SYLLABUS

(With effect from 2018-19 Academic year)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2018–19)

V & VI Semester
Bachelor Degree
in
Electrical & Electronics and Engineering

Out Come Based Education
with
Choice Based Credit System

P.E.S. College of Engineering,

Mandya - 571 401, Karnataka

(An Autonomous Institution Affiliated to VTU, Belagavi)
Grant -in- Aid Institution
(Government of Karnataka)
Accredited by NBA, New Delhi
Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running Eight undergraduate and Eight Postgraduate programs. It consists of Six M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has recently become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our Higher Educational Institution has adopted the CBCS based semester structure with OBE scheme and grading system.

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a 'cafeteria' type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of the academic year 2015-16. Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project and Industrial visit & Interaction are included in all undergraduate programs.

Dr. Umesh D R
Deputy Dean (Academic)
Associate Professor,
Dept. of CS &Engg

Dr. Nagarathna
Dean (Academic)
Professor
Dept. of CS &Engg

P.E.S.COLLEGE OF ENGINEERING, MANDYA-571401
(An Autonomous Institution under VTU, Belgaum)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

- **Vision :**

  The department of E & E would Endeavour to create a pool of Engineers who would be **technically competent, ethically strong** also fulfill their obligation in terms of **social responsibility**

- **Mission:**

- Adopt the best pedagogical methods and provide the best facility, infrastructure and an ambience conducive to imbibe technical knowledge and practicing ethics.
- Group and individual exercises to inculcate habit of analytical and strategic thinking to help the students to develop creative thinking and in still team skills.
- MOUs and Sponsored projects with industry and R & D organizations for Collaborative learning
- Enabling and encouraging students for continuing Education and moulding them for life-long learning process

A. **Program Educational Objectives (PEO)**

PEO1: Excel in professional career and/or higher education by acquiring knowledge in mathematical, computing and engineering principles

PEO 1.1.Progressing professional career
PEO 1.2.Higher education

PEO2: Analyze real life problems, design computing systems appropriate to its solutions that are technically sound, economically feasible and socially acceptable

PEO 2.1.Analyzereal life problem
PEO 2.2.Design and develop economically feasible and socially acceptable Computing Solutions

PEO3: Exhibit professionalism, ethical attitude, communications kills, team work in their profession and adapt to current trends by engaging in lifelong learning.

PEO 3.1.Professional conduct and interpersonal skills
PEO 3.2.Adapting to current trends in technology

B. Programme Outcomes (PO)

PO-1: Graduates will apply the knowledge of mathematics, Physics, chemistry and allied engineering subjects to solve problems in Electrical and Electronics Engineering.

PO-2: Graduates will Identify, formulate and solve Electrical and Electronics Engineering problems.

PO-3: Graduates will design Electrical and Electronics systems meeting the given specifications for different problems taking safety and precautions into consideration.

PO-4: Graduates will design, conduct experiments, analyze and interpret data

PO-5: Graduates will use modern software tools to model and analyze problems, keeping in view their limitations.

PO-6: Graduates will understand the impact of local and global issues / happenings on Electrical Engineers.

PO-7: Graduates will provide sustainable solutions for problems related to Electrical and Electronics Engineering and also will understand their impact on environment.

PO-8: Graduates will have knowledge of professional ethics and code of conduct as applied to Electrical engineers.

PO-9: Graduates will work effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.

PO-10: Graduates will communicate effectively in both verbal and written form.

PO-11: Graduates will have the ability for self- education and lifelong learning.

PO-12: Graduates will plan, execute and complete projects

P.E.S COLLEGE OF ENGINEERING, MANDYA
(An Autonomous Institution under VTU, Belgaum)
SCHEME OF TEACHING AND EXAMINATION

V Semester B.E Electrical & Electronics Engineering

Sl. No.	Course Code	Course Title	Teaching Dept.	Hours/ Week L:T:P	Credits	Examination Marks			Exam Duration in hours
						CIE	SEE	Total	
1.	P17EE51	Power Electronics	E & E E	4:0:0:4	4	50	50	100	3
2.	P17EE52	Linear Control Systems	E & E E	3:2:0:5	4	50	50	100	3
3.	P17EE53	Electrical Machines-II	E & E E	4:0:0:4	4	50	50	100	3
4.	P17EE54	Foundation Course-I Power Transmission & Distribution	E & E E	4:0:0:4	4	50	50	100	3
5.	P17EE55	Foundation Elective-I	E & E E	2:2:0:4	3	50	50	100	3
6.	P17EE56	Elective-I	E & E E	2:2:0:4	3	50	50	100	3
7.	P17EEL57	Power Electronics Lab	E & E E	0:0:3:3	1.5	50	50	100	3
8.	P17EEL58	Electrical Machines Lab - II	E & E E	0:0:3:3	1.5	50	50	100	3
9.	P17EE59	Industry Visit & Interaction	E & E E	0:0:2:2	1	50	--	50	
10.	P17HU510	Aptitude and Reasoning Development –Advanced. (ARDA)	HS&M	2:0:0:2	1	50	50	100	
Total					27	500	450	950	

List of Electives					
Foundation Elective			Elective - 1		
Sl. No	Course Code	Course title	Sl. No.	Course Code	Course title
1.	P17EE551	Operational Amplifiers & Linear Integrated Circuits	1.	P17EE561	Utilization of Electrical Power
2.	P17EE552	Fuzzy Logic	2.	P17EE562	Software Engineering
3.	P17EE553	Operation Research	3.	P17EE563	Electrical Material Science
4.	P17EE554	Management & Entrepreneurship	4.	P17EE564	Micro Electromechanical System

VI Semester B.E Electrical & Electronics Engineering

Sl. No.	Course Code	Course Title	Teaching Dept.	Hours/ Week L:T:P	Credits	Examination Marks			Exam Duration in hours
						CIE	SEE	Total	
1.	P17EE61	Power System Analysis and Stability	E & E E	4:0:0:4	4	50	50	100	3
2.	P17EE62	Digital Signal Processing	E & E E	3:2:0:5	4	50	50	100	3
3.	P17EE63	Electrical Machine Design	E & E E	3:2:0:5	4	50	50	100	3
4.	P17EE64	Foundation Course-II Switchgear & Protection	E & E E	4:0:0:4	4	50	50	100	3
5.	P17EE65	Elective-II	E & E E	2:2:0:4	3	50	50	100	3
6.	P17EE66	Elective-III	E & E E	2:2:0:4	3	50	50	100	3
7.	P17EEL67	Control System & DSP Lab	E & E E	0:0:3:3	1.5	50	50	100	3
8.	P17EEL68	Electrical Auto CAD Lab	E & E E	0:0:3:3	1.5	50	50	100	3
9.	P17EE69	Mini Project	E & E E	0:0:2:2	1	50	--	50	
10.	P17HU610	Aptitude and Reasoning Development – EXPERT (ARDE)	HS&M	2:0:0:2	1	50	50	100	
Total					27	500	450	950	

List of Electives					
Elective-II			Elective - III		
Sl. No	Course Code	Course title	Sl. No.	Course Code	Course title
1.	P17EE651	Modern Control Theory	1.	P17EE661	Programmable Logic Controller & SCADA
2.	P17EE652	Advanced Power Electronics	2.	P17EE662	Illumination Engineering
3.	P17EE653	Embedded Systems	3.	P17EE663	Design of Control System
4.	P17EE654	Operating System	4.	P17EE664	Switched Mode Power Supply

V SEMESTER

Course Title: Power Electronics			
Course Code: P17EE51	**Semester: V**	**L-T-P-H: 4-0-0-4**	**Credits - 4**
Contact period : Lecture: 52Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to:

1. To get overview of various types of power semiconductor devices, their control and switching characteristics.
2. To understand the principle of operation, characteristics and performance parameters of controlled rectifiers and inverters.
3. To get overview of various types of commutations and understand the various types of controllers.
4. To study the operation and basic topologies of Ac-dc converters, Dc-Ac inverters, Dc-Dc Choppers and Ac-Ac voltage controllers.
5. Developing the students with mathematical, scientific and computational skills to design, analyze and solve problems related to various types of power converter systems.

Course Content

Unit – I

Power Semiconductor Devices: Introduction, Applications of Power Electronics, Power semiconductor devices, Control characteristics, Types of power electronics circuits.

Power Transistors: Introduction, Power bipolar junction transistors Power MOSFETs, IGBTs and their Switching characteristics.

Self Study: Peripheral effects and their remedies **10 hrs**

Unit – II

Power Transistors: Base-drive control, Gate drive, di/dt and dv/dt limitations, Isolation of gate and base drives

Thyristors: Introduction, Construction and Static V-I characteristics ; Two transistor model of thyristor, Turn-on and Turn-off, di/dt and dv/dt protection, Thyristor types, Series and parallel operation of thyristors.

Self Study: Thyristor firing circuits **10 hrs**

Unit – III

Thyristor Commutation Techniques: Introduction, Commutation - natural, forced, impulse, resonant pulse & complementary

AC Voltage Controllers: Introduction, Principle of ON-OFF control, Principle of phase control - single phase and bi-directional controller with resistive load and Inductive load.

Self Study: Self Commutation **10 hrs**

Unit – IV

DC Choppers: Introduction, Principle of step-down and step-up choppers, Step-down chopper with RL load and their analysis, Chopper classifications and their operations.

Inverters: Introduction, Principle of operation, Single phase half &full bridge inverters, Analysis of single phase inverters, voltage control of single phase inverters, 3phase voltage source inverters.

Self Study: Performance parameters **11 hrs**

Unit –V

Controlled Rectifiers: Introduction, Principle and operation of single phase controlled converter - half wave, Semi-converter, full wave, 3 phase half wave & full wave converters.(excluding problems on three phase converters).

Self Study: Dual converters **11hrs**

TEXT BOOKS:-

1. Rashid, Power Electronics , Prentice Hall India Pvt Ltd, 4th edition,2014.
2. P S Bhimbra, "Power Electronics", Khanna publishers,3rd edition,1999

REFERENCE BOOKS:-

1. G.K. Dubey, et.al "Thyristorised Power Controllers", Wiley Eastern edition,4th edition.-
2. M.D. Singh &Kanchandoni,"Power Electronics", TMH Publishers Company, reprint 2014.

Course Outcomes

After learning all the units of the course, the student is able to:

CO1: Select various types of power semiconductor devices to develop different types of Power converter systems based on control characteristics.

CO2: Analyze the different base drive control methodologies and various types of Protection Circuits needed for converter system.

CO3: Distinguish between various types of power converter systems, compare and analyze them.

CO4: Understand and analyze the various types of commutation circuits and implement them.

CO5: Design and develop different types of converter and inverter system.

Course assessment Matrix(CAM)														
Course Outcome - CO			Program Outcome (ABET/NBA-(3a-k))											
			a	b	c	d	e	f	g	h	i	j	k	l
1	To get overview of various types of power semiconductor devices, their control and switching characteristics.	L1	1	2	3	_	1	_	_	_		_	-	1
2	To understand the principle of operation, characteristics and performance parameters of controlled rectifiers and inverters.	L2	2	1	3	_	1		_	_	_	_	_	2
3	To study the operation and basic topologies of Thyristor commutation techniques regulators, inverters dc-ac and Ac-ac voltage controllers.	L3	2	2	3	_	1	_	_	_		_	_	2
4	To study the operation basic topologies of dc-dc switching	L4	3	2	3	_	3	_	_	_		_	_	3
5	To study the operation and basic topologies of dc-ac converter.	L5	3	3	2		3	_	_	_		_	_	3
	1-Low, 2-Moderate, 3-High													

Course Articulation Matrix (CAM)														
Course Outcome – CO			Program Outcome (ABET/NBA-(3a-k))											
			a	b	c	d	e	f	g	h	i	j	k	l
1	To get overview of various types of power semiconductor devices, their control and switching characteristics.	L1	L	M	H	_	L	_	_	_		_	-	L
2	To study the operation, characteristics and performance parameters of controlled rectifiers and inverters.	L2	M	L	H	_	L		_	_	_	_	_	M
3	To study the operation and basic topologies of Thyristor commutation techniques regulators, inverters dc-ac and Ac-ac voltage controllers.	L3	M	M	H	_	L	_	_	_		_	_	M
4	To study the operation basic topologies of dc-dc switching	L4	H	M	H	_	H	_	_	_		_	_	H
5	To study the operation and basic topologies of dc-ac converter.	L5	H	H	M	_	H	_	_	_	_	_	_	H
	L-Low, M-Moderate, H-High													

Course Title: LINEAR CONTROL SYSTEMS			
Course Code:P17EE52	**Semester: V**	**L-T-P-H(Hrs): 3-1-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to:

1. Derive the transfer function and mathematical model for a variety of electrical, mechanical and electromechanical systems.
2. Find the time domain specifications and time response for a given system for various inputs.
3. Analyze the performance and stability of a given system through root locus, Polar plots, Nyquist plots and Bode plots.

Course Content

Unit – I

Fundamental Concepts of Control Systems: Basic definitions of control systems, Classification, Open loop and Closed loop systems, types of feedback, effects of feedback on overall gain, stability, sensitivity and external disturbance or noise, Servomechanism.

Modeling of Systems: Differential equations of physical systems, Determinations of transfer function models for Electrical, Mechanical, Electromechanical systems and Analogous systems.

Block diagrams and Signal flow graphs: Transfer functions, Block diagram algebra, Signal Flow graphs (State variable formulation excluded).

Self study: Write the transfer function models for different systems using MATLAB. **10 hrs**

Unit – II

Transient and Steady State Response Analyses of Feedback Control Systems: Standard test signals, Unit step response of First and second order systems.

Time response specifications: Transient response specifications of second order systems, steady state errors and static error constants. Effect of adding poles and zeros to open loop and closed loop transfer function, concepts of dominant poles of transfer function.

