AMRITSAR GROUP OF COLLEGES, AMRITSAR

DEPARTMENT OF ELECTRICAL ENGINEERING

Study Scheme & Syllabus

B.Tech.(Electrical Engineering)

(Batch: 2021 Onwards)

AMRITSAR GROUP OF COLLEGES

(Autonomous status conferred by UGC under UGC act-1956, (2f), NAAC-A Grade)

DEPARTMENT OF ELECTRICAL ENGINEERING

Programme Outcomes (POs)

	POs	Graduate Attributes
PO 1	Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems	Engineering knowledge
PO 2.	Identify, formulate and analyze complex engineering problems in the field of Electrical Engineering.	Problem analysis
PO 3.	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the cultural, societal and environmental considerations.	Design/development of solutions
PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in the field of Electrical Engineering.	Conduct investigations of complex problems
PO 5	Create, select and apply appropriate techniques, resources, and modern engineering for modeling of complex engineering activities in the field of Electrical Engineering.	Modern tool usage
PO 6	Apply reasoning by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	The engineer and society
PO 7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	Environment and sustainability
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	Ethics
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	Individual and team work
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations.	Communication
PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments	Project management and finance
PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	Life-long learning

Programme Specific Outcomes (PSOs)

PSO 1	Able to understand, design and implement the various electrical Networks, Transmission and distribution networks for various industrial and research purposes.
PSO 2	Able to excel in various electrical software/project competitions and technological challenges in the modern era.
PSO 3	Able to gain practical competency with emerging technologies, electrical devices and Instrumentations.

3rd Semester	B. Tech. (Electrical Engineering)							
Course code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGEE - 21301	Engineering Mathematics-III	3	1	-	40	60	100	4
AGEE - 21302	Network Analysis and Synthesis	3	1	-	40	60	100	4
AGEE- 21303	Transformers and Direct Current Machines	3	1	-	40	60	100	4
AGEE- 21304	Semiconductor Devices and Circuits	3	1	-	40	60	100	4
AGEE - 21305	Electrical Measurements and Instrumentation	3	-	-	40	60	100	3
AGEE- 21306	Machine Lab. - I	-	-	2	30	20	50	1
AGEE- 21307	Semiconductor Devices and Circuits Lab	-	-	2	30	20	50	1
AGEE - 21308	Electrical Measurements and Instrumentation Lab	-	-	2	30	20	50	1
AGFE - 21301	Functional English - I	-	-	1	50	0	50	1
AGMC-21301	Indian Constitution	-	-	1	-	-	-	-
AGEE - 21309	Institutional Training	-	-	2	60	40	100	1
		15	**4**	**10**	**400**	**400**	**800**	**24**
	Contact Hours=	**29**						
AGMD - EE01	Minor - 1* (Network Analysis and Synthesis)	3	1	-	40	60	100	4

4th Semester	B. Tech. (Electrical Engineering)							
Course code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGEE - 21401	Linear Control Systems	3	1	-	40	60	100	4
AGEE - 21402	Asynchronous Machines	3	1	-	40	60	100	4
AGEE - 21403	Power Generation and Economics	3	1	-	40	60	100	4
AGEE - 21404	Digital Electronics and Microprocessors	3	1	-	40	60	100	4
AGEE - 21405	Object Oriented Programming System	3	-	-	40	60	100	3
AGEE - 21406	Control System Lab.	-	-	2	30	20	50	1
AGEE - 21407	Digital Electronics and Microprocessors Lab.	-	-	2	30	20	50	1
AGEE - 21408	Object Oriented Programming System Lab.	-	-	2	30	20	50	1
AGAP - 21401	Engineering Aptitude - I	-	-	1	50	0	50	1
AGFE - 21402	Functional English - II	-	-	1	50	0	50	1
AGMC-21401	Essence of Indian Knowledge Tradition	-	-	1	-	-	-	-
		15	**4**	**9**	**390**	**360**	**750**	**24**
	Contact Hours=	**28**						
AGMD - EE02	Minor - 2* (Asynchronous Machines)	3	1	-	40	60	100	4

5th Semester	B. Tech. (Electrical Engineering)							
Course code	Course Name	Load			Marks Distribution		Total Marks	Credit
		L	T	P	Internal	External		
AGEE - 21501	Synchronous Machines	3	1	-	40	60	100	4
AGEE - 21502	Electrical Power System-I	3	1	-	40	60	100	4
AGEE - 21503	Power Electronics	3	-	-	40	60	100	3
AGEE - 21504x	Elective - I	3	-	-	40	60	100	3
AGEE - 21505	Programming in Python	1	-	4	30	20	50	3
AGEE - 21506	Machine Lab. - II	-	-	2	30	20	50	1
AGEE - 21507	Power Electronics Lab.	-	-	2	30	20	50	1
AGEE - 21508	Electrical: Estimation & Costing Lab.	-	-	2	30	20	50	1
AGAP - 21502	Engineering Aptitude - II	-	-	1	50	0	50	1
AGEE - 21509	Summer Training	-	-	-	60	40	100	1
		13	**2**	**11**	**390**	**360**	**750**	**22**
	Contact Hours=	**26**						
AGMD - EE03x	Minor - 3*	**3**	1	-	40	60	100	4

6th Semester	B. Tech. (Electrical Engineering)							
Course code	Course Name	Load			Marks Distribution		Total Marks	Credit
		L	T	P	Internal	External		
AGEE - 21601	Electrical Power System-II	3	1	-	40	60	100	4
AGEE - 21602	Advanced Control Systems	3	1	-	40	60	100	4
AGEE - 21603	Signal and Systems	3	-	-	40	60	100	3
AGEE - 21604x	Elective - II	3	-	-	40	60	100	3
AGEE - 21605	AutoCAD Electrical	1	-	4	30	20	50	3
AGEE - 21606	Power System Lab.	-	-	2	30	20	50	1
AGEE- 21607x	Elective - III	-	-	2	30	20	50	1
AGEE - 21608	Signal and Systems Lab.	-	-	2	30	20	50	1
AGFE - 21603	Functional English - III	-	-	1	50	0	50	1
AGAP - 21603	Engineering Aptitude - III	-	-	1	50	0	50	1
		13	**2**	**12**	**380**	**320**	**700**	**22**
	Contact Hours=	**27**						
AGMD -EE04x	Minor - 4*	**3**	-	-	40	60	100	3
AGMD -EE05x	Minor - 5*	-	-	2	30	20	50	1

7th/8th Semester	B. Tech. (Electrical Engineering)							
Course code	**Course Name**	**Load**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGEE - 21701	Power System Analysis	3	1	-	40	60	100	4
AGEE - 21702x	Elective - IV	3	-	-	40	60	100	3
AGEE - 21702x	Elective - V	3	-	-	40	60	100	3
AGEE - 21703	Power System Analysis Lab.	-	-	2	30	20	50	1
AGOE 2170x	Open Elective -I	3	-	-	40	60	100	3
AGEE - 21704	Project	-	-	4	60	40	100	2
		12	**1**	**6**	**250**	**300**	**550**	**16**
	Contact Hours=	**19**						
AGMD - EE06x	Minor - 6*	3	-	-	40	60	100	3

7th/8th Semester	B. Tech. (Electrical Engineering)							
Course code	**Course Name**	**Load**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGEE - 21801	Industrial Training	-	-	-	300	200	500	12
		0	**0**	**0**	**300**	**200**	**500**	**12**
	Contact Hours=	**0**						

List of Professional Elective Courses for B. Tech. (Electrical Engineering)

	AGEE - 21504x	AGEE - 21604x	AGEE - 21607x	AGEE - 21702x	AGEE - 21702x
x	Elective - I	Elective - II	Elective - III	Elective - IV	Elective - V
A	Electromagnetic Fields	Microcontroller, PLC & SCADA	Microcontroller, PLC & SCADA Lab.	Smart Grid: Basics to Advanced Technologies	
B	Antenna and Wave Propagation	Embedded System Design	Embedded System Design Lab.	Electrical Distribution System Analysis	
C	Power Quality and FACTS	Robotics and Automation	Robotics and Automation Lab.	Economic Operations and Control of Power Systems	
D	Energy Efficient Machines	Digital Signal Processing	Digital Signal Processing Lab.	Advances in UHV Transmission and Distribution	
E					Modeling, Analysis and Estimation of Three Phase Unbalanced Power Network
F					Electrical Vehicle Technology
G					Sensor Technologies
H					Design of Photovoltaic Systems

List of Open Elective Courses	
AGOE - 21701	Air Pollution and Control
AGOE - 21702	Disaster Management
AGOE - 21703	Product Design and Development
AGOE - 21704	Material Management
AGOE - 21705	Non - Conventional Energy Sources
AGOE - 21706	Electrical Power Utilization
AGOE - 21707	Software Engineering Methodologies
AGOE - 21708	Fundamentals of Information Security
AGOE - 21709	Management of Human Resources
AGOE - 21710	Basics of Management

3rd Semester

3rd Semester	Mathematics – III				
AGEE - 21301					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Solve Algebraic and Transcendental equations, linear system of equations using gauss elimination, Jordan and Seidel. Enable the students to learn the properties of Linear Transformation
CO2	Apply Numerical Methods to find the solution of equation using different methods like Euler method, RK Methods, how we can fit a given data in equations.
CO3	Use the concept of Fourier Series and different wave forms, know about Laplace transform and its properties: use of Laplace transform of various standard functions
CO4	Learn the formation of partial differential equations
CO5	Apply partial differential equation to solve various problems of heat conduction and wave equation.
CO6	Know the concept of complex variables, complex integration and its applications.

