasoning System, rule-based systems, the AI approach, Knowledge representation, Expert systems. **Unit-II: ARTIFICIAL NEURAL NETWORKS** Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron, Learning and Training the neural network, Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations, Hopfield network, Self-organizing network and Recurrent network, Neural Network based controller **Unit-III: GENETIC ALGORITHM** Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems. **Unit IV**: **FUZZY LOGIC SYSTEM** Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modelling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modelling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system. **Unit V**: **APPLICATIONS** GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 468	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)		DE (Y/N)
	No	**No**	**No**		**Yes**
Type of Course	Theory				
Course Title	**System Identification and Adaptive Control**				
Course Coordinator					
Course objectives:	To learn the techniques of system identification and to be able to design adaptive control for systems.				
POs					
Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 252				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	System Identification: Theory for the user
	Author	Ljung .L
	Publisher	Prentice Hall, Englewood Cliffs
	Edition	2nd Edition
2.	Title	Adaptive Control
	Author	Astrom .K
	Publisher	Pearson Education Asia Pte Ltd.
	Edition	2ndEdition

Content

Unit I: System Identification

Introduction, dynamic systems, models, system identification procedure. Simulation and Prediction. Non-parametric time and frequency domain methods. Linear dynamic system Identification: Overview, excitation signals, general model structure, time series models.

Unit II: Parameter Estimation

Parameter estimation methods, minimizing prediction errors, linear regressions and Least squares method, Instrumental – variable method, prediction error method. Recursive algorithms.

Unit III: Adaptive Control

Properties of Adaptive systems, Close loop and open loop adaptive control. Self-tuning controller. Auto tuning for PID controllers: Relay feedback. Pole

	placement control, minimum variance control, generalized predictive control, Pole placement design. **Unit IV: Industrial Applications** Industrial Adaptive control, Process control, Automobile control, Ship steering, Ultra-filtration, Future trends.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 469	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	No	**No**	**No**		**Yes**
Type of Course	Theory				
Course Title	**Power Electronics For Renewable Energy Systems**				
Course Coordinator					
Course objectives:	To provide knowledge about various renewable energy technologies, their potential and applications				
POs					
Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 351				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Power Electronics Hand book
	Author	Rashid .M. H
	Publisher	Academic press
	Edition	2001 and Reprints
2.	Title	Non-conventional energy sources
	Author	Rai. G.D
	Publisher	Khanna publishes
	Edition	1993 and Reprints
3.	Title	Solar energy utilization
	Author	Rai. G.D
	Publisher	Khanna publishes
	Edition	1993 and Reprints
Reference Books:		
1.	Title	Wind energy system
	Author	Gray, L. Johnson
	Publisher	prentice hall linc
	Edition	1995 and Reprints

2.	Title	Non-conventional Energy sources
	Author	B.H.Khan
	Publisher	Tata McGraw-hill Publishing Company, New Delhi
	Edition	2nd Edition
Content	**Unit I: Introduction :** Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems. **Unit II: Electrical Machines for Renewable Energy Conversion :**Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG. **Unit III : Power Converters** : **Solar:** Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing. **Wind:** three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters. **Unit IV: Analysis of Wind and PV Systems** : Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS Grid Integrated solar system **Unit V: Hybrid Renewable Energy Systems** : Need for Hybrid Systems-Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).	
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: EEL 470	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Electrical Machine Modeling and Analysis**			
Course Coordinator				
Course objectives:	The objective of this course is to learn Modeling of DC and AC machines, to learn reference frame theory and its usage in machine analysis			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEB 251, EEB 301.				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Electric Motor Drives – Modeling, Analysis & Control
	Author	R. Krishnan
	Publisher	Pearson Publications
	Edition	1st edition, 2002
2.	Title	Analysis of Electrical Machinery and Drive systems
	Author	P. C. Krause, Oleg Wasynczuk, Scott D. Sudhoff
	Publisher	IEEE Press
	Edition	2ndEdition
3.	Title	Electric Machinery
	Author	Fitzerald& Kingsley
	Publisher	McGraw-Hill Education
	Edition	7th Edition