Self study: By using MATLAB software, determine the transient response specifications of second order systems **10 hrs**

UNIT-III

Stability analysis: Concepts of stability, Asymptotic stability, impulse response stability, BIBO stability, necessary conditions for stability, Routh-Hurwitz stability criterion, Routh's tabulation, special cases when Routh's tabulation terminates prematurely.

Root–Locus Techniques: The root locus concepts, summary of general rules for constructing Root Loci, Stability analysis, determination of transient performance specifications and the value of K for specified ξ , gain margin, Effects of adding poles and zeros to the product of G(S)H(S) on shape of the Root locus, Root contour.

Self study: Draw the Root Locus diagrams and analyze using MATLAB software. **10 hrs**

Unit – IV

Frequency-Response Analysis: Introduction, advantages and limitations of frequency domain methods, correlation between time response and frequency response, frequency response specifications- resonant peak, resonant frequency and bandwidth.

Graphical Analysis of Frequency –Response:

(i) Bode Plots:

Gain margin, Phase Margin and stability, determination of K for different Gain margin and Phase Margin, determination of transfer function from Bode magnitude plot, Relative stability analysis.

Self study: Draw the Bode diagrams and analyze using MATLAB software. **10 hrs**

Unit –V

(ii) Polar plots:

Gain margin and Phase Margin and stability, determination of K for different Gain margin and Phase Margin, effects of addition poles and zeros to G(S) on shape of the polar plots, Relative stability analysis.

(iii) Nyquist plots:

Pole-zero configurations, concept of encirclement, analytical function and singularities, mapping theorem, Nyquist stability criteria, and determination of stability from the Nyquist plot.

Self study: Draw the Nyquist diagrams and analyze using MATLAB software. **10 hrs**

Text Books:

1. Benjamin .C Kuo and FaridGolnaraghi "Automatic Control Systems", , 8th edition, Wiley India, 2010.
2. I.J Nagrath& M. Gopal "Control System Engineering", New Age International Pri Ltd, 5th edition 2012

Reference Books:

1. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Limited, 5th edition, 2011
2. Norman S. Nise "Control System Engineering", , 5th edition, ISV, Wiley India, 2010.

Course Outcomes

After learning all the units of the course, the student is able to:

CO1: Do the linear modeling (Transfer Function) for Electrical, Mechanical & Electromechanical systems with the analogy.
CO2: Do the analysis of the second order system with the transient & steady state performance specification & its importance
CO3: Do the stability analysis of different systems with RH criterion & Root locus technique
CO4: Do the frequency response analysis using analytical & Bode diagram
CO5: Do the relative stability analysis using Polar &Nyquist diagrams.

Course Articulation Matrix (CAM)														
Course Outcome – CO			**Program Outcome** (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Derive the transfer function and mathematical model of variety of electrical, mechanical and electromechanical systems	**L2**	H	H	M	_	M	_	L	_	M	_	-	H
2	Analyze the performance and stability of a given system through root locus, Nyquist and Bode plots.	**L1**	H	L	M	_	H	_	M	_	M	_	M	H
3	Find the time domain specifications and time response for various inputs.	**L4**	H	L	M	_	L	_	H	_	M	_	-	H
	L-Low, M-Moderate, H-High													

Course assessment Matrix(CAM)														
Course Outcome - CO			**Program Outcome** (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Recognize the structure and operation of electricity generation, transmission and distribution systems and its impact on the society and environment.	**L1**	3	3	2	_	2	_	1		2	_	-	3
2	Solve problems involving modeling, Mechanical and electrical design and performance evaluation of power transmission lines.	**L2**	3	1	2	_	3	_	2		2	_	2	3
3	Calculate the capacitance and stress Levels to solve simple designing problems of single and three core underground cables.	**L3**	3	1	2	_	1	_	3		2	_	-	3
`	1-Low, 2-Moderate, 3-High													

Course Title: ELECTRICAL MACHINES –II			
Course Code:P17EE53	**Semester: V**	**L-T-P-H(Hrs): 4-0-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course learning objectives

1. To know about basic operation and construction of different types of DC Generators.
2. To know about basic operation and construction of different types of DC Motors.
3. Analysis of various tests to be conducted on DC Machines.
4. To study about voltage regulation of synchronous generators.
5. To learn about principle of operation and the effect of load variation in synchronous motors.

Course content

Unit-I

DC Generator: Types of generators, Types of armature windings, EMF Equation**,** O.C.C and Load characteristics, Armature reaction and methods of reducing its effects. Ideal, Resistance and EMF Commutation.

Self Study: Use of Inter poles, Compensating winding. **10 hrs**

Unit-II

DC Motor: Back EMF and its significance, Torque equation**,** Characteristics of Shunt, Series and Compound motors, Factors controlling motor speed, Rheostatic Speed Control of shunt and series motors, its Merits & Demerits, Necessity of a Starters, 3-point starter , Applications of DC motor

Self Study: 4-point Starter **10 hrs**

Unit-III

Testing Of DC Machines: Direct and Indirect methods of testing of shunt and series motors: Swinburne's test, Hopkinson's test, Field test, Retardation test, Advantages and disadvantages

Self-Study: Construction, principle of operation and Applications: Permanent magnet dc motor. **10hrs**

Unit-IV

Synchronous Generator: Principle of operation, Construction of salient & non-salient pole machines, armature windings, Coil span factor, Distribution factor, Chorded coils and EMF equation.

Voltage Regulation: Significance, EMF, MMF & ZPF methods.

Self Study: Harmonics and its elimination **10 hrs**

Unit-V

Synchronization: Parallel operation of alternators: Reasons & Conditions, Synchronization: synchroscope, Infinite Bus.

Synchronous Motor: Principle of operation, Motor on load with constant Excitation, Power Flow equations, Synchronous motor with different Excitation, Different Torques of Synchronous Motor, Effect of Increased load with constant excitation and vice versa, V and inverted V curves.

Salient Pole Synchronous Machine: Two reaction theory, Power angle diagram, Reluctance power, Slip test.

Self Study: Hunting in synchronous machines and Damper windings **10 hrs**

Text Books:

1. AshfaqHussain "Electrical Machines", DhanapathRai& Co, 3rd Edition, Reprint 2015.
2. B.L Theraja "Electrical Technology" Volume2, S. Chand, 22nd Edition.

Reference Books:

1. A. Langsdorf, "Theory of alternating current machinery" TMH, 2005.
2. M.G.Say "Performance and design of A.C. Machines" C.B.S Publishers, 2002.

Course Outcomes

After learning all the units of the course, the student is able to

1. To know about basic operation and construction of different types of DC Generators.
2. To know about basic operation and construction of different types of DC Motors.
3. Analysis of various tests to be conducted on DC Machines.
4. To study about voltage regulation of synchronous generators.
5. To learn about principle of operation and the effect of load variation in synchronous motors.

Course assessment Matrix(CAM)

	Course Outcome - CO		Program Outcome (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	To know about basic operation and construction of different types of DC Generators	**L2**	2	1	2	3	-	-	1	-	-	-	2	-
2	To know about basic operation and construction of different types of DC Motors	**L2**	1	1	2	3	-	-	1	-	-	-	-	-
3	Analysis of various tests to be conducted on DC Machines	**L5**	2	1	3	2	-	-	2	-	-	-	-	-
4	To study about voltage regulation of synchronous generators. .	**L4**	3	2	2	3	-	-	-	-	2	-	-	-
5	To learn about principle of operation and the effect of load variation in synchronous motors.	**L4**	2	3	2	1	-	-	-	-	-	-	-	-
1-Low, 2-Moderate, 3-High														

Course Articulation Matrix (CAM)														
Course Outcome – CO			**Program Outcome** (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	To know about basic operation and construction of different types of DC Generators	**L2**	**M**	**L**	**M**	**H**	**-**	**-**	**L**	**-**	**-**	**M**	**-**	**-**
2	To know about basic operation and construction of different types of DC Motors	**L2**	**L**	**L**	**M**	**H**		**-**	**L**	**-**	**-**	**-**	**-**	**-**
3	Analysis of various tests to be conducted on DC Machines	**L5**	M	**L**	**H**	**M**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**-**
4	To study about voltage regulation of synchronous generators.	**L4**	**H**	**M**	**M**	H	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**-**
5	To learn about principle of operation and the effect of load variation in synchronous motors.	L4	M	H	M	L	-	-	-	-	-	-	-	-
L-Low, M-Moderate, H-High														

Course Title: POWER TRANSMISSION & DISTRIBUTION			
Course Code:P17EE54	**Semester: V**	**L-T-P-H(Hrs): 4-0-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to:

1. To understand about the transmission and distribution system scheme
2. understand and study the effect of sag and tension on over head transmission line
3. To study and understand about line insulators and UG cables
4. To understand and study the performance evaluation of OH lines having different configurations.
5. To study the calculation of line parameter values of 1-phase and 3-phase OH lines of different configuration.
6. To understand and study the concept of corona and its impact on OH transmission line.
7. To understand and study about DC and AC- distributors carrying point and/or uniformly varying load.

Unit – I

Typical Transmission and Distribution System Scheme: Single line diagram of typical transmission and distribution system scheme indicating various voltage levels, Standard voltages for transmission, Selection of optimal value of transmission voltage, Advantages of high voltage transmission, Effect of increase of transmission voltage on: i) volume of copper used ii) efficiency of transmission iii) line loss and regulation.

Overhead Transmission Line: Study of requirements and types of line conductors, Line supports, Sag calculation in conductors i) suspended on level supports ii) supports at different levels; Effect of wind & ice on sag tension calculations, Stringing charts.

Self Study: Tension & sag at erection. **10 hrs**

Unit- II

Insulators: Requirement, Types & constructional features of insulators, Potential distribution over a string of suspension insulators, String efficiency & methods of improving it, testing of insulators.

Underground Cables: Types, Material used, Insulation resistance, Thermal rating of cables, Charging current, Grading of cables –capacitance grading &inter-sheath grading,

Self Study: Testing of cables. **10hrs**

Unit – III

Line Parameters: Brief review of concept of resistance, inductance and capacitance, Calculation of inductance of single phase & three phase lines with equilateral & unsymmetrical spacing, Inductance of composite conductor lines, Calculation of capacitance for 2- wire & 3-wire lines with equilateral & unsymmetrical spacing.

Self Study: Skin effect & Proximity effect**.** **10hrs**

Unit – IV

Performance of Power Transmission Lines: Brief review of characteristics & types of transmission lines, Regulation of short transmission line, Medium transmission line using nominal T-method, end condenser method, ð-method, Long transmission line-ABCD constants, Power flow through transmission lines, P-V & P-Q coupling, Ferranti effect.
Self Study: performance of ring transmission lines. **10 hrs**

Unit –V

Corona: Phenomenon of corona, Expression for disruptive & visual critical voltage, Corona power loss, Factors effecting corona power loss, Advantages and disadvantages of corona, Methods of reducing corona effect, Radio interference, and effects of corona on transmission line design.
Distribution System (DS): Typical distribution system scheme, Feeders, distributors & service mains; Requirements of distribution system, Primary and secondary distribution systems; Radial & ring main systems, DC distributors, Calculation for concentrated loads and uniformly varying loads, AC Distributors- when the load pfs referred to voltages at load points.
Self Study: AC Distributors- when the load pfs referred to supply voltage point.

10 hrs

Text Books:

1. A Chakrabarti, Soni, Guptha&Bhatnagar, A course in electrical power – DhanpatRai& Co (New Delhi), 2nd edition, 2012.
2. C L Wadwa, Electrical power systems –New Age Publishers, 6th edition, 2010.

Reference Books:

1. Dr. S L Uppa l& S Rao, Electrical Power –Khanna publications, 15th edition, 2001.
2. S M Singh, Electrical Power generation, transmission and distribution –PHI, 2nd edition, 2011

Course Outcomes (COs)

After learning all the units of the course, the students will be able to

CO1: Recognize the structure and operation of electricity generation, transmission and distribution systems and its impact on the society and environment.

CO2: Students are able to analyze the various power transmission methods involved in the power system

CO3: Solve problems involving modeling, mechanical and electrical design and performance evaluation of power transmission lines.

CO4: Calculation of line parameters for the 1-phase and 3-phase systems, considering different configurations.

CO5: Analyze the importance of overhead and underground transmission systems.

CO6: Calculation of the capacitance and stress levels to solve simple designing problems of single and three core underground cables.

CO7: To analyze the causes and effects of corona phenomenon on OHT lines, precautions to be taken to eliminate it.

CO8: To analyze various types of power DSs,

Course assessment Matrix(CAM)														
Course Outcome - CO			Program Outcome (ABET/NBA-(3a-k))											
			a	b	c	d	e	f	g	h	i	j	k	l
1	Recognize the structure and operation of electricity generation, transmission and distribution systems and its impact on the society and environment.	L1	1	3	1	-	1	-	1	-	-	3	-	1
2	Solve problems involving modeling, Mechanical and electrical design and performance evaluation of power transmission lines.	L2	1	3	1	-	1	-	1	-	-	-	-	1
3	Calculate the capacitance and stress Levels to solves imple designing problems of single and three core underground cables.	L3	1	1	1	-	1	-	1	-	-	-	-	1
4	Analyze the importance of overhead and underground transmission system.	L4	1	3	1	2	1	-	1	-	2	-	-	1
1-Low, 2-Moderate, 3-High														

Course Articulation Matrix (CAM)														
Course Outcome – CO			Program Outcome (ABET/NBA-(3a-k))											
			a	b	c	d	e	f	g	h	i	j	k	l
1	Recognize the structure and operation of electricity generation, transmission and distribution systems and its impact on the society and environment.	L2	L	H	L	-	L	-	L	-	-	H	-	L
2	Solve problems involving modeling, Mechanical and electrical design and performance evaluation of power transmission lines.	L1	L	H	L	-		-	L	-	-	-	-	L
3	Calculate the capacitance and stress Levels to solve simple designing problems of single and three core underground cables.	L4		L	L	-	L	-	L	-	-	-	-	L
4	Analyze the importance of overhead and underground transmission system.	L3	L	H	L		L	-	L	-	M	-	-	L
L-Low, M-Moderate, H-High														

Course Title: OPERATIONAL AMPLIFIERS &LINEAR INTEGRATED CIRCUITS			
Course Code:P17EE551	**Semester: V**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Content

UNIT - I

OP-AMPS AS AC AMPLIFIER: Capacitor coupled voltage follower, High Z_{in} capacitor coupled - voltage follower, non-inverting amplifier, inverting amplifier; Capacitor coupled inverting amplifier, setting upper cut off frequency, Capacitor coupled difference amplifie.