Part	Content	CO
I	**Solution of Algebraic and Transcendental equations**: Bisection method, Regula False position method and Newton – Raphson method. **Solution of Linear Systems of Equations**: Gauss - elimination method, gauss- Jordan method.	CO1
II	**Differential Equations**: Solutions of Initial values problems using Euler method and Runge- kutta (upto fourth order) methods. *Curve fitting: fitting of data in straight line, second order equation **Fourier series**: Periodic Functions, Euler's Formula. Even and odd Functions, Half range expansions. **Laplace transformations**: Laplace transforms of various standard functions, properties of Laplace transform, Inverse Laplace transform and its properties.	CO2 & CO3
III	**Partial Differential Equations**: Formation of Partial Differential Equations, Solution of Homogeneous Partial Differential Equations with constant coefficients. **Applications of Partial Differentiation** : Wave Equation and Heat conduction Equation in one dimension	CO4 & CO5
IV	**Function of Complex Variable**: Analytic function, Cauchy Riemann Equations, harmonic function, Cauchy Residue theorem, poles, residues, Integration of function of complex variables using the method of residues.	CO6

References:

(i) E. Kreyszig," Advanced Engineering Mathematics", 5th Edition, Wiley Eastern 1985.
(ii) P. E. Danko, A. G. Popov, T. Y. A. Kaznevnikova, " Higher Mathematics in Problems and Exercise", Part 2, Mir Publishers, 1983.
(iii) Bali, N. P., "A Text Book on Engineering Mathematics", Luxmi Pub., New Delhi.
(iv) Peter V.O'Neil," Advanced Engineering Mathematics", Cengage Learning.

3rd Semester	Network Analysis and Synthesis				
AGEE-21302					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand method of analysis of the circuits by using different theorem & to calculate Z, Y, ABCD and h parameter for two port networks.
CO2	Study different transient conditions using Laplace technique and to prove convolution theorem.
CO3	Design different types of filters and their analysis.
CO4	Detail comparison of different existing filter networks.
CO5	Understand and apply the knowledge gained in analysis and design of different types of circuits.
CO6	Understand and apply method of synthesis of network using foster and causer forms.

Part	Content	CO
I	**CIRCUITS CONCEPTS :** Independent and dependent sources, loop currents and loop equations, node voltage and node equations, Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity. **TWO PORT NETWORK:** Terminal Pair, Relationship of two variables, impedance parameters, Admittance Parameters, Transmission Parameters, and Hybrid Parameters, interconnection of two port network. **TIME AND FREQUENCY DOMAIN ANALYSIS:** Representation of basic circuits in terms of generalized frequency and their response, Laplace transform of shifted functions, transient and steady response, Time domain behaviors from poles and zeros, Convolution Theorem.	CO1 & CO2
II	**FILTERS SYNTHESIS:** Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T-section, π-section, terminating half section, Pass bands and stop bands, Design of constant-K, m-derived filters, Composite filters.	CO3 & CO4
III	**NETWORK SYNTHESIS:** Network functions, Impedance and admittance function, Transfer functions, Relationship between transfer and impulse response, poles & zeros and restrictions, Network function for two terminal pair network, Sinusoidal network in terms of poles & zeros.	CO5

IV	Realizability condition for impedance synthesis of RL , RC & LC Immittance functions, Network synthesis techniques for 2-terminal network, Foster and Causer forms.	CO6

References:

(i) Bird John, *Electrical Circuit Theory and Technology*, 2nd Ed., Newnes
(ii) Chakraborty, Abhijit, *Circuit Theory*, 2nd Edition, Dhanpat Rai, 2001
(iii) Chaudhury D. Roy, *Networks & Synthesis*, New Age International.
(iv) Edminister J.A., *Electric Circuits*, 4th Edition, Tata McGraw Hill, 2002
(v) Iyer T.S.K.V., *Circuit Theory*, Tata McGraw Hill, 2006
(vi) Mohan, Sudhakar Sham, *Circuits & Networks Analysis and Synthesis*, 2nd Edition, Tata Mc Graw Hill, 2005
(vii) Van Valkenberg, M.E., *Network Analysis & Synthesis*, PHI learning, 2009 8. Van Valkenberg, M.E., *Network Analysis & Synthesis*, 3rd Edition, Pearson Education, 2006
(viii) http://nptel.ac.in/courses/108102042/
(ix) https://pdfree.org/pdf/downloads/circuit-theory-analysis-and-synthesis-chakrabarti.pdf

3rd Semester	Transformers and Direct Current Machines				
AGEE-21303					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the various concepts related to single phase transformer
CO2	Explore mathematical concepts related to transformer.
CO3	Understand various concepts related to auto transformer
CO4	Understand the various concepts related to 3 phase transformers.
CO5	Describe about DC Generator.
CO6	Describe about DC Motor

Part	Content	CO
I	**SINGLE PHASE TRANSFORMERS:** Introduction to transformers types, Working principle, construction of single-phase transformer, EMF equation, phasor diagram, Testing -open circuit and short circuit tests, separation of hysteresis and eddy current losses, equivalent circuit, parameters estimation, voltage regulation and efficiency, back-to-back test. Ideal Transformer, Dot Convention, Parallel operation of single-phase transformers.	CO1 & CO2
II	**AUTO TRANSFORMERS:** Principle of operation, equivalent circuit and phasor diagrams, comparison with two winding transformer.	CO3
III	**THREE-PHASE TRANSFORMERS:** Different types of winding connections, Benefits of different types of transformer: Y-Y, Y-Δ, Δ-Y, Δ-Δ, Open Delta, Parallel operation of three phase transformers. Three winding transformer's equivalent circuit, Phase Conversion: Scott connections, three phase to six phase conversion, Cooling of Transformer	CO4
IV	**D.C. GENERATOR:** Working principle, construction of DC Machines, Armature windings, E.M.F. and torque equations, armature reaction, effect of brush shift, compensating winding, commutation, causes of bad commutation, methods of improving commutation, methods of excitation of d.c. generators and their characteristics. **D.C. MOTOR**: Working principle characteristics, starting of shunt, series motor and compound motor, Starters: 3-point and 4-point, speed control methods: field and armature control. Braking: plugging, dynamic and regenerative braking, Testing: Swinburn's test, Hopkinson test, Field test. Estimation of losses and efficiency. Applications of DC motor.	CO5 & CO6

References:

(i) Bhimbra P.S., *Electrical Machinery, Khanna Publishers.*

(ii) Fitzgerald A.E., Kingsley C. and Umans S.D., *Electric Machinery*, 6th Edition, McGraw Hill

(iii) Langsdorff E.H., *Principles of D.C. machines*, McGraw Hill

(iv) Nagrath I.J. and Kothari D.P., *Electrical Machines*, 4th Edition, Tata McGraw Hill,

(v) Say M G, *Alternating Current Machines*, 5th edition, Sir Isaac Pitman & Sons Ltd.

(vi) http://nptel.ac.in/courses/108105017/

(vii) https://sites.google.com/site/eeenotes2u/courses/electrical-machines-1-2

3rd Semester	Semiconductor Devices and Circuits				
AGEE-21304					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the concept of semiconductor materials, PN diode and special purpose diodes
CO2	Understand the implementation and usage of various transistors and their current components
CO3	Understand the common transistor characteristics and operating point stabilization
CO4	Understand the hybrid transistor models and feedback concept of amplifiers
CO5	Understand the basic concept of oscillators and their types
CO6	Understand and analyze the differential and operational amplifiers

Part	Content	CO
I	**SEMICONDUCTOR DIODE:** Intrinsic and Extrinsic Silicon Energy Bands Theory of PN junction diode, Volt Ampere Characteristics, Temperature Dependence of PN diode, and Photo- diodes, Tunnel diode, Zener diode as Voltage Regulator.	CO1
II	**TRANSISTORS, CHARACTERISTICS AND BIASING:** Transistor, Types of Transistor, Transistor current components, Transistor as an Amplifier, Transistor characteristics in CB, CE and CC modes. Operating point, bias stability, stabilization against reverse saturation current, voltage across base emitter junction and beta, Construction, Characteristics & applications of Junction Field Effect Transistor (JFET), and MOSFET.	CO2 & CO3
III	**LOW & HIGH FREQUENCY TRANSISTOR MODEL FEEDBACK AMPLIFIERS AND OSCILLATOR:** Transistor Hybrid Model, h parameter equivalent circuit of transistor, Analysis of transistor amplifier using h-parameters in CB, CE and CC configuration. Basics of Class A power amplifier, Class B, Class AB, Push-pull and Class C amplifiers. Feedback Concept, Effect of negative feedback on gain, bandwidth, stability, distortion and frequency Response,	CO4
IV	Sinusoidal Oscillators, criterion for oscillation, Principle of operation of oscillators: RC Phase Shift, Wein Bridge, Hartley, Colpitts oscillator. **DIFFERENTIAL, MULTISTAGE AND OPERATIONAL AMPLIFIERS:** Introduction to IC's, Differential and power amplifier, direct coupled multistage amplifier, ideal op-amp, non-idealities in an op-amp (output offset voltage, input bias current, input offset current and slew rate, inverting and non-inverting amplifier.	CO5 & CO6

References:

(i) Electronic Devices & Circuits by J.B.Gupta, Katson Publishers

(ii) Electronic Devices & Circuits by Millman- Halkias, Tata Mcgraw Hill

(iii) Electronic Devices & Circuits by S.K Sehdev

(iv) Electronic Devices & Circuits Theory by Boylested, Pearson Education.