<table>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Dynamic simulations of Electric Machinery using MATLAB/ Simulink</td></tr>
<tr><td>Author</td><td>Chee Mun Ong</td></tr>
<tr><td>Publisher</td><td>Prentice Hall</td></tr>
<tr><td>Edition</td><td></td></tr>
<tr><td rowspan="4">2.</td><td>Title</td><td>The General Theory of electrical machines</td></tr>
<tr><td>Author</td><td>B P Adkins</td></tr>
<tr><td>Publisher</td><td>Pergamon press London</td></tr>
<tr><td>Edition</td><td></td></tr>
<tr><td rowspan="4">3.</td><td>Title</td><td>Generalized Theory of Electrical Machines</td></tr>
<tr><td>Author</td><td>P. S. Bhimbhra</td></tr>
<tr><td>Publisher</td><td>Khanna publications</td></tr>
<tr><td>Edition</td><td>5th edition 1995.</td></tr>
<tr><td>Content</td><td colspan="2">Unit I: Basic concepts of Modeling

Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron’s primitive Machine – voltage, current and Torque equations.

Unit II: DC Machine Modeling:

Mathematical model of separately excited D.C motor – Steady State analysis- Transient State analysis- Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor, Mathematical model of D.C series motor, Shunt motor-linearization techniques for small perturbations.

Unit III: Reference frame Theory

Real time model of a two phase induction machine – Transformation to obtain constant matrices – three phase to two phase transformation – Power equivalence.

Unit IV: Dynamic modeling of three phase Induction Machine

Generalized model in arbitrary reference frame- Electromagnetic torque derivation of commonly used Induction Machine models, Stator reference frame model, Rotor reference frame model, Synchronously rotating reference model equations in flux linkages per unit model.

Unit V: Small Signal Modeling of Three Phase Induction Machine

Small Signal equations of Induction Machine- derivation – DQ flux linkage model derivation. Control Principle of Induction machine.

Unit VI: Symmetrical and Unsymmetrical 2 phase Induction Machine

Analysis of symmetrical 2-phase induction machine, voltage and torque equations for unsymmetrical 2 phase induction machine, voltage and torque equations in stationary reference frame variables for unsymmetrical 2 phase induction machine. Analysis of steady state operation of unsymmetrical 2 phase induction machine. Single phase induction motor- Cross field theory of single phase induction machine.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%</td></tr>
</table>

Course no: EEL 471	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**BASICS OF ROBOTICS**			
Course Coordinator				
Course objectives:	This course provides an overview of robot mechanisms, dynamics, and intelligent controls. Student learns about robot drives and transmission system, programming etc.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Robotics Technology and Flexible Automation
	Author	Deb S. R. and Deb S
	Publisher	Tata McGraw Hill Education Pvt. Ltd
	Edition	Second
2.	Title	Introduction to Robotics
	Author	John J.Craig
	Publisher	PEARSON
	Edition	Second
3.	Title	Industrial Robots - Technology, Programming and Applications
	Author	Mikell P. Groover et. Al.
	Publisher	McGraw Hill, New York
	Edition	Third

Reference Books:

1.	Title	Robotics Engineering – An Integrated Approach
	Author	Richard D Klafter, Thomas A Chmielewski, Michael Negin
	Publisher	Eastern Economy Edition, Prentice Hall of India Pvt. Ltd
	Edition	Third
2.	Title	Robotics : Control, Sensing, Vision and Intelligence
	Author	Fu K S, Gonzalez R C, Lee C.S.G
	Publisher	McGraw Hill

	Edition	Second
Content	**Unit I: Introduction** Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots. **Unit II: Robot Kinematics and Dynamics** Positions, Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations - Transformation Arithmetic - D-H Representation - Forward and inverse Kinematics Of Six Degree of Freedom Robot Arm – Robot Arm dynamics **Unit III: Robot Drives and Power Transmission Systems** Robot drive mechanisms, hydraulic – electric – servomotor- stepper motor - pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws. **Unit IV: Manipulators** Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and Pneumatic manipulators. **Unit V: Robot End Effectors** Classification of End effectors – Tools as end effectors. Drive system for grippers-Mechanical- adhesive-vacuum-magnetic-grippers. Hooks & Scoops. Gripper force analysis and gripper design. Active and passive grippers. **Unit VI: Path Planning & Programming** Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion – straight line motion-Robot languages, computer control and Robot software.	
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.	