Self study: Use of single polarity supply. **10hrs**

UNIT - II

OP-AMPS FREQUENCY RESPONSE AND COMPENSATION : Op-amp circuit stability, Frequency and phase response, Frequency compensating methods , Manufacturer's recommended compensation, Op-amp circuit band width, Slew rate effects, Stray & load capacitance effects, Z_{in} mod compensation.

Self study: Circuit stability precautions. **10hrs**

UNIT - III

SIGNAL PROCESSING & GENERATOR CIRCUITS: Precision half wave & full wave rectifiers, Limiting circuits, Clamping circuits, Peak detectors, Sample & hold circuit. Triangular & rectangular wave generator, Waveform generator design, Phase shift oscillator, Oscillator amplitude stabilization, Wein bridge oscillator.

Self study: Signal generator output controllers. **10hrs**

UNIT - IV

OPAMPS-NONLINEAR CIRCUITS & ACTIVE FILTERS: Op-amps in switching circuits, Zero crossing detectors, Inverting & non inverting Schmitt trigger, Astable & monostable multivibrators. First and second order high pass and low pass filters, Band pass filter, Band stop filter.

Self study: Universal Active filter **10hrs**

UNIT - V

SPECIALIZED IC APPLICATIONS: Universal active filter, Switched capacitor filter, Phase locked loops & its applications, Power amplifiers.

DC VOLTAGE REGULATORS: Basics of Voltage regulators, Voltage follower regulator, Adjustable output regulator, Precision voltage regulators

Self study: Integrated circuit voltage regulators. **10hrs**

Text Books:

1. "Operational amplifiers and linear IC's"- David A Bell, -PHI, 4th edition, 2011
2. "Operational amplifiers and linear" - Ramakanth A Gayakwad,- IC's, Pearson Education, 4th edition, 2012

Reference Books:

1. Operational amplifiers and linear IC's- Roy &Choudhry, New age International, 4th edition,2007
2. Operational amplifiers and linear IC's - Stanley William D, Pearson Education, 4th edition, 2007
3. Operational amplifier and linear integrated circuits - K. Lalkishore -Pearson education, 5th edition, 2008

Course Title:FUZZY LOGIC			
Course Code:P17EE552	**Semester: V**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course content

Unit-I

Classical / Crisp sets and Fuzzy sets: Classical sets. Operations on Classical Sets, Properties of Classical Sets, mapping of classical sets to functions; Fuzzy sets –member ship functions for fuzzy set. Properties of Fuzzy sets, Operations in Fuzzy Sets.

Self Study: Obtain the Examples of fuzzy sets for different engineering applications.

10hrs

Unit-II

Classical relations and fuzzy relations: Cartesian Product of Relations, Classical/Crisp relations, Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition. Tolerance and Equivalence Relations - Crisp Tolerance and Equivalence Relations, Fuzzy Tolerance and Equivalence Relations. The Extension Principle.

Self Study: Write MATLAB programs for the different operations of the fuzzy sets and Fuzzy Relations. **10hrs**

Unit-III

Membership functions: Introduction, Features of Membership Functions, Fuzzification, Methods of Membership Value Assignments, and Defuzzification to Crisp sets, λ - Cuts (alpha –cuts) for Fuzzy Relations. Defuzzification methods – Max-membership principle, Centroid method, Weighted Average Method, Mean-Max membership, Center of Sums, and Center of Largest area, First and Last of Maxima.

Self Study: Write MATLAB programs for the different Fuzzification, and Defuzzification methods

10 hrs

Unit-IV

Theory of approximate reasoning: Linguistic Variables, Linguistic Hedges, Fuzzy rule Based Systems, Fuzzy Proportions, Fuzzy if then Statements, Inference rules, Compositional rule of inference. Fuzzy Inference Systems (FIS) - Construction and Working Principals of FIS. Methods of FIS – Mamdani FIS, Sugino FIS, Takagi-Sugino fuzzy model.

Self Study: Detailed study and make Comparisons between Mamdani and Sugino methods.

10 hrs

Unit-V

Fuzzy Logic Control system: Introduction, Simple fuzzy logic controllers. General fuzzy logic controllers. Control system Design Problem, Fuzzy Logic Control (FLC) system Block Diagram - Architecture and Operation of FLC System. Examples of Control design. FLC System Models.

Self Study: Applications of FLC systems. **10 hrs**

Text Books:

1. Timothy J. Ross, Fuzzy logic with Engineering applications**,** McGraw-Hill/Wiley India Publications.2nd Edition. 2009.

2. D. Driankar, H. Hellendoom and M. ReinfrankNarosa An introduction to Fuzzy control, Publishers India, 1996. (Reprint 2009)

Reference Books:

1. S.N.Shivanandam, S.N.Deepa, Principles of Soft Computing, Wiley India (pvt) Ltd publications, First edition 2007

Course Title: OPERATION RESEARCH			
Course Code:P17EE553	**Semester: V**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Content

UNIT – I

Introduction and Overview of the Operations Research Modeling Approach: The Origins of Operations Research, the Nature of Operations Research, the Impact of Operations Research, Algorithms and OR Courseware, Defining the Problem and Gathering Data, Formulating a Mathematical Model, Deriving Solutions from the Model, Testing the Model, Preparing to Apply the Model, Implementation.

Introduction to Linear Programming: Prototype Example, the Linear Programming Model, Assumptions of Linear Programming.

Solving Linear Programming Problems: The Simplex Method: The Essence of the Simplex Method, Setting Up the Simplex Method, The Algebra of the Simplex Method, Tie Breaking in the Simplex Method Adapting to Other Model Forms, Post–optimality Analysis, Computer Implementation.

Text: 1.1 to 1.4, 2.1 to 2.6, 3.1 to 3.3 and 4.1 to 4.8 **10 Hrs**

Self study: Simplex Method in Tabular Form

UNIT – II

Duality Theory and Sensitivity Analysis: The Essence of Duality Theory, Economic, Primal–Dual Relationships, Adapting to Other Primal Forms, the Role of Duality Theory in Sensitivity Analysis, the Essence of Sensitivity Analysis, Applying Sensitivity Analysis.

The Transportation and Assignment Problems: The Transportation Problem, a Streamlined Simplex Method for the Transportation Problem, the Assignment Problem, a Special Algorithm for the Assignment Problem. Text: 6.1 to 6.7, 8.1 to 8.4 **10 Hrs**

Self study: Interpretation of Duality

UNIT – III

Network Optimization Models: Prototype Example, The Terminology of Networks, The Shortest–Path Problem, The Minimum Spanning Tree Problem, The Maximum Flow Problem, The Network Simplex Method and A Network Model for Optimizing a Project's Time–Cost Trade–Off. Text: 9.1 to 9.8 **10 Hrs**

Self study: Minimum Cost Flow Problem

UNIT – IV

Queuing Theory: Prototype Example, Basic Structure of Queuing Models, Examples of Real Queuing Systems and The Role of the Exponential Distribution, the Birth–and–Death Process and Queuing Models Based on the Birth–and–Death Process, Queuing Models Involving Non–exponential Distributions, Priority–Discipline Queuing Models, Queuing Networks .

Text: 17.1 to 17.10 **10 Hrs**

Self study: Application of Queuing Theory

UNIT – V

Dynamic Programming: A Prototype Example for Dynamic Programming, Characteristics of Dynamic Programming Problems, Deterministic Dynamic Programming, Probabilistic Dynamic Programming Conclusions.

Game Theory: The Formulation of Two–Person, Zero–Sum Games, Solving Simple Games – a Prototype Example, Games with Mixed Strategies, Graphical Solution Procedure, Solving by Linear Programming. Text: 10.1 to 10.4, 14.1 to 14.4 **10 Hrs**

Self study: Deterministic Dynamic Programming

TEXT BOOK:

1. "Introduction to Operations Research", Frederick S. Hiller, Gerald J. Lieberman, Tata McGraw Hill, 9th Edition, 2015.

REFERENCE BOOKS:

1. "Operations Research An introduction", Hamdy A. Taha, Prentice Hall of India, 9th Edition, 2011.
2. "Operations Research", Schaum's Series Bronson and Naadimuthu, Tata Mcgraw Hill, 2nd Edition, 2011

Course Title:MANAGEMENT AND ENTREPRENEURSHIP			
Course Code:P17EE554	**Semester: V**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Content

Unit – I

a) Introduction to Management: Scope and functional areas of management, management as a science, art or profession. Management and administration, role of management, levels of management, development of Management thought, early management approaches,

b) Planning: Nature of planning, Importance of Planning, forms of planning, types of plans, steps in planning, limitations of planning, making planning effective, planning skills, strategic planning in Indian industry, meaning of a decision, types of decisions

Self study: Modern management approaches, steps in rational decision making. **10hrs**

Unit – II

a) Organization: Nature and purpose of organization, principles of organization, types of organization, depart mentation, need and significance of departments, process involved in depart mentation, demerits of depart mentation, methods or basis of depart mentation, span of management and span of control, factors influencing the span of control, authority, responsibility, centralization and decentralization, factors determining centralization of authority, advantages of centralization, disadvantages of centralization, decentralization, advantages of decentralization, disadvantages of decentralization,.

b) **Staffing:** Nature of staffing, responsibility of staffing, process of staffing, need and importance of staffing, recruitment, process of recruitment, factors affecting recruitment, recruitment policy, principles of recruitment policy, constraints on recruitment, selection, need or importance of selection, selection procedure, difference between recruitment & selection, management by objectives (MBO), features & process of MBO, benefits of management by objectives,.

Self study: Balancing between centralization & decentralization, limitations of management by objectives **10hrs**

Unit – III

a) Directing

Introduction, Meaning of directing, Nature and characteristics of direction, Principles of effective direction, importance of direction, techniques of directing, motivation, nature of motivation, types of motivation, importance of motivation, theories of motivation, Leadership, nature &characteristics of leadership, types of leaders, formal & informal leaders, leadership functions, qualities of a good leader.

b)Controlling

Control- Importance of control system & characteristics of control, steps in controlling, limitations of control, essentials of a sound control system and methods of establishing control. Communication- characteristics of communication, elements of communication, process and purpose of communication, importance of communication, types of communication, coordination- features or characteristics of co-ordination, aims and importance of communication, need for communication, types of communication.

Self study: Importance of leadership in management, techniques of co-ordination **10hrs**

Unit – IV

Entrepreneurship

a) Meaning of entrepreneurs, evaluation of the concept, functions, and types of entrepreneur. Development of entrepreneurship, stages of entrepreneurial process, role of entrepreneurs in economic development.

b) Small Scale Industry- Definition, characteristics, need, objectives, role of small scale industry in economic development, steps to start and small scale industry, different policies of small scale industry.

Self study: Entrepreneurship in India, institutional support and different schemes. **10hrs**

Unit – V

a)Woman Entrepreneur

Concept of woman entrepreneurs, functions of woman entrepreneurs**,** factors influencing **w**oman entrepreneurs, leadership qualities for a woman entrepreneurs, psycho-social barriers for woman entrepreneurs, basic problems of woman entrepreneurs, association promoting woman entrepreneurs.

b)Preparation of project

Meaning of project, project identification, project selection, project report, need & significance of report, contents, formulation, guide lines by planning commission for project report, project appraisal.

Self study: Case studies of Indian successful entrepreneurs, identification of business opportunities **10hrs**

Text Books:

1. P C Tripati, "Principles of Management", PN Reddy, Tata McGraw Hill, 2007Vasant Desai, " Dynamics of Entrepreneurial Development & Management", Himalaya publishing House .2007 Edition

Reference Books:

1. S S Khanka, "Entrepreneurship Development" S Chand & Co, 2011.Dr. NVR Naidu and T.KrishnaRao, "Management and Entrepreneurship"- I K International Publishing House Pvt. Ltd., New Delhi, 2008

Course Title: UTILIZATION OF ELECTRICAL POWER			
Course Code:P17EE561	**Semester: V**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Content

Unit – I

Heating and Welding: Introduction, mode of heat transfer, advantages and methods of electric heating, resistance ovens, resistance heating, induction heating, the arc furnaces, vertical core type furnace, Indirect core type furnace, Induction furnace, coreless Induction furnace, Dielectric heating, electric welding and their types.

Self Study: Control device and electric equipment. **12 Hrs.**

Unit – II

Illumination: Laws of illumination, light schemes, Design of lighting scheme, factory lighting, flood lighting, different types of lamps: Incandescent, mercury, arc, electric discharge lamps, mercury vapour lamps, fluorescent, vapour and CFL and their working.

Self Study: Recommended levels of Illumination **10 Hrs**

Unit – III

Electric Traction : Introduction, requirement of an ideal traction system scheme of traction and merits and demerits, types of electric traction, electric trains, systems of electrification for traction purposes: direct current, 1 phase AC system, Three phase as system, composite system.