3rd Semester	Electrical Measurements and Instrumentation				
AGEE - 21305					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course:	
CO1	Analyze and study the various bridges used for measurement purposes
CO2	Understand the concept of analog measuring tools
CO3	Understand the utility and applications of digital measuring instruments
CO4	Understand the concept of DC and AC potentiometers
CO5	Understand about the magnetic measurement methods and about their losses
CO6	Understand the basic principle and types of transducers and tachogenerators

Part	Content	CO
I	**BRIDGES:**Sources and Detectors, General equation for bridge balance, Wheatstone bridge and its sensitivity analysis, Kelvin double bridge, AC bridges: applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering bridge, Wien bridge, DeSauty's bridge, Wagner Earthling Device.	CO1
II	**GENERAL THEORY OF ANALOG AND DIGITAL MEASURING INSTRUMENTS:** Operating torque, damping & controlling torque, T/W ratio, Pointers & Scales. Principles of operation of various types of electro mechanical indicating / registering instruments viz. PMMC, dynamometer, Digital storage oscilloscope, spectrum analyzer, Digital frequency meter	CO2 & CO3
III	**POTENTIOMETERS:** Basic D.C. / A.C. potentiometer circuit, Modern form of D.C. potentiometer, Resistance and calibration of voltmeter & ammeter using D.C. potentiometer, volt ratio box.	CO4
IV	.**MAGNETIC MEASUREMENTS and TRANSDUCERS** : Flux meter, B-H Curve, Hysteresis loop, iron loss measurement by Wattmeter and Bridge methods.Electrical transducer, Basic principles of Photovoltaic transducers, Photo and digital transducers. Basic principles of Inductive transducers, Capacitive transducers, Thermoelectric, Piezo electric transducers. Tachogenerators	CO5 & CO6

References:

(i) Bell David A., *Electronics Instrumentation and Measurements,* Prentice Hall, India
(ii) Golding Edward William and Widdis Frederick Charles, *Electrical Measurements and Measuring instruments,* Wheelers India
(iii) Helfrick A.D. and Cooper W.D., Modern *Electronic Instrumentation. &Measurement Techniques,* Prentice Hall
(iv) Murthy D. V. S., Transducers and Instrumentation, Prentice-Hall, India
(v) Sawhney A. K., *A Course in Electrical &Electronics Measurement &Inst*rumentation., Dhanpat Rai & Sons.

3rd Semester	Machine Lab.-I				
AGEE-21306					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Analyze the performance of single-phase transformer
CO2	Understand experimentally the various concepts of transformers i.e. voltage regulation, efficiency etc.
CO3	Perform the parallel operation of transformer
CO4	Analyze the performance of DC motor transformer
CO5	Understand virtual contents related with laboratory
CO6	Understand the design of winding in transformer and dc machines

Part	Content	CO
I	• To perform Open circuit and short circuit tests on a single-phase transformer and hence find equivalent circuit, voltage regulation and efficiency. Also do it under different loading conditions.	CO1
II	• To perform parallel operation of two single phase transformers. • To perform Scott connections on three phase transformer to get two phase supply. • To obtain load characteristics of direct current (D.C.) shunt/series /compound generator. Also draw its speed – torque characteristics.	CO2 & CO3
III	• To perform Swinburne's test (no load test) to determine losses of direct current (D.C.) shunt motor. • To observe the magnetic field behavior in a coil. • To observe speed control of D.C. motor by field resistance control.	CO4 & CO5
IV	• To design the core and winding of a single-phase transformer. • To design the core and winding of a D.C. machine.	CO6

References:

(i) Bhimbra P.S., *Electrical Machinery, Khanna Publishers.*

(ii) Nagrath I.J. and Kothari D.P., *Electrical Machines*, 4th Edition, Tata McGraw Hill,

3rd Semester	Semiconductor Devices and Circuits Lab.				
AGEE-21307					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Implement Zener diode characteristics in physical and virtual form
CO2	Understand and calculate the transistor characteristics in different configurations
CO3	Understand and demonstrate the oscillator characteristics
CO4	Understand and analyze the characteristics of operational amplifier
CO5	Understand and analyze the operational amplifier waveshapes virtually
CO6	Understand and implement of different minor projects using semiconductor components

Part	Content	CO
I	• To implement and design a voltage regulator circuit with help of Zener diode on kit as well as with the help of a virtual lab.	CO1
II	• To determine the input and output characteristics of common base configuration. • To determine the input and output characteristics of common emitter configuration. • To analyse the operation of Wein Bridge oscillator.	CO2 & CO3
III	• To analyse the inverting and non-inverting properties of operational amplifier using virtual lab. • To perform a virtual Lab with Function generator using operational amplifier (sine, triangular & square wave)	CO4 & CO5
IV	• To construct a simple power supply circuit • Project based on 3X3X3 LED Cube using 555 Timer and CD4020 IC. • Project based on temperature controlled automatic switch. • Project based on broken wire detector circuit using IC CD 4069. • Any other project of their choice.	CO6

References:

(i) Electronic Devices & Circuits by J.B.Gupta, Katson Publishers

(ii) Electronic Devices & Circuits by Millman- Halkias, Tata Mcgraw Hill

(iii) Electronic Devices & Circuits by S.K Sehdev

(iv) Electronic Devices & Circuits Theory by Boylested, Pearson Education.

3rd Semester	Electrical Measurements and Instrumentation Lab				
AGEE - 21308					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course:	
CO1	Understand the characteristics of LDR and RTD sensor
CO2	Evaluate the earth resistance and insulation
CO3	Understand the working of CRO in detail
CO4	Understand experimentally the working of LVDT
CO5	Virtually analyze the working of Q meter and measure the capacitance of Schering bridge
CO6	Construct minor projects related to electrical measurements and instrumentation

Part	Content	CO
I	To Study the characteristics of (i) Light measurement using LDR and photo cell sensor (ii) Resistance Temperature Detector (RTD)	CO1
II	To measure Insulation and Earth Resistance. Determination of frequency and phase angle using CRO	CO2 & CO3
III	Performance analysis of linear variable differential transducer. To measure the quality factor and characteristics of coils using Q meter Virtually. Measurement of capacitance by virtual mode using Schering bridge.	CO4 & CO5
IV	To construct minor projects using sensors and electronic components. To prepare a small project related to Light detecting Resistor (LDR). Any other project related to Electrical Measurements.	CO6

References:

(i) Bell David A., *Electronics Instrumentation and Measurements,* Prentice Hall, India

(ii) Golding Edward William and Widdis Frederick Charles, *Electrical Measurements and Measuring instruments,* Wheelers India

(iii) Helfrick A.D. and Cooper W.D., Modern *Electronic Instrumentation. & Measurement Techniques,* Prentice Hall

(iv) Murthy D. V. S., Transducers and Instrumentation, Prentice-Hall, India

(v) Sawhney A. K., *A Course in Electrical & Electronics Measurement & Inst*rumentation., Dhanpat Rai & Sons.

3rd Semester	Functional English - I				
AGFE-21301					
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**0**	**1**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Self Introduction to prepare students to face one to one interaction.
CO2	Body Language detail to prepare students in non-verbal communication.
CO3	Vocabulary based session to improve language proficiency of students.
CO4	Basic Grammar to make students proficient in English correspondence.
CO5	Book reading to improve reading skills of students.
CO6	Formal/ Informal Letter writing to make students proficient in written correspondence.

Part	Content	CO
I	Components of Self Introduction, Exemplary Performances,	CO1
	Student Performances on Self Introduction along with resume.	CO2
II	This section includes Common Vocabulary and its usage. Synonyms and Antonyms as a part of vocabulary to be done.	CO3
	This section includes editing, omission, gap filling, rearranging jumbled sentences to test knowledge of passive voice, reported speech, articles and the other determiners, modals,tense, etc. Basic Grammar such as Tenses, Voice, Narration shall be done.	CO4
III	Connect The Dots by Rashmi Bansal shall be prescribed for honing reading skills and comprehension in depth.	CO5
IV	Formal/ Informal Letter Writing**,** Basic Format, Example, Practice shall be done.	CO6

References:

(i) www.Indiabix.com
(ii) English Grammar by Wren and Martin
(iii) www.freshersworld.com
(iv) www.alison.com

3rd Semester	Indian Constitution				
AGMC-21301					
Internal Marks:	-		**L**	**T**	**P**
External Marks:	-		**0**	**0**	**1**
Total Marks:	-		**Credits**		**0**

Part	Content	CO
-	• Meaning of the constitution law and constitutionalism. • Historical perspective of the Constitution of India. • Salient features and characteristics of the Constitution of India. • Scheme of the fundamental rights. • The scheme of the Fundamental Duties and its legal status. • The Directive Principles of State Policy – Its importance and implementation. • Federal structure and distribution of legislative and financial powers between theUnion and the States. • Parliamentary Form of Government in India – The constitution powers and status ofthe President of India. • Amendment of the Constitutional Powers and Procedure. • The historical perspectives of the constitutional amendments in India. • Emergency Provisions: National Emergency, President Rule, Financial Emergency. • Local Self Government – Constitutional Scheme in India. • Scheme of the Fundamental Right to Equality. • Scheme of the Fundamental Right to certain Freedom under Article 19. • Scope of the Right to Life and Personal Liberty under Article 21	-

3rd Semester	Institutional Training				
AGEE - 21309					
Internal Marks:	**60**		**L**	**T**	**P**
External Marks:	**40**		**0**	**0**	**2**
Total Marks:	**100**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:

CO1	Familiarize the students with basic hands-on training of wiring and different types of switches and basic elements.
CO2	Study the use of multimeter, CRO etc. in lab.
CO3	Identify different basic components used in electrical engineering and their testing.
CO4	Observing response of circuits on CRO and design, fabrication of power supply.
CO5	Make single line diagram of power generation, transmission, and distribution, also, introduction to the concept of heating, ventilation and air conditioning.
CO6	Make small project by themselves.