Course no: EEL 472	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Inverters and Resonant Pulse Converters**			
Course Coordinator				
Course objectives:	This course provides a strong foundation on inverters and resonant pulse converters/inverters and their control in modern Power Electronic Systems. Understand the working principle of an inverter and its classification. Understand different inverter control techniques along with their advantages and drawbacks. Understand and analyze different types of PWM along with its application and importance.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Power Electronics - Circuits, Devices and Applications
	Author	M. H. Rashid
	Publisher	P.H.I Private Ltd.
	Edition	Second Edition
2.	Title	Power Electronics- Converters, Applications and Design
	Author	N. Mohan et.al.
	Publisher	John Wiley & Sons (Asia) Private Ltd.,Singapore, 1996.
	Edition	Fourth
3.	Title	Modern Power Electronics and AC Drives
	Author	Bimal K Bose
	Publisher	PHI
	Edition	Second

Reference Books:

1.	Title	Fundamental of Power Electronics
	Author	R W Erickson and D Makgimovic
	Publisher	Springer,
	Edition	2nd Edition
2.	Title	Elements of Power Electronics
	Author	P. T. Krein
	Publisher	OUP
	Edition	First

3.	Title	Power Electronics - Principles and Applications
	Author	Joseph Vithayathil,
	Publisher	McGraw Hill Inc., New York, 1995.
	Edition	Second
4.	Title	Power Electronics
	Author	Vedam Subrahmanyam, "
	Publisher	New Age International (P) Limited, New Delhi, 1996.
	Edition	Third
5.	Title	Power Electronic Converters,
	Author	R. Bausiere & G. Seguier,
	Publisher	Springer- Verlag, 1987.
	Edition	Second
Content	**Unit I : Inverters** Single and three phase bridge inverters with R, RL and RLE loads, Voltage control, Harmonic reduction, square wave inverters, PWM inverters, modulation techniques, SPWM, Selective Harmonic Elimination PWM and delta modulation. Blanking time. Harmonic spectrum and comparison among different PWM techniques. Boost inverter. Current source inverters, Inverter circuit design. **Unit II: Resonant Pulse Converters** Series and parallel resonant inverters - zero current and Zero voltage switching resonant converters, frequency response. Two quadrant zero voltage switching resonant converters, Resonant dc link inverters, design and analysis, soft switching, load dependent problem. **Unit III: Multi level inverters** types, operations & features**.** Modulation Techniques: Space vector based, Voltage level based methods. **Unit IV: Dynamics of above converters** Modeling and control of inverters, resonant pulse converters, Application of microcomputer. **Unit V: Design** Method for control design: averaging method, small signal analysis, linearization, challenge. Geometric control: hysteresis control, boundary control. Triggering circuits. Design of inverters, resonant pulse converters. PLL / Micro computer based inverters.	
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.	

Course no: EEL 473	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Cycloconverters and AC voltage controllers**			
Course Coordinator				
Course objectives:	To provide a strong foundation on ac to ac converters and their design in modern Power Electronic Systems. Students will be able to understand the working principle of cycloconverters and ac voltage controllers along with its classification, understand and implement different control techniques along with their advantages and drawbacks, understand and analyze matrix converter along with its application and importance.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Power Electronics - Circuits, Devices and Applications
	Author	M. H. Rashid
	Publisher	P.H.I Private Ltd.
	Edition	Second Edition
2.	Title	Power Electronics- Converters, Applications and Design
	Author	N. Mohan et.al.
	Publisher	John Wiley & Sons (Asia) Private Ltd.,Singapore, 1996.
	Edition	Fourth
3.	Title	Modern Power Electronics and AC Drives
	Author	Bimal K Bose
	Publisher	PHI
	Edition	Third

Reference Books:		
1.	Title	Fundamental of Power Electronics
	Author	R W Erickson and D Makgimovic
	Publisher	Springer,
	Edition	2nd Edition
2.	Title	Elements of Power Electronics
	Author	P. T. Krein
	Publisher	OUP
	Edition	Second
3.	Title	Power Electronics - Principles and Applications
	Author	Joseph Vithayathil,
	Publisher	McGraw Hill Inc., New York, 1995.
	Edition	First
4.	Title	Power Electronics
	Author	Vedam Subrahmanyam, "
	Publisher	New Age International (P) Limited, New Delhi, 1996.
	Edition	Third
5.	Title	Power Electronic Converters,
	Author	R. Bausiere & G. Seguier,
	Publisher	Springer- Verlag, 1987.
	Edition	First
Content	**Unit I : Cycloconverters** Single phase and three phase cycloconverters with R, RL and RLE loads – Voltage control , Harmonic analysis, operation waveforms designs. Effects of the source and load impedances. **Unit II : AC Voltage Controllers:** Single phase and three phase ac voltage controllers with R, RL and RLE loads, Voltage control, Harmonic analysis, operation waveforms PWM, Matrix converter, design. **Unit III: Dynamics of Above Converters:** Modelling and control of cyclo-converters, ac voltage controllers. Applications. Different modulation techniques used. **Unit IV: Design**: Method for control design: averaging method, small signal analysis, linearization, challenge. Geometric control: hysteresis control, boundary control. Triggering circuit. Design of cyclo-converters, ac voltage controllers circuits. PLL / Micro computer based cycloconverters, AC voltage controllers.	
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.	