Self Study: Diesel electric traction **10 Hrs.**

Unit – IV

Speed-Time Characteristics: Types of railway systems, Analysis of speed-time curve for electric train, Mechanism of train movement tractive effort, for propulsion of train, specific energy output,

Self Study: various factors affecting energy consumption. **10 Hrs**

Unit – V

Traction Motors: Introduction, selection of traction motors, methods of speed control, energy saving by series-parallel method, AC traction equipment, AC series motor, characteristics, traction motor control, electric braking- plugging, rheostatic braking, regenerative breaking on AC& DC series motor,

Self Study: linear induction motor and their use. **10 Hrs**

Text Books:

1. Electrical Power systems by Dr. S.L. Uppal, Prof. S Rao , Khanna Publishers,15th edition, 2011
2. Power System Engineering by A Chakrabarti M.L. Soni , P.V. Gupta Bhatnagar, DhanpatRai& Co (pvt) Ltd., 2013
3.Utilization of Electrical power by R K Rajput, Laxmi publication

reference books:

1. Utilization of Electric Energy-Open shaw Taylor, University Press,3rd Edition,2009.
2. Utilization of Electrical power by Dr. Ramesh L Chakrasali, 2014

Course Title: SOFTWARE ENGINEERING			
Course Code:P17EE562	**Semester: V**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Content

Unit – I

OVERVIEW: Introduction to Software Engineering, Introduction, Professional software development ,Software engineering ethics, Case studies.

Software processes: Software process models, Process activities, Coping with change.

Self Study: The Rational Unified Process.

. **8 Hrs**

Unit – II

Agile software development: Agile methods, Plan driven and agile development, Extreme programming, Agile project management, Scaling agile methods

Requirements engineering:

Functional and non-functional requirements, The software requirements document Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements management.

Self Study: Requirements validation

12 Hrs

Unit – III

System modelling: Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering.

Architectural design: Architectural design decisions, Architectural views, Application architectures

Self Study: Architectural patterns

12 Hrs

Unit – IV

Design and Implementation: Object-oriented design using the UML Design patterns, Implementation issues, Open source development

Software testing: Development testing, Test-driven development, Release testing,

Self Study: User testing.

. **10 Hrs**

Unit – V

Project management: Risk management, Managing people, Teamwork.

Configuration management: Change management, Version management System building.

Self Study: Release management.

8 Hrs

Text book:

1. Software Engineering – Ian Somerville, 9th Edition, Pearson Education, 2012.

Reference books:

1. Software Engineering: A Practitioners Approach - Roger S. Pressman, 7th Edition, McGraw Hill, 2011
2. Software Engineering Theory and Practice - Shari Lawrence Pfleeger, Joanne M. Atlee, 3rd Edition, Pearson Education, 2014.
3. Software Engineering Principles and Practice – Waman S Jawadekar, Tata McGraw Hill, 2004
4. Software Engineering – PankajJalote, Tata McGraw Hill

Course Title:ELECTRICAL MATERIALSCIENCE			
Course Code:P17EE563	**Semester: V**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course content

UNIT 1

Conductivity of Materials: Free Electron Theory of Metals; Ohm's Law and the Relaxation Time of Electrons; Factors affecting Resistivity of Metals; Emission of Electrons from Metals; Thermal Conductivity of Metals; Thermoelectric Effects; Superconductivity; Band Theory of Solids;

Self study: Conduction in Liquids **10 hrs**

UNIT 2

Dielectric Properties of Materials-1: The Static Dielectric Constant; Polarization and Dielectric Constant; Polarization Mechanisms; Behaviour of Dielectrics in Alternating Fields; Complex Dielectric Constant; Dipolar Relaxation; Dielectric Losses-Loss Tangent; Temperature Dependence of Dielectric Constant.

Self study: Frequency Dependence of Dielectric Constant **10 hrs**

UNIT 3

Dielectric Properties of Materials-2: Breakdown Mechanisms in Gaseous, Liquid and Solid Dielectrics; Dielectric Strength; Temperature Classification of Insulating Materials; Properties of Insulators-Insulation Resistance; Volume Electrical Resistivity; Surface Electrical Resistivity.

Self study: Ferro Electricity; Piezoelectricity **10 hrs**

UNIT 4

Magnetic Properties of Materials: Magnetization; Atomic Magnetic Moments; Classification of Magnetic Materials; Diamagnetic, Paramagnetic and Ferromagnetic Materials; Ferromagnetic Domains; Magnetization Curve; Soft and Hard Ferromagnetic Materials; Losses in Magnetic Materials; Anti-Ferromagnetism; Ferromagnetism; Magnetic Resonance.

Self study: Factors Affecting Permeability and Hysteresis Loss **12 hrs**

UNIT 5

Materials and their Applications: Properties of Various Conducting, Insulating and Magnetic Materials and their Applications; Superconducting Materials and their Applications;; Thermocouple Materials;

Self study: Special Purpose Materials **10 hrs**

Text books:

1. J. Dekker, "Electric Engineering Materials", Prentice Hall,2012
2. L. Solymer and D. Walsh, "Electric Properties of Materials", Oxford University Press, 2004

Reference books:

1. S. P. Seth, "A course in Electrical Engineering Materials", DhanpatRai Publication,2013\
2. William Smith," Foundation of Materials Science and Engineering", 3rd Edition, McGraw Hill, 2007. ISBN:9780073529240
3. Flexible Electronics: Materials and Applications, William S. Wong and Alberto Salleo, eds. ISBN 978-0-387-74362-2, 2009.

Course Title: MICRO ELECTRO MECHANICAL SYSTEM			
Course Code:P17EE564	**Semester: V**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits - 4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course content

UNIT 1

INTRODUCTION TO MICROSYSTEMS

Overview of microelectronics manufacture and Microsystems technology. Definition - MEMS materials. Laws of scaling. Themulti disciplinary nature of MEMS. Survey of materials central to micro engineering.

Self Study: Applications of MEMS in various industries. **10 Hrs**

UNIT 2

MICRO SENSORS AND ACTUATORS

Working principle of Microsystems - micro actuation techniques - micro sensors – types – Micro actuators – types – micro pump – micro motors – micro – valves – micro grippers

Self Study: micro accelerometers. **10 Hrs**

UNIT 3

FABRICATION PROCESS

Substrates - single crystal silicon wafer formation – Photolithography – Ion implantation – Diffusion – Oxidation – CVD - Physical vapor deposition - Deposition epitaxy

Self Study: Etching process. **10 Hrs**

UNIT 4

MICRO SYSTEM MANUFACTURING

Bulk Micro manufacturing - surface micro machining – LIGA – SLIGA - Micro system packaging materials - die level - device level - system level - packaging techniques – die preparation – surface bonding.

Self Study: Wire bonding - sealing. **10 Hrs**

UNIT 5

MICROSYSTEMS DESIGN AND PACKAGING

Design considerations, Mechanical Design, Process design, Realization of MEMS components using intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems,

Self Study: Reliability in MEMS. **10 Hrs**

TEXT BOOKS

1. Tai-Ran Hsu “MEMS and Microsystems Design and Manufacture” , Tata McGraw-Hill Publishing Company Ltd
2. Chang Liu, “Foundation of MEMS” , Pearson Education

REFERENCES

1. Rai - Choudhury P. “MEMS and MOEMS Technology and Applications”, PHI Learning Private Limited, 2009
2. Julian W. Gardner, Vijay K.Varadan, Osama O. Awadelkarim, “Micro Sensors MEMS and Smart Devices”, John Wiley & Sons Limited, 2002

Course Title: POWER ELECTRONICS LAB			
Course Code:P17EEL57	**Semester: V**	**L-T-P-H(Hrs): 0-0-3-3**	**Credits –1.5**
Contact period : Lecture: 36Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives

This course aims to:

1. To study the working of different types of power semi-conductor devices and their switching characteristics.
2. To develop and analyze the different types of thyristor firing and commutation circuits.
3. To observe and analyze the operation and characteristics of various types of converter choppers, AC voltage controllers and Inverters.

List of experiments

1. Static characteristics of SCR and TRIAC
2. Static characteristics of MOSFET and IGBT
3. SCR turn on using synchronized UJT relaxation oscillator
4. Single phase Half control bridge rectifier operation with R-load & Motor load.
5. Single phase Full control bridge rectifier operation with R-Load & Motor load.
6. AC Voltage Controllers using Triac-Diac combination
7. Speed control of Universal motor /single phase Induction motor.
8. Speed control of a Stepper Motor.
9. Chopper operation with constant and variable Frequency Control.
10. Study of Commutation circuits.
11. Self study experiment

Course Outcomes

At the end of the course, students will:

CO1: Able to understand the working of various power electronic devices/switches for various applications.

CO2: Able to Design and develop the Firing circuits for various types of firing.

CO3: Able to Design and develop various types of commutation circuits

CO4: Able to operate and analyze the various types of power converter circuits with various types of loads

Topic learning Objectives

1. Analyze the basic switching operation of SCR AND TRIAC
2. Analyze the basic switching operation of MOSFET AND IGBT
3. Analyze the basic operation of UJT based firing circuit
4. Analyze the basic operation of Half control bridge rectifier operation with various loads.
5. Analyze the basic operation of Full control bridge rectifier operation with various loads.
6. Analyze the basic operation of AC Voltage Controllers with various loads.
7. Analyze the method of speed control of Universal motor
8. Analyze the method of speed control of Stepper Motor
9. Analyze the basic operation of DC-DC Power conversion
10. Analyze the basic operation of different types of Commutation circuits.

Course Articulation Matrix (CAM)												
Course Outcomes (CO)		**Program outcomes** (ABET/NBA-(3a-k))										
		a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1	Able to understand the working of various power electronic devices/switches for various applications	M	H	M	H	-	-	L	-	M	-	-
2	Able to Design and develop the Firing circuits for various types of firing.	L	M	H	H	-	-	M	-	M	-	-
3	Able to Design and develop various types of commutation circuits	L	M	H	H	-	-	M	-	M	-	-
4	Able to operate and analyze the various types of power converter circuits with various types of loads	L	M	M	M	-	-	M	-	M	-	-
	L-Low, M-Moderate, H-High											

Course Assessment Matrix (CAM)												
Course Outcomes (CO)		**Program outcomes** (ABET/NBA-(3a-k))										
		a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1	Able to understand the working of various power electronic devices/switches for various applications	2	3	2	3	-	-	1	-	2	-	-
2	Able to Design and develop the Firing circuits for various types of firing.	1	2	3	3	-	-	2	-	2	-	-
3	Able to Design and develop various types of commutation circuits	1	2	3	3	-	-	2	-	2	-	-
4	Able to operate and analyze the various types of power converter circuits with various types of loads	1	2	2	2	-	-	2	-	2	-	-
	1-Low, 2-Moderate, 3-High											

Course Title: ELECTRICAL MACHINES LAB -II			
Course Code:P17EEL58	**Semester: V**	**L-T-P-H(Hrs): 0-0-3-3**	**Credits – 1.5**
Contact period : Lecture: 36Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to:

1. They will be able to study OCC and load characteristics of DC generator & DC Motor
2. They will be able study the different methods of speed control of DC motor
3. They will be able to determine the efficiency of machine both as generator and motor by conducting various tests.
4. They will know the working of synchronous Motor

List of Experiments

1. a. OCC of DC shunt Generator
   b. Speed control of DC shunt motor
2. Load Characteristics of a DC Generators
3. Load test on DC shunt motor by Electrical Loading
4. Load test on DC motor using mechanical loading
5. Swinburne's test
6. Field test on DC series motor
7. Regulation of Alternator by EMF & MMF methods
8. Synchronization of alternator with the busbar
9. Slip test
10. V & Inverted V curves of synchronous motor
11. Self-study experiment

Course outcomes

The course enable the students to:

CO1: Know about load characteristics of Dc generator and DC motor

CO2: Find the efficiency of motors by conducting various test as a motor and generator

CO3: Know about Synchronization of alternator with bus bar

CO4: Determine the regulation of an alternator by EMF& MMF methods

CO5: Study the characteristics of synchronous motor

Topic learning objective

1. Speed control of DC motor by Armature control method and field control method
2. Determine the efficiency of machine both as generator and motor by conducting various tests
3. Find the efficiency, BHP, Torque of a DC motor by Mechanical loading
4. Determining the regulation of an alternator by EMF & MMF methods
5. Synchronization of alternator with bus bar
6. Determining Xd and Xq by conducting slip test
7. Study of V & Inverted V curves of synchronous motor

Course Articulation Matrix (CAM)

Course Outcome – CO			Program Outcome (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Conduct different methods of speed control of DC motor	**L3**	L	M	M	M	-	-	-	-	-	-	-	M
2	Conduct Mechanical load test on different types of DC motor	**L3**	L	M	-	-	-	-	-	-	L	-	-	-
3	Find the efficiency of a machine as motor and generator	**L6**	L	L	M	M	-	M	-	-	-	-	-	-
4	Find the external and internal characteristics of a DC generator	**L4**	M	M	M	M	-	-	-	-	-	-	-	L
5	Discuss the various types of entrepreneur.	**L4**	L	M	M	M	-	-	-	-	-	-	-	M
	L-Low, M-Moderate, H-High													

Course assessment Matrix(CAM)

Course Outcome - CO			Program Outcome (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Describe the importance of management philosophy and the functional areas of management.	**L3**	1	2	2	2								2
2	Analyze the process of decision making	**L3**	1	2							1			
3	Understand the various types of organizations.	**L6**	1	1	2	2		2						
4	Analyze the importance of communication , techniques of co-ordination and sound control system	**L4**	2	2	2	2								1
5	Discuss the various types of entrepreneur.	**L4**	1	2	2	2								2
	1-Low, 2-Moderate, 3-High													

Course Title : Aptitude and Reasoning Development - Advanced (ARDA)			
Course Code : P17HU510	Semester : 5	L:T:P:H :0:0:2:2	Credits: 1
Contact Period: Lecture: 32 Hr, Exam: 3 Hr		Weightage: CIE:50;% SEE:50%	
Prerequisites: Vocabulary builder, Concept of Percentage.			