Part	Content	CO
I	• Hands on training of wiring (Tube light, Incandescent bulb & LED light fitting, Extension board, Staircase). • Preparation of wiring diagram for domestic load / commercial load. • Study of types of switches, protective devices.	CO1
II	• Introduction to multimeter, function generator, CRO. • Identification and testing of resistors, capacitors, transistors, and diodes, etc.	CO2 & CO3
III	• Observing the response of various circuits on CRO. • Design and fabrication of +5V / +12V powers supply on bread board.	CO4
IV	• Single line diagram of power generation, transmission and distribution. • Power scenario in india. • Introduction to the concept of heating, ventilation and air conditioning. • To make different project from the study of above-mentioned different techniques.	CO5 & CO6

References:

(i) Bell David A., *Electronics Instrumentation and Measurements,* Prentice Hall, India.
(ii) Golding Edward William and Widdis Frederick Charles, *Electrical Measurements and Measuring instruments,* Wheelers India.
(iii) Helfrick A.D. and Cooper W.D., Modern *Electronic Instrumentation & Measurement Techniques*, Prentice Hall.
(iv) Murthy D. V. S., Transducers and Instrumentation, Prentice - Hall, India.
(v) Sawhney A. K., *A Course in Electrical &Electronics Measurement &Inst*rumentation, Dhanpat Rai & Sons.

4th Semester

4th Semester	Linear Control Systems				
AGEE - 21401					
Internal Marks:	40		L	T	P
External Marks:	60		3	1	0
Total Marks:	100		Credits		4

Course Outcomes: After studying the course, students will be able to:	
CO1	To introduce the fundamental concepts of control systems with emphasis on open loop and closed loop control system.
CO2	Determination of transfer function of electrical, mechanical system using different techniques, analogous systems and controllers.
CO3	Introduction to transient response of 1st, 2nd order system, static error coefficients, steady state error and routh hurwitz criterion.
CO4	To demonstrate the use of root locus method.
CO5	Frequency domain analysis using bode plot, nyquist plot and introduction to frequency domain specifications.
CO6	Need of compensation in control system.

Part	Content	CO
I	**INTRODUCTORY CONCEPTS:** Plant, Systems, Servomechanism, regulating systems, disturbances, Open loop control system, closed loop control systems, linear and non-linear systems, time variant and invariant, continuous and sampled-data control systems. **MODELING:** Formulation of equation of linear electrical, mechanical, electrical, mechanical analogies. Transfer function, Block diagram representation, signal flow graphs and associated algebra, characteristics equation. P, PI, PD and PID Modes of Feedback.	CO1 & CO2
II	**TIME DOMAIN ANALYSIS:** Typical test - input signals, Transient response of the first and second order systems. Time domain specifications, Dominant closed loop poles of higher order systems. Steady state error and coefficients, pole-zero location and stability, Routh-Hurwitz Criterion. **ROOT LOCUS TECHNIQUE:** The extreme points of the root loci for positive gain. Asymptotes to the loci, Breakaway points, intersection with imaginary axis, location of roots with given gain and sketch of the root locus plot.	CO3 & CO4
III	**FREQUENCY DOMAIN ANALYSIS:** Closed loop frequency response, Bode plots, stability and loop transfer function. Frequency response specifications, Relative	CO5

	stability, Relation between time and frequency response for second order systems, Log. Magnitude versus Phase angle plot, Nyquist criterion for stability.	
IV	Compensation, Necessity of compensation, series and parallel compensation, different compensating networks.	**CO6**

References:

(i) Dorf Richard C. and Bishop Robert H., *Modern Control System*, Addison –Wesley, Pearson New Delhi
(ii) Ogata K., *Modern Control Engineering*", Prentice Hall,
(iii) Kuo B. C., *Automatic Control System*", Prentice Hall
(iv) Nagrath I.J. and Gopal M., *Control System Engineering*, Wiley Eastern Ltd.
(v) Automatic Control Systems by Hasan Saeed.
(vi) nptel.ac.in/courses/108101037/
(vii) https://www.electrical4u.com/types-of-systems-linear-and-non-linear-system/link.springer.com/book/10. 1007% F978-1-4615-0553-2

4th Semester	Asynchronous Machines				
AGEE - 21402					
Internal Marks:	40		L	T	P
External Marks:	60		3	1	0
Total Marks:	100		Credits		4

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand various concepts related to three phase motors
CO2	Explore mathematical concepts related to slip, rotor frequency etc.
CO3	Understand the various concepts related to starters.
CO4	Explore about the concept related with induction generator.
CO5	Understand the various concepts related to special machines.
CO6	Explore about the concepts related to single phase motors.

Part	Content	CO
I	**POLYPHASE INDUCTION MACHINES:** Analogy between induction motor and transformer, production of rotating magnetic field in three-phase winding, constructional features, concept of slip and operation, rotor frequency, current, power, Torque and maximum torque criterion, equivalent circuit, phasor diagram, torque-slip characteristics, effect of rotor circuit resistance, crawling and cogging, cage motors (double cage and deep bar motor).	CO1 & CO2
II	**STARTING METHODS AND SPEED CONTROL**: Starting methods: DOL starter, Y-Δ Starter, Auto Transformer Starter, speed control: (i) control of speed of rotating field, (ii) control of slip speed. Effect of voltage injection in rotor circuit of slip ring induction motor. No load and Blocked rotor test.	CO3
III	**INDUCTION GENERATOR:** Isolated and Grid mode operation, method of excitation, performance characteristics of three-phase self-excited induction generator. **SPECIAL PURPOSE MOTORS:** Stepper Motors: Types construction, principle of operation and applications. Linear Induction Machines: construction, principle of operation and applications. Universal Motor: construction, principle of operation and applications.	CO4 & CO5
IV	**SINGLE –PHASE MOTORS:** Double revolving field theory, types of single phase motors, Torque –speed characteristics, equivalent circuit. Shaded pole motor: working principle and characteristics.	CO6

References:

(i) Fitzgerald A.E., Kingsley C. and Umans S.D., *Electric Machinery*, 6th Edition, McGraw Hill

(ii) Langsdorff E.H., *Principles of A.C. Machines*, McGraw Hill

(iii) Nagrath I.J. and Kothari D.P., *Electrical Machines*, 4th Edition, Tata McGraw Hill

(iv) Bimbhra P.S., *Electrical Machinery, Khanna Publishers* 5. Say M G, *Alternating Current Machines*, 5th edition, Sir Isaac pitman & Sons Ltd.

(v) http://nptel.ac.in/courses/108106072/

(vi) http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Roorkee/Electrical%20Machines%202%20(Video).htm

4th Semester	Power Generation and Economics				
AGEE-21403					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Focus on the resources and types of electric power generation and understand the concepts of co-generation
CO2	Estimate load requirements using various factors and load curves.
CO3	Understand various factors for site selection of power plants
CO4	Explore their knowledge about existing tariff plans and power plant economics.
CO5	Explore the significance of economic operation of steam plants.
CO6	Understand the combined operation of power plants and pollution from various power plants.

Part	Content	CO
I	**POWER GENERATION:** Electrical energy sources, organization of power sector in India, single line diagram of thermal, hydro, nuclear, diesel and Gas turbine power plants and their site selections. Classification of power plants in base load and peak load plants. Cogeneration - Definition and scope, Topping and Bottoming Cycles, Benefits, cogeneration technologies.	**CO1**
II	**LOADS AND LOAD CURVES:** Maximum demand, connected load, demand factor, diversity factor, types of load, chronological load curves, load-duration Curve, mass curves, energy curve, load factor, capacity factor, utilization factor, load forecasting. Criteria for the selection of plant location, size and number of units.	**CO2 & CO3**
III	**POWER PLANT ECONOMICS:** Capital cost of plants, annual fixed cost, operating costs, depreciation, Objectives and types of tariffs for different types of loads. Need for power factor improvement, determination of economic power factor. **ECONOMIC LOAD DISPATCH:** Methods of loading turbo-generators, input-output curve, heat rate, incremental cost, method of Lagrangian multiplier, effect of transmission losses, co-ordination equations, and iterative procedure to solve co-ordination equations.	**CO4 & CO5**
IV	**COMBINED OPERATION OF POWER PLANTS AND POLLUTION CONTROL:** Advantages of combined operation of power plants, Hydro-thermal co-ordination: its advantages and scheduling methods. Pollution from power plants - Air	**CO6**

	pollution, Aquatic impacts, nuclear plant and hydro plant impacts.	

References:

(i) Deshpande M.V., *Power Plant Engineering,* Tata McGraw Hill (2004).

(ii) EI-Wakit M.M., *Power Plant Engineering*, McGraw Hill, USA

(iii) Rajput R.K., Power Plant Engineering, Luxmi Publications

(iv) Sharma P.C., *Power Plant Engineering*, Kataria and Sons

(v) Skrotzki B.G.A. and Vapot W.A., *Power Station Engineering and Economy*, Tata McGraw-Hill

(vi) Arora S.C. and Dom Kundwar S., A course in *Power Plant Engineering,* Dhanpat Rai.

(vii) Nag, P.K., *Power Plant Engineering,* Tata McGraw Hill

(viii) Gupta B.R., *Generation of Electrical Energy,* S. Chand (1998).