Course no: EEL 474	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Solid State Power Controllers**			
Course Coordinator				
Course objectives:	Operation, control and application of different FACTS devices and custom power devices. The students should be able to understand the importance of controllable parameters and benefits of FACTS controllers, know the significance of shunt, series compensation and role of FACTS devices on system control, analyze the functional operation and control of TSC, TCR and FC-TCR, describe the principles, operation and control of UPFC and IPFC.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:

1.	Title	Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems",
	Author	Narain G. Hingorani and Laszlo Gyugyi, "
	Publisher	Standard Publishers, New Delhi, 2001.
	Edition	Second
2.	Title	Thyristor Based FACTS Controller for ElectricalTransmission Systems
	Author	R. Mohan Mathur and Rajiv K. Varma
	Publisher	Wiley Interscience Publications, 2002
	Edition	Second
3.	Title	Flexible ac transmission systems (FACTS)
	Author	Song, Y.H. and Allan T. John,
	Publisher	Institution ofElectrical Engineers Press, London, 1999.
	Edition	Second

Content	**Unit I: Review of Concepts** Electrical Transmission Network – Necessity – Power Flow in AC System – Power Flow and Dynamic stability considerations of a transmission interconnection – relative importance of controllable parameter – opportunities for FACTS – possible benefits for FACTS Technology – FACTS Controllers – Types, brief description and definitions. Power Quality problems in distribution systems, harmonics, harmonics creating loads, modeling, harmonic propagation, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, filters, passive filters, Active filters, shunt, series hybrid filters, voltage sags & swells, voltage flicker. Mitigation of power quality problems using power electronic conditioners. **Unit II: Static VAR Compensation** Need for compensation – introduction to shunt and series compensation – objectives of shunt and series compensation – configuration and operating characteristics – Thyristor Controlled Reactor (TCR) – Thyristor Switched Capacitor (TSC) – Fixed Capacitor - Thyristor Controlled Reactor (FC – TCR) – Comparison of TCR, TSC and FC –TCR. **Unit III: Series Compensators** Commutation in DC motors, difference between mechanical and electronic Commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square – Wave permanent magnet brushless motor drives, torque and EMF equation, torque – speed characteristics of Permanent Magnet Brush less DC Motors – controllers PM DC Motor. **Unit IV: Static Voltage and Phase Angle Regulators** Objectives of voltage and phase angle regulators – approaches to Thyristor – Controlled Voltage and Phase Angle Regulator. **Unit V: Emerging Facts Controllers** Construction and principle of operation of Linear Induction Motor - Universal Motor - Hybrid Motor – Linear Synchronous motor – Applications. **Unit VI: UPFC and IPFC** The Unified Power Flow Controller - **:** Principles of operation and characteristics, operation, comparison with other FACTS devices - control of P and Q - dynamic performance - Special Purpose FACTS Controllers - Interline Power Flow Controller - operation and control. independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.

Course no: EEL 475	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**Power System Stability & Control**			
Course Coordinator				
Course objectives:	To impart knowledge to the students about real time security monitoring and control (computer and operator) of power system for economic and reliable operation. The student will be able to understand about supervisory control and data acquisition, real time software and state estimation and security management			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers	EEL 253 EEL 302 EEL 352				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Power system stability and control
	Author	P. Kundur,
	Publisher	Tata- McGraw Hill.
	Edition	Second Edition
2.	Title	Power System Stability
	Author	Kimbark
	Publisher	Vol-I,II,III, Wiley India
	Edition	First
3.	Title	Topics on small signal stability analysis
	Author	K. R. Padiyar, M. A. Pai, K. Sen gupta
	Publisher	Tata-McGraw Hill
	Edition	First
Reference Books:		
1.	Title	Power system stability
	Author	M. A. Pai and Peter W. Sauer
	Publisher	Pearson Education.
	Edition	Third