Course Learning Objectives (CLOS)

This course aims to,

1. Describe the importance of reading with comprehension.
2. Explain seven dimensions approach to better reading skills.
3. Explain the purpose, plan and the ways to identify specific details in a paragraph for better comprehension.
4. Formulate easier ways to solve problems of averages.
5. Explain the Application of the technique of alligation while solving weighted average and mixture problems.
6. Describe the concepts of profit, loss, discount, marked price.
7. Explain the application of percentage in our daily life.
8. Discover different ways to identify the progressions and to compare between AP< GP and HP.
9. Explain the basic concepts in calculating simple interest and compound interest.
10. Differentiate between simple interest and compound interest and describes the importance of compound interest and its behavior.

Course Content

UNIT – I

Reading Comprehension:

Introduction: Read more and more, the process of writing and its relevance to the process of writing, how reading skills are important for aspects other than the reading comprehension questions, the daily reading scheme.

Seven dimension approach to better reading skills:

Developing the ability of understanding vocabulary in context, Ability to identify and understand main ideas, Ability to predict and identify supporting details, Understanding the use of transition and idea organization patterns, Inferences, Identifying purpose and tone, Recognizing and evaluating arguments and their common structures.

Theory of reading comprehension:

Solving RC passages is an exact science, tackling RC on the basis of evaluation of support, All passages have a topic, purpose and a plan, Other things to pick up while reading the passage– The tonality and other software related the author's viewpoint in the passage, specific details and their use in the passage, Types of questions asked in reading comprehension passage.

10 Hrs

UNIT – II

Averages and Alligations mixtures:

Average: relevance of average, meaning of average, properties of average, deviation method, concept of weighted average. **Alligation method:** situation where allegation technique, general representation of alligations, the straight line approach, application of weighted average and alligation method in problems involving mixtures. Application of alligation on situation other than mixtures problems.

6 Hrs

UNIT – III

Profit and Loss: percentage change, original 100 concept effect of percentage increase or decrease in number, effect of successive percentage change, amount of change, comparison of two numbers through percentage and ratio, return to original concept, net percentage change to keep product fixed. Definition of basic terms— cost price, selling price, profit percentage, discount and marked price, solving problems using n/d method, techniques to tackle from standard set of problems, the concept of mark up. Concept of partnership and problems involving partnership

6 Hrs

UNIT IV

Progression:

Arithmetic Progression: sum of given number of terms in an A.P., arithmetic mean, to insert a given number of arithmetic means between two given quantities, nth term of an A.P., finding common difference of an A.P. given 2 terms of an A.P., types of A.P.s– increasing A.P.s and decreasing A.P. s

Geometric: to find, the geometric mean between two given quantities, to insert a given number of geometric means between two given quantities, sum of a number of terms in a G.P. Types of G.P.s— increasing G. P. s type one and two , decreasing G. P. s type one and two.

Harmonic Progression: to find the harmonic mean between two given quantities, theorems related with progressions, solved examples sample company questions

6 Hrs

UNIT- V

Simple Interest and Compound Interest

Concept of time value of money, Terminology pertaining to interest, Relation among Principal, Time, Rate percent per annum and total interest. Compound interest, Depreciation of value, Population, Application of interest in D.I.– The difference between simple annual growth rate and compound annual growth rate.

4 Hrs

Reference books:

1. **Trachtenberg speed system of basic mathematics**, published by Rupa publications.
2. AbhijithGuha **"CAT Mathematics"** published by PHI learning private limited.
3. Dr. R. S Agarwal "**Quantitative aptitude**" published by S.Chand private limited.
4. Dr. R. S Agarwal , " **Verbal reasoning**" published by S. Chand private limited.
5. Arun Sharma " **Quantitative aptitude**" for CAT by, published by McGraw Hill publication.

Course Outcomes (CO)

After learning all the units of the course, the student is able to:

1. Apply the approach of seven dimensions to better reading skills. L2
2. Solve the questions under reading comprehension confidently with higher accuracy than random reading. L4
3. Apply the technique of alligation for effective problem solving. L2
4. Interpret the requirement of different methods of calculating average and apply the right method at right scenario. L4

5. Effectively solve problems of profit and loss and problems related to discount, simple interest and compound interest. L5
6. Formulate the equations for summation and other functions for all the kinds of progressions– AP, GP and HP. L1

Course Articulation Matrix (CAM)															
Course Outcome (CO)	Program Outcome (ABET/NBA-(3a-k))														
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
Apply the approach of seven dimensions to better reading skills.	L2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Solve the questions under reading comprehension confidently with higher accuracy than random reading.	L4	-	-	-	-	-	-	2	-	2	-	-	-	-	-
Apply the technique of alligation for effective problem solving.	L2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Interpret the requirement of different methods of calculating average and apply the right method at right scenario.	L4	2	-	-	-	-	-	-	-	2	-	-	-	-	-
Effectively solve problems of profit and loss and problems related to discount, simple interest and compound interest.	L5	3	-	-	-	-	-	-	-	2	-	-	-	-	-
1 – Low, 2 – Moderate and 3 – High															

VI SEMESTER

Course Title: POWER SYSTEM ANALYSIS & STABILITY			
Course Code:P17EE61	**Semester: VI**	**L-T-P-H(Hrs): 4-0-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to:

1. Develop the mathematical model for various types of power systems by using Single Line Diagrams (SLD) and per-unit impedance diagram.
2. Determine short-circuit currents for three-phase faults and design protective devices for various faults.
3. Utilize the concept of symmetrical components to determine the short-circuit currents and phase voltages for unbalanced faults.
4. Perform the calculation of 3-phase unsymmetrical faults.
5. Understand the concept of system stability by applying equal area criterion and by using swing equations &curve.

Course Content

Unit-I

Representation of Power System Components:
Single line diagram, Impedance and Reactance diagrams. Per unit system- merits and demerits. Per unit impedance/reactance diagrams of power systems. Illustrative examples.

10hrs

Self Study: Circuit models-transmission line, synchronous machines, transformer and load.

Unit-II

Symmetrical Fault Analysis:
Transients on a transmission line, Short circuit currents and reactance of synchronous machines on no load, internal voltages of loaded machine under transient conditions, Illustrative examples.

Self Study: Selection of circuit breakers **10hrs**

Unit-III

Symmetrical Components:
Symmetrical components analysis of unbalanced phasors, Power in terms of symmetrical components, Phase shift of symmetrical components in star-delta transformer bank, Analysis of balanced and unbalanced loads against unbalanced three phase supplies, Sequence impedances and sequence networks, Positive, Negative and Zero sequence networks of power system elements. Illustrative examples.

10hrs

Self Study: Sequence impedance of power system elements (alternator, transformer and transmission line).

Unit-IV

Unsymmetrical Faults: SLG/L-G, L-L, L-L-G/DLG faults on an unloaded alternator with and without fault impedances. Unsymmetrical faults on power system with and without fault impedances. Illustrative examples. **10hrs**

Self Study: Open conductor faults in power systems (No numerical problems, only theory).

Unit-V

Stability Studies: Steady state and transient stability, Steady state and transient stability limits. Power angle equation, Rotor dynamics and Swing equation. Illustrative examples.

10hrs

Self Study: Equal area Criterion for stability.

Text Books:

1. W.D. Stevenson, "Elements of Power System Analysis", Mac Graw Hill, 4th Edition, 2013.
2. I. J. Nagarath and D.P. Kothari, "Modern Power System Analysis", TMH, 4th Edition, 2013.

Reference Book:

1. Hadi Sadat, "Power system analysis", TMH,2nd Edition, 2010

Course Outcomes

After learning all the units of the course, the student is able to:

CO1: Model the Power System having the components viz., transformers, lines and generators and represent in a Single line diagram.

CO2: Analyze the given power system by using the per-unit Z-diagram

CO3: Analyze the three-phase faults and determine fault (short-circuit) currents.

CO4: By utilizing the symmetrical component techniques, determine short-circuit currents for different unsymmetrical faultCO5: Explain the stability problems and solve them.

Course assessment Matrix(CAM)

Course Outcome - CO			Program Outcome (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Modeling of the P.S components viz., transformers, lines and generators to represent in Single line diagram.	**L1**	3	2	2	-	2	-	-	-	-	1	2	3
2	Analysis of a given power system using per-unit system.	**L2**	2	2	2	-	1	-	-	-	-	-	3	2
3	Design and determining the performance of a Power system.	**L3**	3	1	2	-	3	-	-	-	-	-	2	3
4	Analysis of short-circuit currents for three-phase faults.	**L4**	3	2	1	-	1	-	-	-	-	-	1	3
5	Utilizing symmetrical components to determine short-circuit currents, and phase voltages for unbalanced faults.	**L5**	2	2	3	-	1	-	-	-	-	-	1	2
	1-Low, 2-Moderate, 3-High													

Course Articulation Matrix (CAM)													
Course Outcome – CO			**Program Outcome** (ABET/NBA-(3a-k))										
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Modeling of the P.S components viz., transformers, lines and generators to represent in Single line diagram.	**L1**	H	M	M	-	M	-	-	-	-	L	M	H
2	Analysis of a given power system using per-unit system.	**L2**	M	M	M	-	L	-	-	-	-	-	H	M
3	Design and determining the performance of a Power system.	**L3**	H	L	M	-	H	-	-	-	-	-	M	H
4	Analysis of short-circuit currents for three-phase faults.	**L4**	H	M	L	-	L	-	-	-	-	-	L	H
5	Utilizing symmetrical components to determine short-circuit currents, and phase voltages for unbalanced faults.	**L5**	M	M	H	-	L	-	-	-	-	-	L	M
	L-Low, M-Moderate, H-High													

Course Title: DIGITAL SIGNAL PROCESSING			
Course Code:P17EE62	**Semester: VI**	**L-T-P-H(Hrs): 3-2-0-5**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course Aims to:

1. Describe the concept of discrete-time Fourier transform (DFT) and its Inverse DFT (IDFT).
2. Analyze the discrete signals by using the different properties of DFT
3. Understand and use the FFT algorithms and its applications
4. Understand the general design and implementation of digital structures
5. Carry out the design and implementation of IIR filters and FIR filters

Course Content

Unit – I

Introduction to discrete Fourier transform (DFT):

Introduction, Frequency domain sampling and reconstruction of discrete time signals, definitions of Discrete Fourier Transform (DFT) and Inverse Discrete Fourier transform (IDFT). DFT as a linear transformation, DFT Relationship to z-transforms, DFT of standard signals. Find the IDFT using the DFT.

Self-Study: Relation between DFT and DFS. **10 hrs**

Unit – II

Properties of DFT:

Properties of DFT – Periodicity, Linearity, Circular Symmetries of a sequence. Symmetry properties of the DFT - real valued sequences, real & even sequences, real & odd sequences, purely imaginary sequences. Multiplication of two DFTs and circular convolution. Additional DFT properties – time reversal of sequences, circular time shift of a sequence, circular frequency shift, complex conjugate properties, multiplication of two sequences, Parsaval's theorem. **10hrs**

Self study: Circular correlation and Multiplication of two sequences.

Unit – III

Fast Fourier Transform (FFT) :

Efficient computation of the DFT: FFT algorithms - Direct computation of DFT, Radix-2 algorithms - Decimation In Time and Frequency algorithms, Applications of FFT algorithms - Efficient computation of the DFTs of two real sequences (using a Single N-point DFT), Efficient computation of the DFTs of 2N point real sequences.

Self Study: To implement FFT and IFFT Algorithms using MATLAB **10hrs**

Unit – IV

Implementation of Discrete Time Systems :

Structures for realization of discrete time systems.

(a) Structures for IIR systems: direct form structure, signal flow graphs & transposed structures, cascade form structures, parallel form structures for IIR systems.

(b) Structures of FIR systems: direct form structure, cascade form structure, Linear phase structure**.**
Self study: Lattice structure for FIR and IIR systems. **10hrs**

Unit –V

Design of filters :

(a) Design of Analog IIR filters – Analog Filter Specifications, classification of analog Filters, Butterworth analog filter, frequency/spectral transformations, design of Low pass (analog) Butterworth filters.

(b) Digital filters: Design of IIR filters from analog filters -Bilinear transformation, Impulsive invariance transformation.

(c) Design of FIR filters: Introduction, design of Linear phase FIR filter using windows. Windowing functions - rectangular window, Bartlett window, Hanning window, Hamming window, Blackman window. **10hrs**

Self study: Design of Chebyshev Filter.

Text books:

1. Proakis, "Digital Signal Processing - Principle, Algorithms & Applications", 3rd edition, Pearson Education / PHI , 2013.
2. Dr. D Ganesh Rao&Vineeta P. Gejji , "Digital Signal Processing", Sanguine Technical Publishers, 2013.