(ix) Nagrath I.J. and Kothari D.P., Power System Analysis Tata McGraw-Hill Publication

(x) Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., *A Textbook on Power Sy Engineering,* Dhanpat Rai and Co.

4th Semester	Digital Electronics and Microprocessors				
AGEE-21404					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Be well versed with Number Systems, Boolean Algebra, logic gates and Boolean minimization techniques
CO2	Design combinational circuits such as encoder, decoder, code converters, adder, Subtractor, multiplexer and de-multiplexer
CO3	Understand the basic sequential circuits such as flip flops, shift registers and counters
CO4	Have working knowledge of various types of D/A and A/D converters.
CO5	Understand the architecture 8085 along with various instructions required in programming
CO6	Know about the architecture of 8086.

Part	Content	CO
I	**INTRODUCTION TO DIGITAL ELECTRONICS AND COMBINATIONAL CIRCUITS:** Introduction to number system and Logic Gates, Boolean theorems and DeMorgan Theorem, Sum of product and Product of sum form of Logic expressions, Duality, Logical functions using Karnaugh map methods, multiplexers, demultiplexers, encoders, decoders, adders, subtractors, code converters.	**CO1 & CO2**
II	**SEQUENTIAL CIRCUITS:** Flip-flops, JK flip-flops, D flip-flops, T flip- flops, SR flip- flops, Registers and Counters: Series and Parallel registers; Synchronous & Asynchronous counters. **INTRODUCTION TO A/D AND D/A:** Weighted register D/A converter, binary ladder, D/A converter, specifications for D/A converters, parallel A/D converter, successive approximation A/D converter single & dual slope A/D converter, countertype A/D converters.	**CO3 & CO4**
III	**INTRODUCTION TO 8085 MICROPROCESSOR:** Types of computers, Microprocessor evolution and types, Central Processing Unit (CPU) operation and terminology, Introduction to 8-bit Microprocessor: 8085 Microprocessor architecture, classification of instructions, Instruction format, interrupts and overview of the 8085 instruction set.	**CO5**
IV	**INTRODUCTION TO 8086 MICROPROCESSOR:** Introduction to 16-bit Microprocessor: 8086 Internal Architecture and pin configuration, interrupts, differentiation between 8085 and 8086.	**CO6**

References:

(i) R.P. Jain, "Modern digital electronics" , 3rd edition , 12th reprint Tata McGraw Hill Publication, 2007.

(ii) Anand Kumar, "Fundamentals of digital circuits" 1st edition, Prentice Hall of India, 2001

(iii) Gaonkar, Ramesh S. Microprocessor Architecture, Programming and Applications with the 8085, Penram International

(iv) Ram B, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai and Sons,

(v) Hall, Douglas V. Microprocessors and interfacing: Programming and Hardware, Tata McGraw Hill

4th Semester	Object Oriented Programming System				
AGEE-21405					
Internal Marks:	40		L	T	P
External Marks:	60		3	0	0
Total Marks:	100		Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Apply the various datatypes, operators, UDF in program design.
CO2	Understand and implement the object-oriented concepts of Classes & Objects, friend function in program design.
CO3	Understand memory management techniques using pointers, constructors, destructors, etc.
CO4	Design and implement various forms of inheritance, operator overloading.
CO5	Understand exception handling.
CO6	Analyze and explore file handling.

Part	Content	CO
I	**INTRODUCTION TO C++:** Basic terminologies & Control structure: Introduction, Applications, Different compilers. Basic concepts of object-oriented programming concepts of an object and a class, implementation of a class, abstraction, encapsulation, data hiding, inheritance, overloading, polymorphism. **TOKENS:** keywords, identifier, constant, operators, special characters and strings, control statements- conditional, loop, branch, data types- basic, user, & derived, manipulators, Concept of streams, input/output using overloaded operators >> and << and members functions of I/O stream classes, formatting output.	CO1
II	**FUNCTION, ARRAY & STRUCTURE:** Types of functions-standard & user-defined, Advantages and disadvantages of using functions, Types of calling, inline function, difference between inline and macros, default valued function, function overloading, array definition and types, uses, advantages and disadvantages of using array, passing an array to a function. Defining structure, role of structure, self-referential structure, bit level field along with examples. **C++ CLASSES, DATA ABSTRACTION AND POINTERS:** Specifying a class, creating class objects, accessing class members, access specifiers, empty class, static data members and member functions, use of constant keyword**,** friend of a class, friend with multiple classes, nested classes, container classes, difference between class and structure, Declaring and initializing pointers, accessing data through pointers, pointer arithmetic.	CO2
III	**CONSTRUCTOR:** Definition of constructor, characteristics, need for constructors and destructors, Types of constructors- default, parameterized, default valued, copy constructor, constructor overloading, dynamic constructors, explicit constructor calling and implicit constructor calling, destructors. **INHERITANCE:** Defining a class hierarchy, Different forms of inheritance, Defining the Base and Derived classes, Access to the base class members, Base	CO3&CO4

	and Derived class construction, Destructors, Virtual base class, Order of execution of constructors and destructors.	
IV	**POLYMORPHISM:** Implications of polymorphic use of classes, Virtual destructors, Overloading different operators in C++. **FILE AND EXCEPTION HANDLING:** File streams, hierarchy of file stream classes, error handling during file operations, reading/writing of files, accessing records randomly, updating files, Exception handling in C++.	**CO5 & CO6**

References:

(i) The Complete Reference C++, 4th Edition, Herbert Schildt, Tata McGraw Hill.

(ii) Learn Programming in C++ for 3rd Edition by Dr. Hardeep Singh, Vikram Sharma, Anurag Gupta & Anshuman Sharma

(iii) Lafore R., Object Oriented Programming in C++, Waite Group.

(iv) E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.

(v) R. S. Salaria, Mastering Object-Oriented Programming with C++, Salaria Publishing House.

(vi) Bjarne Stroustrup, The C++ Programming Language, Addison Wesley.

(vii) Problem solving with C++: The Object of Programming, 4th Edition, Walter Savitch, Pearson Education.

4th Semester	Control System Lab				
AGEE - 21406					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Describe the use of synchros as an error detector and study the speed - torque characteristics of an AC servomotor and to explore its applications.
CO2	Study the basics of matlab and its uses in control system.
CO3	Determination the transfer function of a control system using matlab.
CO4	Determination the transfer function of a control system using matlab.
CO5	Implementation and finding stability of control system using pole - zero plot, root loci diagrams, bode plot and nyquist plot using matlab.
CO6	Design of any control system using matlab and simulink.

Part	Content	CO
I	• To study the basics of MATLAB. • To study use of MATLAB in Control system. • . To study the synchros Transmitter-Receiver set and to use it as an error detector.	**CO1 & CO2**
II	• To study the Speed – Torque characteristics of an AC Servo Motor and to explore its applications • A program to determine the transfer function using MATLAB • A program to find Time and Frequency response of control systems using MATLAB	**CO3 & CO4**
III	• To plot pole-zero plot, Bode plot, Nyquist and Root Loci diagrams using MATLAB. • To study open loop characteristics of dc motor using simulation. • To study closed loop characteristics of DC motor with Proportional and derivative control	**CO5**
IV	• Design of Control Systems using MATLAB and SIMULINK.	**CO6**

References:

(i) Automatic Control Systems by Hasan Saeed.

(ii) Ogata K., *Modern Control Engineering*", Prentice Hall,

(iii) Kuo B. C., *Automatic Control System*", Prentice Hall

(iv) Nagrath I.J. and Gopal M., *Control System Engineering*, Wiley Eastern Ltd.

(v) Automatic Control Systems by Hasan Saeed.

4th Semester	Digital Electronics and Microprocessors Lab.				
AGEE – 21407					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Verify the truth table of universal gates.
CO2	Implement combinational logic circuits such as half/full adder and subtractor.
CO3	Verify the truth table of the Multiplexer and demultiplexer
CO4	Verify the truth table of S-R, J-K, D and T Flip flops.
CO5	Understand the basic architecture of 8- bit microprocessor and 16- bit microprocessor
CO6	Learn the programming of 8085 microprocessor

Part	Content	CO
I	• Design and verification of universal Gates.	CO1
II	• Design and verification of Half Adder/ Full Adder Circuit. • Design and verification of Half Subtractor / Full Subtractor Circuit. • Verification of the truth table of the Multiplexer and De-Multiplexer.	CO2 & CO3
III	• Design and test of S-R, J-K, D and T Flip flops. • Study of 8085 Microprocessor Kit. • Write a program to add two 8-bit number using 8085. • Write a program to add and subtract two 16-bit number using 8085. • Write a program to multiply two 8-bit numbers by repetitive addition method using 8085.	CO4 & CO5
IV	• To design and develop safety detector • To design and develop musical bell. • To design and develop flashing LED. • To develop Electronic Lock. • To design automatic porch light.	CO6

References:

(i) R.P. Jain, "Modern digital electronics" , 3rd edition , 12th reprint Tata McGraw Hill Publication, 2007.
(ii) Anand Kumar, "Fundamentals of digital circuits" 1st edition, Prentice Hall of India, 2001
(iii) Gaonkar, Ramesh S. Microprocessor Architecture, Programming and Applications with the 8085, Penram International
(iv) Ram B, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai and Sons,
(v) Hall, Douglas V. Microprocessors and interfacing: Programming and Hardware, Tata McGraw Hill

4th Semester	Object Oriented Programming System Lab.				
AGEE-21408					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand and Applying various Datatypes, Operators, Conversions in program design.
CO2	Apply the concepts of Classes & Objects, friend function, constructors & destructors in program design.
CO3	Design & implement various forms of inheritance, constructors.
CO4	Apply & Analyze operator overloading, runtime polymorphism.
CO5	Usage of file handling to store and retrieve data.
CO6	Analyze and explore various Stream classes, exception handling.