2.	Title	Power system dynamics
	Author	K. R. Padiyar
	Publisher	BSP publications
	Edition	Second
Content	**Unit I: Introduction to Power System Stability Problems** Definition of stability, classification of stability, rotor angle stability, frequency stability, voltage stability, mid-term and long term stability, classical representation of synchronous machine in a single machine infinite bus system (SMIB), equal area criterion to asses stability of a SMIB system, limitations of classical model of synchronous machines. **Unit II: Modeling of Power System Components for Stability Analysis** Synchronous machine modeling: sub-transient model, two axis model, one axis (flux decay) model, classical model, excitation systems modeling: DC excitation, AC excitation and static excitation, prime mover and energy supply systems modeling, transmission line modeling, load modeling, methods of representing synchronous machines in stability analysis. **Unit III: Small Signal Stability** Fundamental concepts, state space representation, modal analysis: eigen properties, participation factors, stability assessment, effects of excitation system on stability, power system stabilizer and its design, angle and voltage stability of multi-machine power systems and phenomenon of sub synchronous resonance. **Unit IV: Transient Stability** Fundamentals of transient stability, numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response, analysis of unbalanced faults, direct method of transient stability, transient energy function method, Methods of improving transient stability. **Unit V: Voltage Stability** Classification of voltage stability, modeling requirements, voltage stability analysis: static and dynamic, sensitivity analysis, modal analysis, voltage collapse, prevention of voltage collapse.	
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.	

Course no: EEL 476	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**Yes**
Type of Course	Theory			
Course Title	**EHV AC/DC Transmission**			
Course Coordinator				
Course objectives:	To expose students to the advanced concepts in EHV AC/ DC transmission systems, their analysis and control. Upon completion of this course, students will be able to critically evaluate AC and DC transmission systems with all aspects, evaluate and analyze modern and classical EHV AC/ DC systems.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	**3**	**0**	**0**	**3**	**36(L)**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Direct current Transmission
	Author	E W Kimbark
	Publisher	Vol. I, Wiley Interscience
	Edition	First
2.	Title	High Voltage Direct Current Transmission
	Author	J. Arrillaga
	Publisher	Peter. Peregrines
	Edition	Second
3.	Title	HVDC Power Transmission Systems
	Author	KR Padiyar
	Publisher	New Age International (P) Ltd., Publishers,
	Edition	3rd Edition.
Reference Books:		
1.	Title	EHV AC Transmission engineering
	Author	Begamudre
	Publisher	Willey Easter Ltd.
	Edition	2nd Ed.
2.	Title	EHV transmission reference book
	Author	Edison Electric Institute

	Publisher	GE Co.
	Edition	First
Content	**Unit I: HVDC Power Transmission** Comparison of AC and DC Transmission, Application of DC transmission, types of DC links, recent trends. **Unit II: Analysis of HVDC Converters** Three phase and six phase converter circuits, voltage current waveforms and ratios, apparent power factor and utilization factor, delay angle, transformer rating pulse number, commutation group, Graetz Circuit, Overlap, advance angle and extinction angle, analysis of two and three valve conduction mode, equivalent commutation resistance, reactive power requirements of HVDC converters. **Unit III: Control of HVDC Converters** Power flow in HVDC transmission system, constant ignition angle control, constant extinction angle control, constant current control, actual control characteristics. **Unit IV: EHV AC Transmission Lines** Introduction, calculation of line and ground parameters, bundled conductors, bundle spacing and bundle radius, sequence inductance and capacitance parameters, line parameters for modes of propagation, digitalization procedure, interpretation of eigen vectors, Resistance and Inductance of ground return. **Unit V: Voltage Gradient of Conductors** Field of a point charge and its properties, field of a sphere gap, method of image charges, field of line charges and their properties, corona inception gradient, charge potential relations for multi-conductor lines, maximum charge condition on a three phase line. Surface voltage gradients on conductors: single conductor, 2 conductor and multi conductor bundle, maximum surface voltage gradient, Mangoldt (Markt-Mengle) formula, design of cylindrical cage for corona experiments, single conductor concentric as well with eccentricity inside a cylinder.	
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.	