Reference books:

1. J.S.Chitode , "Digital Signal Processing" - Technical publications. Pune. 2013

Course Outcomes

After learning all the units of the course, the student is able to

CO1: Apply the knowledge of DFT and IDFT to various discrete signals.
CO2: To analyze the discrete signals by using the different properties of DFT
CO3: Understand the FFT algorithms and apply FFT algorithms to find DFT
CO4: Understand the general design and implementation of different digital structure for digital systems
CO5:Carry out the design and implementation of IIR filters and FIR filters

Course Articulation Matrix (CAM)														
Course Outcome – CO			**Program Outcome** (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Modeling of systems with difference equations and computing their solutions.	**L1**	H	M	H	-	H	-	-	-	-	-	H	H
2	Apply the knowledge of DFT and FFT in its various applications	**L2**	H	M	M	-	L	-	-	-	-	-	M	H
3	Transformation of digital signals into the frequency domain using FFT/DFT methods.	**L3**	M	M	L	-	L	-	-	-	-	-	M	M
4	Implementation or realization of different digital structures for IIR and FIR systems	**L4**	M	L	H	-	M	-	-	-	-	L	L	M
5	Design and Implementation of IIR filters using Bilinear Transformation	**L**	M	L	H	-	M	-	-		-	L	L	M
	L-Low, M-Moderate, H-High													

Course assessment Matrix(CAM)														
Course Outcome - CO			**Program Outcome** (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Modeling of systems with difference equations and computing their solutions.	**L1**	3	2	3	-	3	-	-	-	-	-	3	3
2	Apply the knowledge of DFT and FFT in its various applications	**L2**	3	2	2	-	1	-	-	-	-	-	2	3
3	Transformation of digital signals into the frequency domain using FFT/DFT methods.	**L3**	2	2	1	-	1	-	-	-	-	-	2	2
4	Implementation or realization of different digital structures for IIR and FIR systems	**L4**	2	1	3	-	2	-	-	-	-	1	1	2
5	Design and Implementation of IIR filters using Bilinear Transformation	**L5**	2	1	3	-	2	-	-		-	1	1	2
1-Low, 2-Moderate, 31-High														

Course Title: ELECTRICAL MACHINE DESIGN			
Course Code:P17EE63	**Semester: VI**	**L-T-P-H(Hrs): 3-1-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to:

1. Different types of conducting, magnetic and insulating materials used in electrical machines.
2. Design of D.C. Machines.
3. Design of Transformers.
4. Design of Induction machines.
5. Design of Synchronous machines

Course Content

Unit – I

PRINCIPLES OF ELECTRICAL MACHINE DESIGN: Introduction, Considerations for the design of electrical machines, Limitations. Different types of materials used in electrical machines.
Design of machines: Output equation of a DC machine, Choice of specific loadings and choice of number of poles in a DC machines, Design of Main dimensions of the DC machines.
Self Study: Constructional features of DC machines. **10hrs**

Unit – II

DESIGN OF DC MACHINES: Design of armature slot dimensions, Commutator and brushes, Design of yoke and pole, Field windings-shunt & series.
Self Study: Magnetic circuit- estimation of ampere turns **10hrs**

Unit – III

DESIGN OF TRANSFORMERS: Output equation for single phase and three phase transformer, Choice of specific loadings, Expression for volts/turn, Determination of main dimensions of the core, Types of windings and estimation of number of turns and cross sectional area of primary and secondary coils, Estimation of no load current, Design of tank and cooling tubes (round and rectangular).
Self Study: Methods of cooling of Transformers **10hrs**

Unit – IV

DESIGN OF INDUCTION MOTORS: Output equation, Choice of specific loadings, Main dimensions of three phase induction motor, Stator winding design, Choice of length of the air gap, Estimation of number of slots for the squirrel cage rotor.
Self Study: Design of Rotor bars and end rotor **10hrs**

Unit – V

DESIGN OF SYNCHRONOUS MACHINES: Output equation, Choice of specific loadings, Short circuit ratio, design of main dimensions, Armature slots and windings, Slot details for the stator of salient and non-salient pole synchronous machines. Design of rotor of salient pole synchronous machines, Magnetic circuits, Design of the field winding.
Self Study: Design of Turbo alternators **10hrs**

TEXT BOOKS:

1. A.K.Sawhney, **"**A Course In Electrical Machine Design **"**-6th edition, Dhanapathrai & co, Delhi
2. V.N. Mittle, Design of Electrical Machines — 4th edition, standard publishers, New Delhi

REFERENCE BOOKS:

M.G Say, Performance& Design of AC Machines - CBS Publishers

Course Outcomes

After learning all the units of the course,

CO1: The students are familiarized with different types of conducting, magnetic and insulating materials used in electrical machines.

CO2: The students will be able to Design different parts of D.C. Machines.

CO3: The students will be able to Design sign of different parts of transformer.

CO4: The students will be able to Design of a different parts of Induction motors.

Course Articulation Matrix (CAM)

Course Outcome – CO			Program Outcome (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	The students are familiarized with different types of conducting magnetic and insulating materials used in electrical machines	**L4**	H	H			H		M		M		L	
2	The students will be able to Design different parts of D.C. Machines.	**L2**	H	M			H		M		M		M	
3	The students will be able to Design different parts of transformer.	**L6**	H	M					M		M			
4	The students will be able to Design a different parts of Induction motors.	**L5**	H	M					H		M		M	
5	The students are familiarized with Design of different parts of Synchronous machines.	**L1**	H	H			L		M		M		L	
	1-Low, 2-Moderate, 3-High													

CO5: The students are familiarized with Design of different parts of Synchronous machines

Course assessment Matrix(CAM)													
Course Outcome - CO			Program Outcome (ABET/NBA-(3a-k))										
			a	b	c	d	e	f	g	h	i	j	k	l
1	The students are familiarized with different types of conducting magnetic and insulating materials used in electrical machines	L4	3	3			3		2		2		1	
2	The students will be able to Design different parts of D.C. Machines.	L2	3	2			3		2		2		2	
3	The students will be able to Design different parts of transformer.	L6	3	2					2		2			
4	The students will be able to Design a different parts of Induction motors.	L5	3	2					3		2		2	
5	The students are familiarized with Design of different parts of Synchronous machines.	L1	3	3			1		2		2		1	
	1-Low, 2-Moderate, 3-High													

Course Title: SWITCHGEAR AND PROTECTION			
Course Code:P17EE64	**Semester: VI**	**L-T-P-H(Hrs): 4-0-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to:

1. Identify the characteristics of fuse, switches and types of Circuit breakers and relays
2. Study the operation principles of circuit breakers and its arc extinction
3. Study the operation principles of protective relays and its selection criteria
4. Study the different protection scheme for Generator, Transformers and Induction motors
5. Introduce students to power system protection and switchgear

Course content

Unit-I

SWITCHES AND FUSES:

Isolating switch, Load breaking switch, Fuse law, cut -off characteristics: Time- current characteristics, Fuse material, HRC fuse, Application of fuse.

PRINCIPLES OF CIRCUIT BREAKERS:

Principles of AC circuit breaking, Principles of DC circuit breaking, Problems encountered in DC breaking, Initiation & maintenance of arc, Arc interruption – high resistance and low resistance interruption, Arc interruption theories – slepian's theory and energy balance theory, Re-striking voltage, Recovery voltage, Rate of rise of Re-striking voltage, Current chopping, Capacitance switching, Resistance switching, Rating of circuit breakers. **,12hrs**

Self study: Liquid fuse and its applications

Unit-II

CIRCUIT BREAKERS:

Air Circuit breakers – air break and air blast circuit breakers, **SF_6 breaker** - preparation of SF_6 gas, puffer and non puffer type of SF_6 breakers. GIS and its advantages.

Vacuum circuit breakers - Construction, Principle of operation, Advantages and disadvantages of different types of circuit breakers, Short circuit test lay out

Self study: Operation of MCB, ELCB and its applications **10hrs**

Unit-III

PROTECTIVE RELAYING:

Requirement of protective relaying, Zones of protection, Primary and backup protection, Essential qualities of protective relaying, Classification of protective relays

INDUCTION TYPE RELAY:

Non-directional and directional over current relays, IDMT and Directional characteristics. Differential relay – principle of operation, percentage differential relay, bias characteristics, Distance relay – three stepped distance protection ; Impedance relay, Reactance relay,

Self study: Operation of Mho relay, Relay **10hrs**

Unit-IV

PROTECTION SCHEMES

Generator Protection - Merz price protection, prime mover faults, stator and rotor faults; Protection against abnormal conditions – unbalanced loading, loss of excitation, over speeding. Negative Sequence relay

Self study: Bus bar protection **10hrs**

Unit-V

Transformer Protection – Introduction, Possible transformer faults, differential protection, Merz-prize protection, Buchholz relay, harmonic restraint, Frame leakage protection. **Induction motor protection** – protection against electrical faults such as phase fault and ground fault, Abnormal operating conditions such as single phasing, over load protection : Phase reversal Protection

Self study: Protection against lighting

10hrs

TEXT BOOKS:

1. **Switchgear & Protection**- Sunil S.Rao, Khanna Publishers. 13th edition, 2013
2. **Power System Protection & Switchgear 2nd Edition**- Badriram&Viswakarma, McGraw-Hill Education-2011 .

REFERENCE BOOKS:

1.Power System Protection & Switchgear- Ravindarnath& Chandra,2014, New age Publications.

Course Outcomes

After learning all the units of the course, the student is able to

CO1: Select a fuse and/or a circuit breaker for a given application.

CO2: Distinguish between various types of circuit breakers and analyze theoperation principles of circuit breakers and its arc extinction.

CO3: Compare the characteristic of different relays and selection criteria

CO4: Understand and analyze the different protection scheme for Generator

CO5: Understand and analyze the different protection scheme for Transformers and Induction motors.

Course Articulation Matrix (CAM)														
Course Outcome – CO			**Program Outcome** (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Select a fuse and/or a circuit breaker for a given application.	**L4**	H	M	L	-	-	-	-	-	-	-	-	-
2	Distinguish between various types of circuit breakers and analyze the operation principles of circuit breakers and its arc extinction.	**L2**	L	M	H	-	L	-	-	-	-	-	-	-
3	Compare the characteristic of different relays and selection criteria	**L6**	H	M	H	-	-	-	-	-	-	-	L	-
4	Understand and analyze the different protection scheme for Generator	**L5**	H	M	L	-	L	-	-	-	-	-	L	-
5	Understand and analyze the different protection scheme for Transformers and Induction motors.	**L1**	L	M	H	-	L	-	-	-	-	-	L	-
	L-Low, M-Moderate, H-High													

Course assessment Matrix(CAM)														
Course Outcome - CO			**Program Outcome** (ABET/NBA-(3a-k))											
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	Select a fuse and/or a circuit breaker for a given application.	**L4**	3	2	1									
2	Distinguish between various types of circuit breakers and analyze the operation principles of circuit breakers and its arc extinction.	**L2**	1	2	3		1							
3	Compare the characteristic of different relays and selection criteria	**L6**	3	2	3								1	
4	Understand and analyze the different protection scheme for Generator	**L5**	3	2	1		1						1	
5	Understand and analyze the different protection scheme for Transformers and Induction motors.	**L1**	1	2	3		1						1	
	1-Low, 2-Moderate, 3-High													

Course Title: MODERN CONTROL THEORY			
Course Code:P17EE651	**Semester: VI**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Content

Unit-I

Industrial Automatic controllers: - Two position/ on-off control, Proportional (P) controller, Integral (I) controller, Proportional- Integral (PI) controller, Proportional -Differential (PD) controller, Proportional –Integral – Differential (PID) controller. Effects of the PID controller on the second order system performance, realization of PI, PD and PID controllers.

Compensation techniques:-Introduction, Classification of compensation, compensation networks, lead compensator, lag compensator and lag-lead compensators, Effects and limitations of compensators**.** (Design Problems are excluded) **10 hrs**

Self study: Write the MATLAB programs for the different P, PI, PD, and PID Controllers.

Unit – II

Modeling in state space: Introduction, Limitations of classical control theory, Concept of State, State variables, State vector, State space, State-space equations and block diagram of the linear, continuous –time control system represented in state space, State space model for physical systems-electrical, mechanical and electro mechanical systems, linearization of state equation.

State space representations of transfer function systems: Canonical forms- Controllable, observable, diagonal, Jordan canonical forms, Eigenvalues, diagonalisation, invariance of Eigenvalues. **10 hrs**

Self study: Write the MATLAB programs for the Modeling in state space.

Unit – III

Solution of the linear time invariant state equation: state transition matrix –properties, computation using Laplace transformation, power series, modal matrix &Cayley- Hamilton method, solution of homogeneous and non-homogenous state equations.

Concept of Controllability & Observability- Kalman's test and Gilbert's test, complete controllability & observability in the s-plane, Stabilizability and Detectability. **10 hrs**

Self study: Principle of Duality

Unit – IV

Design of control systems in state space; Design by Pole Placement technique, stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement, computation of feedback gain matrix by direct substitution, Ackermann's formula, and design of full order state observer. **10 hrs**

Self study: Design of Minimum order and Reduced order state observer.

Unit –V

Liapunov stability analysis: Equilibrium state, Stability in the sense of Liapunov, Asymptotic stability, asymptotic stability in the large, instability and its graphical representation. Sign definiteness of scalar functions, Liapunov's function, and Liapunov stability analysis of linear, time

invariant systems. Construction of Liapunov functions for nonlinear system by Krasovskii's method. **10 hrs**

Self study: Liapunov stability analysis of nonlinear systems.

Text Books:

1. KatshuikoOgata"Modern Control Engineering", - 3rdedition 2002 & 5th Edition, 2012, PHI.
2. I. J Nagrath& M. Gopal,"Control Systems Engineering", New Age International Publishers, 5th Edition 2010.

Reference Books:

1. M Gopal"Digital Control & State variable methods", 3rd edition, TMH

Course Title: ADVANCED POWER ELECTRONICS			
Course Code:P17EE652	**Semester: VI**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course content

Unit-I

DC-DC Switched Mode Converters: Topologies, Buck, Boost, Buck-Boost, and Cuk converters, Full Bridge DC-DC converter-detailed theory, working principles, Modes of operation with detailed circuits and wave forms, Applications, Merits and demerits

Self study : Fly back converters **10 Hrs**

Unit-II

DC-AC switched mode inverters: Single-phase inverter, three phase inverters. SPWM inverter, Detailed theory, Working principles, Modes of operation with circuit analysis, Merits and demerits, Problems based on input output voltage relationship, effect of blanking time on o/p voltage.