Part	Content	CO
I	• Use of control structures, functions, arrays and structures.	**CO1**
II	• Implementation of pointers and classes & objects. • Implementation of constructors and destructors.	**CO2**
III	• Defining friend function. • Usage of inheritance, operator overloading and polymorphism.	**CO3 & CO4**
IV	• Usage of typecasting, templates and file handling. • Handling exceptions in C++. • Creating a small application using C++ as front end and file handling as back-end. • Application should have a login screen, some menus, CRUD operations. any other operations as per the choice of the student group.	**CO5 & CO6**

References:

(i) The Complete Reference C++, 4th Edition, Herbert Schildt, Tata McGraw Hill.

(ii) Learn Programming in C++ for 3rd Edition by Dr. Hardeep Singh, Vikram Sharma, Anurag Gupta & Anshuman Sharma

(iii) Lafore R., Object Oriented Programming in C++, Waite Group.

(iv) E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.

(v) R. S. Salaria, Mastering Object-Oriented Programming with C++, Salaria Publishing House.

(vi) Bjarne Stroustrup, The C++ Programming Language, Addison Wesley.

Problem solving with C++: The Object of Programming, 4th Edition, Walter Savitch, Pearson Education.

4th Semester	Engineering Aptitude - I				
AGAP-21401					
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**0**	**1**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Develop a Proper Understanding of the Number system
CO2	Understand the Concept of HCF &LCM to solve problems related to Racetracks, Traffic lights etc.
CO3	Recognize parts and wholes both visually and numerically
CO4	Recognize and apply Ratios, Proportions and Percentage to solve real-life problems
CO5	Recognize company's revenues and expenditures over a specified period of time,
CO6	Understand the concept of time value of money

Part	Content	CO
I	**Number System:**Various types of numbers ,Face Value & Place value of a digit in anumeral, Divisibility Tests **Problems on Numbers:**To find Unknown numbers	CO1
II	**HCF &LCM:**Factors and multiples to find Highest Common Factor and Least Common Multiple of fractions, Comparison of Fraction	CO2
	Decimal and Fractions: Operations on Decimal and Fractions	CO3
III	**Ratio & Proportion :**Tricks to Find ratio and Proportions **Percentage:** Concept of Percentage , Tricks to find Percentage	CO4
IV	**Profit & loss:** Cost Price, Selling Price, Profit, Loss, Profit Percentage and Loss Percentage	CO5
	Simple & Compound Interest: Interest computed annually, half yearly and Quarterly..	CO6

References:

(i) Quantitative Maths :Arihant Publishers.
(ii) Objective Mathematics : R S Aggarwaal.
(iii) Quantitative Maths : TMH Publications

4th Semester	Functional English - II				
AGFE-21402					
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**0**	**1**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Self Introduction and Body Language to prepare students to face one to one interaction.
CO2	Spoken Activity such as Topic Presentation or extempore to hone spoken skills of students.
CO3	Vocabulary based session to improve language proficiency of students.
CO4	Basic Grammar to make students proficient in English correspondence.
CO5	Book reading to improve reading skills of students.
CO6	Formal/ Informal Letter writing to make students proficient in written correspondence.

Part	Content	CO
I	Components of Self Introduction, Exemplary Performances, Student Performances on Self Introduction along with resume.	CO1
II	This section includes Spoken Activity such as Topic Presentation or extempore to hone spoken skills of students.	CO2
	This section includes Root words and its usage.	CO3
III	This section includes editing, omission, gap filling, rearranging jumbled sentences to test knowledge of passive voice, reported speech, articles and the other determiners, modals, tense, etc. Basic Grammar such as Tenses, Voice, Narration shall be done.	CO4
IV	IKIGAI shall be prescribed for honing reading skills and comprehension in depth.	CO5
	Formal/ Informal Letter Writing**,** Basic Format, Example, Practice shall be done.	CO6

References:

(i) www.Indiabix.com
(ii) English Grammar by Wren and Martin
(iii) www.freshersworld.com
(iv) www.alison.com

4th Semester	Essence Of Indian Knowledge Tradition				
AGMC-21401					
Internal Marks:	-		**L**	**T**	**P**
External Marks:	-		**0**	**0**	**1**
Total Marks:	-		**Credits**		**0**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the concept of traditional knowledge and its importance
CO2	Know the need and importance of protecting traditional knowledge.
CO3	Know the various enactments related to the protection of traditional knowledge.
CO4	Understand the concepts of Intellectual property to protect the traditional knowledge.
CO5	Understand significance of traditional knowledge in different sectors

Part	Content	CO
-	**INTRODUCTION TO TRADITIONAL KNOWLEDGE:** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physicaland social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge **PROTECTION OF TRADITIONAL KNOWLEDGE:** Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK. **LEGAL FRAMEWORK AND TK:** The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006,Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.Geographical indicators act 2003. **TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY** Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge. **TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS:** Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK. 139.	-

References:

(i) **Traditional Knowledge System in India**, by Amit Jha, 2009.
(ii) **Traditional Knowledge System and Technology in India** by Basanta Kumar Mohanta and VipinKumarSingh, Pratibha Prakashan 2012.
(iii) **Knowledge Traditions and Practices of India,** Kapil Kapoor1, Michel Danino2

5th Semester

5th Semester	Synchronous Machines				
AGEE-21501					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Study general aspects related to Synchronous Machine
CO2	Solve mathematical concepts related Synchronous Motor and Alternator
CO3	Study the concepts of voltage regulation and characteristics of Alternator
CO4	Study performance of a Synchronous Motor and parallel operation of Alternator
CO5	Study concepts related to transients.
CO6	Study various concepts related to single phase motors.

Part	Content	CO
I	**General Aspects** Construction and working principle of synchronous machines, Excitation systems, production of sinusoidal electromotive force (EMF), flux and magnetomotive force (MMF) phasors in syn. machines; cylindrical and salient pole rotors. **Windings** Classification of windings: concentrated winding, distributed winding , Winding Factor. Electromagnetic Force equation.	CO1 & CO2
II	**Alternators** Construction, Phasor diagram of cylindrical rotor alternator, ratings, nature of armature reaction: armature reaction at different power factor loads , determination of synchronous reactance; open-circuit characteristics, short- circuit characteristics, short-circuit ratio. Determination of voltage regulation: EMF method, MMF. method. Zero power factor (Z.P.F).method. Power-angle characteristics of synchronous machines:- cylindrical and salient pole. Two reaction theory of salient pole machines.	CO3
III	**Synchronous Motor** Operating characteristics, power-angle characteristics, conditions for maximum power developed. V-curves and inverted V-curves, methods of starting, synchronous motors applications, synchronous condensers. Hunting and damper windings. **Parallel Operation of Alternators** Conditions for proper synchronizing for single phase and three phase alternators, synchronizing power, current and torque, effect of increasing excitation of one of the alternators, effect of change of speed of one of the alternators, effect of unequal voltages, load sharing.	CO4
IV	**Transients** Synchronous machine reactances and their determination. Synchronization with the grid system, Qualitative introduction to the transient stability of the synchronous machines. **Single Phase Synchronous Motor** Reluctance and Hysteresis motors.	CO5 & CO6

References:

(vi) Tripathy S.C., Electrical Machines, New Age International Publishers
(i) Bimbhra P.S., Electrical Machinery, Khanna Publishers
(ii) Nagrath I.J. and Kothari D.P., Electrical Machines, 4th Edition, Tata McGraw Hill,
(iii) Fitzgerald A.E., Kingsley C. and Umans S.D., Electric Machinery, 6th Edition, McGraw Hill
(iv) Langsdorff E.H., Principles of D.C. machines, McGraw Hill
Say M G, Alternating Current Machines, 5th edition, Sir Isaac Pitman and Sons Ltd.

5th Semester	Electrical Power System – I			
AGEE-21502				
Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**3**	**1**	**0**
Total Marks:	**100**	**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Study supply system of a power system.
CO2	Gain knowledge about Construction of Transmission line and types of conductors.
CO3	Study various mathematical concepts related to Power System.
CO4	Study various types of transmission lines and its performance.
CO5	Study line Compensation Techniques in power system.
CO6	Gain knowledge about Underground System.

Part	Content	CO
I	**Supply System** Introduction to Transmission and Distribution systems, Comparison between DC and AC systems for Transmission and Distribution, Evolution of Power Systems and Present-Day Scenario. comparison of cost of conductors, economic size of conductors - Kelvin's law, Radial and mesh distribution networks, Voltage regulation.	CO1
II	**Conductors and Transmission Line Construction** Conductor materials; solid, stranded, ACSR, hollow and bundle conductors. Different types of supporting structures for overhead lines. Elementary ideas about transmission line construction and erection. Stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, concept of string efficiency.	CO2 & CO3
III	**Transmission Line Parameters and Performance** Introduction to line parameters, Resistance of transmission line, inductance of single phase two wire line, concept of G.M.D., Inductance of three phase line, Use of bundled conductor, transposition of power lines, capacitance of 1- phase and 3-phase lines, effect of earth on capacitance of conductors. Representation of short transmission line, medium length line (nominal T & II circuits). long length line by hyperbolic equations and equivalent T & II circuits. Travelling-wave Equations, Power flow through transmission lines, ABCD constants.	CO4
IV	**Circle Diagram and Line Compensation** Receiving end circle diagram for long transmission lines based on ABCD constants, power loci, surge impedance loading, reactive power requirement of system, series and shunt compensation, Synchronous phase modifiers , rating of phase modifiers. **Underground Cables** Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines.	CO5 & CO6

References:

(i) Wadhwa C.L., Course in Electrical Power, New Age International (P) Ltd.
(ii) A. Chakrabarti P. V. Gupta Soni Ml Power System Engineering Dhanpat Rai & Co. (P) Limited
(iii) Gupta B.R., Power System Analysis & Design, Wheeler Publishing.
(iv) Elgerd O.L., Electrical Energy System Theory - An introduction, Tata McGraw-Hill Publication
(v) http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/power-system/ui/TOC.htm

5th Semester	Power Electronics				
AGEE-21503					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the basics and importance of thyristor family.
CO2	Explain the different types of commutation techniques.
CO3	Describe the various types of phase controlled rectifiers.
CO4	Understand the operation and function of choppers and cycloconverters.
CO5	Familiar with different kind of inverters.
CO6	Acquainted with various types of power devices.

Part	Content	CO
I	**Thyristors and their characteristics:** Introduction to Thyristor family, V-I characteristics of silicon- controlled rectifier (SCR), Principle of operation of silicon-controlled rectifier (SCR). Two transistor analogy. Turn on methods of a thyristor Switching characteristics of thyristors during tum-on and turn-off. Gate characteristics. Firing of thyristors. Series and parallel operation of silicon-controlled rectifiers (SCR) and their triggering circuits. Thyristor specifications; such as latching current and holding current. Protection of SCR from over voltage and over current. Snubber circuits. Power dissipation.	CO1
II	**Thyristor commutation techniques:** Self commutation by resonating the load (Class A), Self commutation by LC circuit (class B), Complementary commutation (class C), Auxiliary commutation (class D), External pulse commutation (class E), AC Line commutation (class F). **Phase controlled techniques:** Introduction to phase angle control. Single phase half wave controlled rectifiers. Single phase half controlled and full controlled bridge rectifiers. Effect of resistive, inductive and resistive cum inductive loads. Applications of rectifiers speed control of DC motor drives.	CO2 & CO3
III	**Choppers:** Introduction of chopper, Basic chopper classification, Chopper configuration, voltage commutated chopper, Current commutated chopper. **Cycloconverters:** Basic principle of operation, Single phase to. single phase cycloconverter. Three phase half wave cycloconverter. Advantages and disadvantages of cycloconverters.	CO4
IV	**Inverters:** Introduction & Classification of inverter. Operating principle, Single phase half bridge voltage source inverters, Single phase full bridge inverter. Three-phase bridge inverter. Voltage control (Pulse-width modulation (PWM) control etc.) and reduction of harmonics in the inverter output voltage. **Symbols and V-I characteristics** of Silicon Unilateral Switch (SUS), Silicon Bilateral Switch (SBS), Unijunction Transistor (UJT), Light-activated silicon-controlled rectifier (LASCR), N- Metal Oxide Semiconductor Controlled Thyristor (N-MCT).	CO5 & CO6

References:

(i) Bimbhra, P.S., *Power Electronics*, Khanna Publishers.
(ii) Singh M.D. and Khanchandani K.B., *Power Electronics,* Tata Mc Graw Hill Publishing company limited.
(iii) Rashid M.H., *Power Electronics*, Circuits Devices and Applications, Prentice Hall (India)
(iv)Sen, P.C., *Power Electronics*, Tata McGraw Hill Publishing Company limited.
(v) Bhattacharya S.K. and Chatterji, S. *Industrial Electronics and Control,* by New Age international Publications(P) Ltd, New Delhi.

5th Semester	Electromagnetic Fields				
	AGEE-21504A				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the various applications and basic laws of electromagnetism.
CO2	Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.
CO3	Apply the principles of magnetostatics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
CO4	Understand the concepts related to Maxwell equations for solving the problems of electromagnetic fields.
CO5	Understand the concept of Poynting vector and boundary conditions for time varying electromagnetic fields.
CO6	Apply Maxwell's equations to solutions of problems relating to EM wave propagation.

Part	Content	CO
I	**REVIEW OF VECTOR ANALYSIS:** Vector analysis, del, gradient, divergence and curl with their physical interpretations, Integral theorems: Divergence theorem and Stoke's theorem. **ELECTROSTATICS:** Introduction to fundamental relations of electrostatic field, Coulomb's Law, Electric potential, Field due to continuous distribution of charges, Electric flux density, Equipotential surfaces, Potential gradient, Gauss's law and its applications, Point form of Gauss's law, Poisson's equation and Laplace's equation, capacitance, electrostatic energy, Conditions at Boundary between dielectrics, Uniqueness theorem.	CO1 & CO2
II	**STEADY MAGNETIC FIELD:** Fundamentals of magnetostatics, Biot-Savart law, Ampere's work law, Faraday's law, Magnetic flux density, magnetic field strength and magneto motive force, Ampere's work Law in the differential form, permeability, energy stored in a magnetic field, Magnetic scalar and vector potential, Boundary conditions for steady magnetic fields, Analogies between electric and magnetic fields.	CO3
III	**MAXWELL'S EQUATIONS AND POYNTING VECTOR:** Equation of continuity for time varying fields, concept of displacement current and conduction current, Maxwell's equations in integral and differential form for static and time varying fields, conditions at a Boundary surface, Concept of Poynting vector, Poynting Theorem and its interpretation, Boundary conditions for electromagnetic fields.	CO4 & CO5
IV	**ELECTROMAGNETIC WAVES:** Wave equations for free space and conducting medium, Uniform plane wave propagation, Intrinsic impedance, Relation between E and H, Polarization and its types, Wave propagation in conductors and dielectrics, Direction cosines, Skin effect, Brewster angle, Surface impedance.	CO6

References:

(i) Rao N. Narayana, Elements of Engineering Electromagnetics, Pearson Education.
(ii) Sarin A., Concepts of Electromagnetic field theory.
(iii) Edward C. Jordan and Keith G Balmain, Electromagnetic Waves and Radiating Systems, Prentice- Hall Inc.
(iv) Sadiku Matthew N.O., Principles of Electromagnetics, Oxford University Press.
(v) Kraus John D., Electromagnetics, McGraw-Hill Publishers.
(vi) Edminister Joseph A., Schaum's Theory and Problems of Electromagnetics, McGraw-Hill.
(vii) https://nptel.ac.in/courses/108104087

5th Semester	Antenna and Wave Propagation				
	AGEE-21504B				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the performance parameters of Antenna
CO2	Get familiar with Linear Wire and Aperture Antenna
CO3	Understand the Microstrip Patch and Fractal Antenna
CO4	Understand antenna array with its classification
CO5	know about the ground wave propagation
CO6	Acquaint with Ionospheric Propagation

Part	Content	CO
I	**Introduction and Fundamental Parameters of Antenna**: Physical concept of radiation in single wire, two wire, and dipole, Current Distribution on a thin wire antenna. Radiation Pattern, Radiation Power Density, Radiation intensity, Directivity, Gain, Antenna efficiency, Beamwidth, Bandwidth, Polarization, Antenna Input Impedance, Elementary idea about self and mutual impedance, Radiation efficiency, Effective aperture, Antenna Temperature.	CO1
II	**Linear Wire Antennas and Aperture Antennas:** Retarded potential, Infinitesimal dipole, Current distribution of short dipole and half wave dipole, Far-field, Radiating near-field and reactive near-field region, Monopole and Half wave dipole. Field Equivalence principle, Rectangular and circular aperture antennas, Babinet's Principle, Slot Antenna, Reflector antenna Horn antenna, Microstrip Patch Antenna and Fractal Antenna	CO2 & CO3
III	**Antenna Arrays:** Array of two-point sources, Array factor, n-element linear array with uniform amplitude and spacing, Analysis of Broadside array, Ordinary end-fire array, Hansen-woodyard end fire array, n-element linear array with non-uniform spacing, Analysis of Binomial and Dolph-Tschebyscheff array, Scanning Array	CO4
IV	**Ground wave and Ionospheric Propagation:** Friis Free space equation, Reflection from earth's surface, Surface and Space wave propagation for vertical and horizontal dipole, Field strength of Space wave, Range of space wave propagation Structure of ionosphere, propagation of radio waves through ionosphere, Refractive index of ionosphere, Reflection and refraction of waves by ionosphere, Critical frequency, Maximum usable frequency, Optimum working frequency, Lowest usable high frequency, virtual height, Skip Distance, Effect of earth's magnetic field	CO5 & CO6

References:

i. Antenna and wave propagation by K.D. Prasad, Satya Prakashan
ii. Antenna Theory , Balanis C.A ,John Wiley & sons.
iii. Antenna and radio wave propagation, Collins R.E., McGraw Hill.
iv. Antenna Theory , Krauss J.D.,McGraw Hill.