Self study : Applications of Switch mode inverters **10 Hrs**

Unit-III

Resonant converters: Introduction, series and parallel resonant inverters, Zero voltage and zero current switching, Resonant switch converters, Comparison with hard switching, zero voltage switching with clamping.

Self study : resonant DC link inverter with zero voltage switching **10 Hrs**

Unit-IV

Power Supplies: Introduction, DC power supplies: fly back converter, forward converter, push-pull converter, half bridge converter, full bridge converter, AC power supplies: switched mode ac power supplies, resonant ac power supplies, bidirectional ac power supplies ,Multistage conversions.

Self study : Power factor conditioning **10 Hrs**

Unit-V

High frequency inductor and transformers: Introduction, Design steps, Detail Design of Inductors and Transformers.

Self study: **10 Hrs**

TEXT BOOKS:

1. **Power Electronics-** converters, application & design- Mohan N, Undeland T.M., Robins, W.P-John Wiley 1989
2. **Power Electronics-Circuits, Devices,** Applications- Rashid M.H.-3rd Edition, Prentice Hall India, 2008.

REFERENCE:

1. **Power Electronics and A.C. Drives-** Bose B.K.-Prentice Hall 1986.
2. **Digital Power Electronics And Applications**- Muhammad Rashid. first edition, 2005, Elsevier.

Course Title:EMBEDDED SYSTEMS			
Course Code:P17EE653	**Semester: VI**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course content

UNIT-1

Introduction: What is an embedded system, Embedded VS General Computing Systems, Classification of Embedded Systems Major Application Areas of Embedded Systems, Purpose of Embedded system.

Overview of Embedded Systems: embedded system design challenges, common design metrics and optimizing them. Processor Technology, IC Technology, Design Technology.

Self study: Microprocessors vs microcontrollers **10 Hrs**

UNIT-2

General Purpose Processor: Introduction, Basic Architecture, Operation, Programmer's View, Development Environment, Application-Specific Instruction-Set Processors (ASIPs), Selecting a Microprocessor.

Standard Single-Purpose Processors: Peripherals, Introduction, Timers, Counters, and Watchdog Timers, Timers and Counters, Watchdog Timers, UART, Pulse Width Modulators, LCD Controllers, Keypad Controllers, Stepper Motor Controllers, Analog-to-Digital Converters, Real-Time Clocks

Self study: General-Purpose Processor Design

10 Hrs

UNIT-3

Memory: Introduction, Memory Write Ability and Storage Permanence, Memory Types, ROM, Mask-Programmed ROM, OTP ROM, EPROM, EEPROM, Flash Memory, Read-Write Memory **—** RAM, SRAM,DRAM, PSRAM, NVRAM, Composing Memory, Memory Hierarchy and Cache, Advanced RAM, various DRAMs, DRAM Integration Problem, Memory Management Unit (MMU)

Interfacing: Introduction, Communication Basics, Microprocessor Interfacing: I/O Addressing, Interrupts, DMA, Advanced Communication Principles, Serial Protocols, Parallel Protocols, Wireless Protocols.

Self study: Arbitration **10 Hrs**

UNIT-4

Hardware Software Co-Design: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design: Data Flow Graph/Diagram (DFG) Model, Control Data Flow Graph/Diagram (CDFG), State Machine Model, Sequential Program Model, Concurrent/Communicating Process Model, Object Oriented Model, Unified Modeling Language (UML): UML Building Blocks, Things, Relationships, UML Diagrams.

Self study: The UML Tools **10 Hrs**

UNIT-5

Interrupts & RTOS: Basics - Shared Data Problem - Interrupt latency. Survey of Software Architecture, Round Robin, Round Robin with Interrupts - Function Queues - scheduling - RTOS architecture.

Introduction to RTOS: Tasks - states - Data - Semaphores and shared data - operating systems services - Massage Queues - Mail Boxes –Timers – Events - Memory Management.

Self study: Interrupt routines in an RTOS environment

10 Hrs

Text Books:

1. Introduction to Embedded Systems: Shibu K V, Tata McGraw Hill, 2015
2. Embedded System Design: A Unified Hardware/Software Introduction – Frank Vahid, Tony Givargis, John Wiley & Sons, Inc.2002
3. An Embedded software Primer- David E.Simon, Pearson Education, 2014

Reference Books:

1. Embedded Systems: Architecture and Programming, Raj Kamal, TMH.
2. Embedded C programming, Barnett, Cox &O'cull , Thomson (2005).

Course Title: OPERATING SYSTEM			
Course Code:P17EE654	**Semester: VI**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course content

Unit – 1

Introduction to operating systems

Overview: Need of operating systems, Computer System organization, Computer System architecture, Operating System structure, Operating System operations, Process management, Memory management, Storage management, Protection and security, , computing environments.

System structure: Operating System Services, User- Operating System interface, System calls, Types of system calls, System programs, Operating System design and implementation, Operating System structure, **10 Hrs**

Self Study: Distributed system, Virtual machines, System boot.

Unit – 2

Process management

Process concepts: Overview, Process scheduling, operations on processes, Inter-process communication.

Multi-Threaded Programming: Overview, Multi-threading models, Thread Libraries,.

Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple-Processor scheduling, **11 Hrs**

Self Study: thread scheduling, threading issues

Unit – 3

Process synchronization

Synchronization: Background, The Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, , Monitors

Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, **10 Hrs**

Self Study: Classical problems of synchronization, Deadlock detection and recovery from deadlock

Unit – 4

Memory and i/o management

Memory Management Strategies: Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation.

Virtual Memory Management: Background, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing.

I/O Systems: Overview, I/O hardware, Application I/O interface. **11 Hrs**

Self Study: STREAMS, Thrashing.

Unit – 5

Storage management and protection

File system: File concept, Access methods, Directory structure, File system mounting, File sharing, Protection.

Implementing File System: File system structure, File system implementation, Directory implementation, Allocation methods,.

Secondary storage structures: Mass storage structures, Disk structure, Disk attachment, Disk scheduling, Disk management,

Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights. **10 Hrs**

Self Study: Free space management, Swap space management.

Text Books:

1. **Operating System Principles –** Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 7th edition, Wiley-India, 2006.

Reference Books:

1. **Operating Systems: A Concept Based Approach** – D.M Dhamdhere, 2nd Edition, Tata McGraw- Hill, 2002.
2. **Operating Systems** – William Stallings, 5th Edition, PHI, 2006.

Course Title: PROGRAMMABLE LOGIC CONTROLLER & SCADA			
Course Code:P17EE661	**Semester: VI**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Content

Unit – I

Introduction: Introduction to Programmable Logic Controller(PLC),roll of PLC in automation, advantages and disadvantages, internal architecture, sourcing and sinking, PLC System, IEC Standards, Programming PLC, characteristics of I/O devices, input devices and output Devices(Relay, DC Motor, Stepper Motor)

Self study: List the forms and specifications of PLCs available from various manufacturers **10hrs**

Unit - II

Applications & I/O Processing: PLC applications (conveyor belt, lift, liquid level monitoring, packages on conveyor belt systems), I/O processing, input/output units, signal conditioning, serial and parallel communications, remote connections, networks, processing inputs I/O, addresses

Self study: Examples of Commercial Network systems **10hrs**

Unit – III

Programming & Internal Relays: ladder diagrams, function blocks, multiple outputs, location of stop and emergency switches, Instruction list, sequential function charts and structured texts, Internal Relay: Battery-backed relays, one-short operation, set and reset

Self study: Master control internal relay **10hrs**

Unit – IV

Timers, Counters & shift registers: Types of timers, On-delay timers, Off-delay timers, Pulse timer, Programming Examples, forms of counters, programming, up and down counting, timers with counters, sequencer, Shift registers, ladder programs

Self study: retentive timer, Timer/counter sequencer **10hrs**

Unit – V

Data handling & SCADA: registers and bits, data handling, Introduction to SCADA, Role of SCADA in automation, SCADA Architecture, Elements of SCADA ,Remote terminal unit, Master Terminal unit, Input/Output, Applications.

Self study: case study of a real time SCADA Application **10hrs**

Text Books:

1. w.Bolton, "Programmable Logic Controllers"- 6th edition, Elsevier-newness,2015
2. Jitender Singh, Monika Deswal, “PLC & SCADA” -laxmi publication,2015

Reference Books:

1. Stuart A. Boyer, “Scada: Supervisory Control And Data Acquisition”- 2nd edition,1999,the Instrumentation, Systems, and Automation Society
2. L.A.Bryan, E.A.Bryan,-"Programmable Controller Theory and applications"-2nd edition, An Industrial text company publication,1997.

Course Title: ILLUMINATION ENGINEERING			
Course Code:P17EE662	**Semester: VI**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

COURSE CONTENT

Unit – I

Sources of light: Day light, artificial light sources, energy radiation, visible spectrum of radiation, black body radiation and full radiator. Incandescence, Theory of gas discharge and production of light. **10Hrs**

Self study: Dependence of light output on temperature

Unit – II

Measurement of light: Radiometric and photometric quantities, units of measurement, standardization. Measurement of light distribution, direct and diffused reflection, fundamental concepts of colourimentry. **10Hrs**

Self study: Measurement of colour.

Unit – III

Types of lamps: GLS, Tungsten - halogen, Discharge, low pressure sodium vapour fluorescent, metal - halide, IR and VV lamps - their construction, filament material, theory of operation, life, characteristics. **10Hrs**

Self study: Applications of various lamps

Unit – IV

Design, objectives and specifications of lighting and systems: Design of luminance, basic lighting design, consideration and lighting parameters for extension lighting, interior lighting and day lighting. **10Hrs**

Self study: Electrical circuits and auxiliaries

Unit – V

Energy conservation in lighting: Perception of light and colour, optical system of human eye, eye as visual processor. Reflection, refraction. **10Hrs**

Self study: Behaviour of light

Text Book:

1. Wadha C L: Utilization of Electric Power - New Age International LtdEdition 2011.
2. Wadha C L: Generation, Distribution and Utilization of electrical energy - New Age International Ltd, Edition 2011.

Reference Books:

1. Singh, Electric Power Generation, Transmission & Distribution, PHI, Edition 2014.
2. Partab H: Art and Science of Utilization of Electrical Energy, DhanpatRai& Sons, Edition 2010.
3. Fink &Beaty - Standard Hand Book for Electrical Engineers - McGraw Hill International, Edition 2010.

Course Title: DESIGN OF ANALOG CONTROL SYSTEM			
Course Code:P17EE663	**Semester: VI**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Content

UNIT-I

Introduction and Design using PI, PD, PID Controllers:

Introduction: Design specifications, Controller configurations, and fundamental principles of design. Design with the PD controller: time domain interpretation of PD control, frequency domain interpretation of PD control, summary of effects of PD control. Design with the PI controller: time domain interpretation and design of PI control, and design of PI control. Design with PID controller.

Self Study: frequency domain interpretation **12 Hrs**

UNIT-II

Design using compensators: Introduction: classification of compensation, compensating networks-lead, lag, lag-lead. Polar & Bode plot of lead, lag, lag-lead compensators. Design of lead, lag and lag-lead compensators using Bode plot and Root locus method Effects and limitations of lag, lead.

Self Study:limitations of lag-lead compensation **12 Hrs**

UNIT-III

Design of control systems in state space:

Introduction, Design by pole placement, Necessary and Sufficient Condition for Arbitrary Pole Placement, Determination of Matrix K using Ackermann's Formula, Regulator system and Control system, Choosing the Locations of Desired Closed Loop Poles, solving Pole Placement problems with MATLAB, Design of servo systems, Design of Type1 servo systems when the plant has an Integrator.

Self Study: Unit step-response characteristics of the Designed System. **10 Hrs**

UNIT-IV

State observers: Full-order State Observer, State observer Gain Matrix K using Ackermann's Formula, , Transfer Function of the Observer-Based controller, Design of Regulator System with Observers

Self Study: Effects of the Addition of the Observer on closed loop system **8 Hrs**

UNIT-V

Quadratic optimal regulator systems: Quadratic optimal regulator problems. Reduced order Riccati equation, Design steps using reduced order Riccati equation.

Self Study: **8 Hrs**

TEXT BOOKS:

1. Automatic Control Systems, Benjamin.C.Kuo. PHI 7th& 8th edition,2002.

REFERENCE BOOKS:

1. Modern control systems, Katsuhiko Ogata. PHI 4th& 5th edition, 2010.
2. Control Systems- Principles and Design, M.Gopal,McGraw Hill, 4th edition,2012.
3. Control System Analysis and Design, A.K.Tripathi and Dinesh Chandra, New Age International (P) Ltd. First edition: 2009, Reprint: 2011.

Course Title: SWITCH MODE POWER SUPPLY			
Course Code:P17EE664	**Semester: VI**	**L-T-P-H(Hrs): 2-2-0-4**	**Credits –4**
Contact period : Lecture: 50Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course content

UNIT - I

DC – DC CONVERTERS (BASIC CONVERTERS): Linear voltage regulators (LVRs), a basic switching converter(SMPC), comparison between LVR & SMPC, principle of operation and analysis of buck converter analysis, inductor current ripple and output voltage ripple, capacitor resistance effect, synchronous rectification, design considerations, buck converter for discontinuous current operation, principle of operation and analysis of boost converter, inductor current ripple and output voltage ripple, inductor resistance effect, design considerations,

Self study: Boost converter for discontinuous current operation. **10 Hrs**

UNIT - II

Principle of operation and analysis of buck-boost converter analysis, inductors current ripple and output voltage ripple, design considerations, buck-boost converter for discontinuous current operation, principle of operation and analysis of CUK converter , inductor current ripple and output voltage ripple, capacitor resistance effect, design considerations.

Self study: Single Ended Primary Inductance Converter(SEPIC). **10 Hrs**

UNIT - III

DERIVED CONVERTERS: Introduction, transformer models, principle of operation and analysis of fly back converter-continuous and discontinuous current mode of operation, design considerations, principle of operation and analysis of forward converter, design considerations, double ended(Two switch) forward converter, principle of operational analysis of push-pull converter, design considerations, principle of operation and analysis of full bridge and half-bridge DC-DC converters, design considerations.

Self study: Current fed converters **10 Hrs**

UNIT - IV

RESONANT CONVERTERS: Introduction, resonant switch ZCS converter, principle of operation and analysis, resonant switch ZVS converter, principle of operation and analysis, series resonant inverter, series resonant DC-DC converter, parallel resonant DC-DC converter, series- parallel resonant DC-DC converter, resonant converters comparison.

Self study: Resonant DC link converter. **10 Hrs**

UNIT - V

POWER CONDITIONERS, UPS & FILTERS

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications .

Self study: Selection of capacitors **10 Hrs**

TEXT BOOKS

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rd Edition, Wiley India Pvt Ltd, 2010.
2. Daniel W Hart, "Power Electronics", Tata McGraw Hill, 2011.
3. Umanand L " Power Electronics- Essentials and Applications", Wiley 2011
4. Christophe P. Basso, "Switch-Mode Power Supplies Spice Simulations and Practical Designs" BPB Publication, 2010.

REFERENCE BOOKS

1. Umanand L and Bhatt S R, "Design of Magnetic Components for Switched Mode Power Converters", New Age International, New Delhi, 2001
2. H W Whittington, B W Fynn, "Switched Mode Power Supplies: Design and Construction", 1st Edition, Universities Press

Course Title: CONTROL SYSTEMS AND DSP LABORATORY			
Course Code:P17EEL67	**Semester: VI**	**L-T-P-H(Hrs): 0-0-3-3**	**Credits –1.5**
Contact period : Lecture: 36Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to

Control system Lab:

1. Provide the basic knowledge of how to use MATLAB for Control System & DSP concepts.
2. Simulate a typical second order system and to determine the step response.
3. Study the Compensating networks viz., Lag, Lead and Lag- lead compensating networks.
4. Study the effect of P, PI, PD and PID controller.
5. Draw the speed – torque characteristic of a two - phase A.C. servomotor and D.C. servomotor.
6. Draw the Root locus and Bode for the given transfer function.

DSP - Lab:

1. Illustrate the Verification of sampling theorem.
2. Determine the impulse response and step response of a given system.
3. Determine the Circular convolution and Linear convolution of two given sequences.
4. Compute the N - point DFT of a given sequence and IDFT for given DFT points.
5. Design of Butterworth Low Pass IIIR filter

List of experiments

Control system Lab:

1. Provide the basic knowledge of how to use MATLAB for Control System & DSP concepts.
2. Simulate a typical second order system and to determine the step response.
3. Study the Compensating networks viz., Lag, Lead and Lag- lead compensating networks.
4. Study the effect of P, PI, PD and PID controller.
5. Draw the speed – torque characteristic of a two - phase A.C. servomotor and D.C. servomotor.
6. Draw the Root locus and Bode plots for the given open loop transfer function.

DSP - Lab:

7. Illustrate the Verification of sampling theorem.
8. Determine the impulse response and step response of a given system.
9. Determine the Circular convolution and linear convolution of two given sequences.
10. Compute the N - point DFT of a given sequence and IDFT for given DFT points.
11. Design of Butterworth Low Pass IIR filter

Course Outcome

After conducting all the experiments the student is able to

1. Analyse the performance of any second order system. (L4)
2. Analyse the effects and limitations of Lag, Lead, Lag-Lead compensators. (L4)
3. Explain the importance of different types of PID controllers.(L3)
4. Explain the behaviour of AC &DC Servo motors. (L3)
5. Analyse the performance and stability of lower and higher systems.(L4)
6. Demonstrate the Verification of sampling theorem. (L3)
7. To determine the impulse response and step response of a given system. (L5)
8. Compute the Circular and Linear convolution of two given sequences. (L3)

9. Compute the N - point DFT and IDFT (L4)
10. Design of Butterworth Low Pass IIR filter (L5)

Course Articulation Matrix (CAM)												
Course Outcome (CO)			**Program outcome** (ABET/NBA-(3a-k))									
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
01	Analyze the performance of any second order electrical system.	**L4**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
02	Analyze the effects and limitations of Lag, Lead, and Lag-Lead compensating networks Lag-Lead compensators.	**L4**	**L**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
03	Explain the importance of different types of PID controllers	**L3**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
04	Explain the behavior of AC &DC Servo motors.	**L3**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
05	Analyze the performance and stability of lower and higher systems	**L4**	**L**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
06	Demonstrate the Verification of sampling theorem.	**L3**	**M**	**M**	**-**	**-**	**-**	**-**		**-**	**-**	**-**	**-**
07	Determine the impulse response and step response of a given system	**L5**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
08	Compute the Circular and Linear convolution of two given sequences.	**L3**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
09	Compute the N - point DFT and IDFT	**L4**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
10	Design of Butterworth Low Pass IIR filter	**L5**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	L-Low, M-Moderate, H-High												

Course Assessment Matrix (CAM)												
Course Outcome (CO)			**Program outcome**(ABET/NBA-(3a-k))									
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
01	Analyze the performance of any second order electrical system.	**L4**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
02	Analyze the effects and limitations of Lag, Lead, and Lag-Lead compensating networks Lag-Lead compensators.	**L4**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
03	Explain the importance of different types of PID controllers	**L3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
04	Explain the behavior of AC &DC Servo motors.	**L3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
05	Analyze the performance and stability of lower and higher systems	**L4**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
06	Demonstrate the Verification of sampling theorem.	**L3**	**2**	**2**	**-**	**-**	**-**	**-**		**-**	**-**	**-**	**-**
07	Determine the impulse response and step response of a given system	**L5**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
08	Compute the Circular and Linear convolution of two given sequences.	**L3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
09	Compute the N - point DFT and IDFT	**L4**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
10	Design of Butterworth Low Pass IIR filter	**L5**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	1-Low, 2-Moderate, 3-High												

Course Title:ELECTRICAL AUTO CAD			
Course Code:P17EEL68	**Semester: VI**	**L-T-P-H(Hrs): 0-0-3-3**	**Credits –1.5**
Contact period : Lecture: 36Hrs, Exam 3 Hrs		**Weightage : CIE:50; SEE:50**	

Course Learning Objectives (CLOs)

This course aims to

1. Students should be able to draw single line diagram.
2. Students should be able to develop the AC and DC Winding diagrams.
3. Students should be able to draw the elevation of transformer and DC Machine.

List of experiments

1. Draw Single Line Diagrams of generating station and substation.
2. Draw layout diagram of Hydro, Thermal and Nuclear power plant.
3. Develop winding diagrams of D.C. machines Simplex single layer Lap and wave winding.
4. Develop winding diagrams of D.C. machines Simplex double layer Lap and wave winding.
5. Develop winding diagrams of D.C. machines Duplex single layer Lap and wave winding.
6. Develop winding diagrams of D.C. machines Duplex double layer Lap and wave winding.
7. Develop winding diagrams of A.C. machines Integral slot full pitched single layer Lap and Wave windings.
8. Develop winding diagrams of A.C. machines Integral slot full pitched Double layer Lap and Wave windings.
9. Develop winding diagrams of A.C. machines Fractional pitched full pitched single layer Lap and Wave windings.
10. Develop winding diagrams of A.C. machines Fractional pitched full pitched single layer Lap and Wave windings.
11. Draw the Electrical machine assembly drawing for single and three phase core type transformer.
12. Draw the Electrical machine assembly drawing for single and three phase shell type transformer.

Course outcome:

CO1: Draw the single line diagram of Generating station, Receiving station and Substation.
CO2: Design the AC and DC windings in Lap and Wave winding.
CO3: Develop the Electrical machine assembly drawings.

Topic learning Objectives (TLOs):

1. To analyze and to draw the single line diagram of stations.
2. To analyse and to draw the layout diagram of some generating stations.
3. To design the winding diagrams of D.C. machines Simplex single layer Lap and wave winding.
4. To design the winding diagrams of D.C. machines Simplex double layer Lap and wave winding.
5. To design the winding diagrams of D.C. machines Duplex single layer Lap and wave winding.
6. To design the winding diagrams of D.C. machines Duplex double layer Lap and wave winding.
7. To design the winding diagrams of A.C. machines Integral slot full pitched single layer Lap and Wave windings.
8. To design the winding diagrams of A.C. machines Integral slot full pitched Doublelayer Lap and Wave windings.

9. To design the winding diagrams of A.C. machines Fractional pitched full pitched single layer Lap and Wave windings.
10. To design the winding diagrams of A.C. machines Fractional pitched full pitched single layer Lap and Wave windings.
11. To develop the Electrical machine assembly drawing for single and three phase core type transformer.
12. To develop the Electrical machine assembly drawing for single and three phase shell type transformer.

Text Book:

1. Performance& Design of Alternating Current machines, M. G. Say, CBS publishers,3rd Edition, 2002.
2. The Performance & Design of DC machines A.E Clayton &N.N.H ancock CBS Publication,3rd Edition, 2004.

Reference Books:

1. Electrical Drafting – S F Devalapur.,Eastern Book Promoters, Belgaum, 2006.
2. Manuals of Auto – CAD

Course Outcomes:	**Program Outcomes:**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1. Students should be able to draw single line diagram.	**L**	**S**	**M**									
2.Students should be able to develop the AC and DC Winding diagrams.	**M**	**L**	**S**									
3. Students should be able to draw the elevation of transformer and DC Machine.	**M**	**S**	**L**									

Course Title : Aptitude and Reasoning Development - EXPERT (ARDE)			
Course Code : P17HU610	Semester : VI	L:T:P:H -0:0:2:2	Credits: 1
Contact Period: Lecture: 32 Hr, Exam: 3 Hr	Weightage: CIE:50%; SEE:50%		
Pre requisites : Number system, Concept of percentage, Analytical reasoning-2.			

Course Learning Objectives (CLOS)

This course aims to

1. Explain different types of functions, representation of different functions on the graphs.
2. Describe the properties of quadratic equations and application of quadratic equations.
3. Demonstrates the principle of counting.
4. Differentiates between permutation and combination and solve problems conceptually.
5. Predict the probabilities in different scenarios and its application in our day-to-day life.
6. Evaluate the cause and effect of the statements logically.
7. Recognize different ways in which a statement can be strengthened or weakened.
8. Explain the criticality of data sufficiency chapter., universal methodology to solve any problem.
9. Analyse the data in a bar graph , pie chart and tabular column and line graph and the combination of these graphs.
10. Compare the data in different format and understand the difference between them

Course Content

UNIT – I

Functions and Quadratic equations:

Functions: Basic methods of representing functions– Analytical representation, tabular representation, graphical representation of functions. Even and odd functions, Inverse of a function, Shifting of graph. Representation of standard set of equations. Methodology to tackle inverse functions. Graphical process for solving inequalities, graphical view of logarithmic function.

Quadratic equations: Theory, properties of quadratic equations and their roots, the sign of quadratic equation, Equations in more than one variable. Simultaneous equations, number of solutions of the simultaneous equations. **6 Hours**

UNIT – II

Permutation and Combination: Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of 2^n, Arrangement in a circle.

Probability: Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes. **8 Hours**

UNIT – III

Analytical reasoning 3: Punch line: Introduction, format of the problem, An analysis, Does a suggested statement qualify as a punch line?. If a given statement fits as a punch line, what is its idea or wavelength?, The complete method of solving a punch line problem, Solved examples, conclusion, Sample company questions.

Strengthening and Weakening arguments: Format of the problem, An analysis, Suggested methods, solved examples, conclusion, sample company questions.

Cause and Effect : Cause and Effect—A theoretical discussion, Immediate cause, Principal cause, A quick check– Cause always antecedent. The strategy for solution. **6 Hours**

UNIT- IV

Data Sufficiency: Introduction, answer choices in data sufficiency, tips to solve data sufficiency problems, directions of questions, classification of sections in data sufficiency– Number system, Algebra, series and sequence, logical, geometry and mensuration, arithmetic. **6 Hours**

UNIT- V

Data Interpretation: Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data– Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs **6 Hours**

Reference Books:

1. **"The Trachtenberg speed system of basic mathematics**, published by Rupa publications.
2. **CAT Mathematics** by Abhijith Guha. published by PHI learning private limited.
3. **Quantitative aptitude** by Dr. R. S Agarwal, published by S.Chand private limited.
4. **Verbal reasoning** by Dr. R. S Agarwal , published by S. Chand private limited.
5. **Quantitative aptitude** for CAT by Arun Sharma, published by McGraw Hill publication.
6. **Analytical reasoning** by M.K Pandey BSC PUBLISHING.CO.PVT.LTD

Course Outcomes (CO)

After learning all the units of the course, the student is able to:

1. Graphically represent the functions and analyze it.
2. Infer the conclusions based on the roots obtained by solving quadratic equations and establish relationship between them.
3. Effective solve the problems of permutation and combination.
4. Predict different possibilities by the principle of probability.
5. Interpret the data given in the graphical format and infer the results.

Analyze the statement critically and solve the questions from verbal logic.

A. Course Articulation Matrix (CAM)															
Course Outcome (CO)	**Program Outcome (ABET/NBA-(3a-k))**														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Graphically represent the functions and analyze it.	L5	2	-	-	-	2	-	-	-	-	-	-	-	-	-
Infer the conclusions based on the roots obtained by solving quadratic equations and establish relationship between them.	L6	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Effective solve the problems of permutation and combination.	L4	3	-	-	-	2	-	-	-	2	-	-	-	-	-
Predict different possibilities by the principle of probability.	L3	3	-	-	-	-	-	-	-	2	-	-	-	-	-
Interpret the data given in the graphical format and infer the results.	L5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
L- Low, M- Moderate, H-High															