5th Semester	Power Quality and FACTS				
AGEE-21504C					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Know the severity of power quality problems in distribution system and Understand the concept of voltage sag transformation from up-stream (higher voltages) to down-stream (lower voltage).
CO2	Study the concept of harmonics concept and transient as well as steady state variations.
CO3	Discuss about selection of proper controller and filter for the specific application based on system requirements
CO4	Study about importance of power quality and various types of disturbances.
CO5	Understand the static series compensator.
CO6	Understand the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

Part	Content	CO
I	Power Quality Problems in Distribution Systems: Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement.	CO1
II	Harmonics & Harmonics Filters: Definition, odd and even harmonics, causes of harmonics, Individual & total distortion, Interharmonics, Harmonics signatures, Effect of harmonics, various types of Filters, passive, active & hybrid filters, application of filters for power quality improvement & reactive power compensation, harmonics mitigation techniques.	CO2 & CO3
III	Power Quality: Introduction, Importance of Power Quality, Common Disturbances in Power Systems, Short-Duration Voltage Variation, Long-Duration Voltage Variations, Transients, Impulsive Transients, Oscillatory Transients, Voltage Imbalance, Harmonics, DC Offset, Notching, Noise, Voltage Fluctuations, Power Frequency Variations	CO4 & CO5
IV	FACTS: Introduction, need of FACTS devices in power system, types of compensation techniques, various FACTS controllers, different FACTS devices like TCSC, TCSR, SVC etc., advantages & disadvantages, Emerging FACTS Controllers The STATCOM, The SSSC, The UPFC, Comparative Evaluation of Different FACTS Controllers, Future Direction of FACTS Technology	CO6

References:

(i) Power Quality by C.Sankaran, CRC publication
(ii) Electrical Power Systems Quality by Roger C.Dugan , TMH publication
(iii) R. Sastry Vedam, Mulukulta S Sarma "Power Quality VAR Compensation in Power Systems" CRC Press Indian Edition Indian reprint 2013
(iv) Harmonics and Power Systems by Francisco C. De La Rosa, CRC Publication
(v) Understanding FACTS: Concepts & Technology of Flexible AC Transmission System by Narain G. Hingorani, Wiley India Pvt. Ltd 2011.

5th Semester	Energy Efficient Machines				
AGEE-21504D					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Introduce about basics of energy efficient machines and discuss concept of Tariff.
CO2	Study different Energy Efficient Motors and method to make them more efficient.
CO3	Focus on role of power factor for make motor energy efficient.
CO4	Study Induction Motor and adjustable Drive Motor as Energy Efficient Motor.
CO5	Study applications of Electric Motor.
CO6	Study Economics of Energy Efficient Motor and System.

Part	Content	CO
I	INTRODUCTION: Energy efficient machines, energy cost and two part tariff, energy conservation in industries and agricultural sector -a necessity, introduction to energy management and energy audit system. Review of induction motor characteristics.	CO1
II	ENERGY EFFICIENT MOTORS: Standard motor efficiency, energy efficient motor, efficiency determination methods, Direct Measurement method, Loss segregation method, Comparison, motor efficiency labeling, energy efficient motor standards. POWER FACTOR: The power factor in sinusoidal systems, power factor improvement, power factor with nonlinear loads, Harmonics and the power factor	CO2 & CO3
III	INDUCTION MOTORS AND ADJUSTABLE DRIVE SYSTEMS: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads. APPLICATION OF ELECTRIC MOTORS: Varying duty applications, Voltage variation, Voltage Unbalance, over motoring, Poly-phase induction motors supplied by adjustable frequency power supplies	CO4 & CO5
IV	ECONOMICS OF ENERGY EFFICIENT MOTORS AND SYSTEMS: Motor life cycle, Direct Savings and pay back analysis, efficiency evaluation factor, present worth method with constant power costs, present worth method with increasing power costs, net present worth method.	CO6

References:

i. Tripathi S.C. , Electric Energy Utilization and Conservation, Tata McGraw-Hill 1991.
ii. Andreas John C., *Energy efficient electric motors*, Marcel Dekker Inc. 1992.
iii. Thuman Albert, *Introduction to Efficient Electric System Design*, The Fairmount Press Prentice Hall.
iv. Belove Charles, *Handbook of Modem Electronics and Electrical Engineering*, John Wiley and Sons

5th Semester	Programming in Python				
AGEE - 21505					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**1**	**0**	**4**
Total Marks:	**50**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Interpret the python syntax and semantics of control flow statements.
CO2	Apply lists, tuples, sets, dictionaries, functions and string handling in python to solve problems.
CO3	Analyze the concepts of object - oriented approach to solve problems.
CO4	Implement inheritance programming.
CO5	Implement operator overloading, function overloading.
CO6	Implement exception handling, file handling and GUI design.

Part	Content	CO
I	**Introduction to Basics of Python Programming** including literal constants, variables and identifiers, data types, comments, reserved words, indentation, operators, type conversion, decision control statements, functions, lists, tuples, sets, dictionaries and arrays	CO1
II	• Program using integer arithmetic, variables and branching • Implementation of strings, iteration • Implementation of functions • Implementation of lists, tuples, sets, dictionaries • Implementation of array and matrices	CO2 & CO3
III	• Object - oriented programming • Implementation of inheritance and its types • Implementing operator overloading • Implementing function overloading	CO4 & CO5
IV	• Implementation of exception handling • File I / O, reading CSV files, reading text files, writing and saving to files • Matplotlib module and its implementation for data visualization	CO6

References:

(i) Introduction to Computing and Problem-Solving Using Python, E. Balagurusamy, McGraw Hill Education.
(ii) Programming Python, Mark Lutz, O`Reilly.
(iii) Python Crash Course, Eric Matthews.

5th Semester	Machine Lab-II			
AGEE-21506				
Internal Marks:	**30**	**L**	**T**	**P**
External Marks:	**20**	**0**	**0**	**2**
Total Marks:	**50**	**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Perform Various types of test on 3-phase and 1-phase Induction Motor
CO2	Study and Perform various Speed Control Techniques
CO3	Perform Voltage Regulation and Characteristics of Synchronous Motor
CO4	Perform Parallel Operation of Alternators
CO5	Prepare Industry based project on Alternator
CO6	Prepare Industry based project on Synchronous Motor

Part	Content	CO
I	• To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics. • To perform no-load and blocked–rotor tests on three-phase Induction motor to obtain equivalent circuit parameters and to draw circle diagram. • To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor circuit. And to plot torque –speed characteristics. • To perform no-load and blocked–rotor test on single-phase Induction motor and to determine the parameters of equivalent ckt. Drawn on the basis of double revolving field theory. • To perform load –test on single-phase. Induction motor and plot torque –speed characteristics.	CO1
II	• To study the speed control of three-phase Induction motor by Kramer's Concept. • To study the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor. • To study star- delta starters physically and a) to draw electrical connection diagram b) to start the three-phase Induction motor using it. c) to reverse the direction of three-phase Induction motor	CO2
III	• To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics. • To find voltage regulation of an alternator by zero power factor (ZPF) method. • To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor. • To measure negative sequence and zero sequence reactance of Synchronous Machines. • Parallel operation of three phase alternators using • Dark lamp method • Two-Bright and one dark lamp method	CO3 & CO4
IV	• To prepare star- delta starters and draw electrical connection diagram • To prepare core and winding of synchronous motor • To prepare the circuit of speed control of AC Machines • To prepare various excitation techniques of Synchronous Machines • To prepare a project related to power factor improvement of Asynchronous Machines	CO5 & CO6

References:

(i) Nagrath I.J. and Kothari D.P., Electrical Machines, 4th Edition, Tata McGraw Hill,
(ii) Bimbhra P.S., Electrical Machinery, Khanna Publishers

(iii)Wadhwa C.L., Course in Electrical Power, New Age International (P) Ltd.
(iv)Langsdorff E.H., Principles of D.C. machines, McGraw Hill

5th Semester	Power Electronics Lab.				
AGEE-21507					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Learn to measure the V-I characteristics and study the effect of gate triggering on turning on of SCR, UJT.
CO2	Plot waveforms, for single phase full-wave, fully controlled bridgerectifier, for resistive and resistive cum inductive loads.
CO3	Study of Jones chopper or any chopper circuit to check the performance.
CO4	Study the performance of inverter and a single-phase cycloconverter.
CO5	Prepare projects related to the SCR components.
CO6	Prepare projects related to the electronics components.

Part	Content	CO
I	• To study principle of operation of SCR, plot V-I characteristics and study the effect of gate triggering on turning on of SCR. • To draw V-I characteristics of an UJT and to use UJT as relaxation oscillator.	CO1
II	• To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load. • To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridgerectifier, for resistive and resistive cum inductive loads. • To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles. • Study of Jones chopper or any chopper circuit to check the performance.	CO2 & CO3
III	• Thyristorised speed control of a D.C. Motor. • Speed Control of induction motor using thyristors. • Study of series inverter circuit and to check its performance. • Study of a single-phase cycloconverter. • To check the performance of a McMurray half-bridge inverter.	CO4
IV	• To design the circuit of Jones chopper. • To design the circuit of McMurray half-bridge inverter. • To design any application related to microcontrollers. • Simulation of the any project or the experiment.	CO5 & CO6

References:

(i) Bimbhra, P.S., *Power Electronics*, Khanna Publishers.
(ii) Singh M.D. and Khanchandani K.B., *Power Electronics*, Tata Mc Graw Hill Publishing company limited.

5th Semester	Electrical: Estimation and Costing Lab				
AGEE-21508					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Gain Knowledge about Indian electricity rules and lighting Schemes
CO2	Draw and design various electricity systems
CO3	Estimate the cost of Industrial Installation and Underground System
CO4	Estimate the cost of Overhead System and the repair Cost of electrical appliances
CO5	Prepare projects related to Domestic Installation
CO6	Prepare projects related to the Estimation Cost of electricity in a Campus

Part	Content	CO
I	• To study Indian electricity rules • To study various types of light sources and lighting schemes.	CO1
II	• To study the design consideration of Panel Boards. • To study the design consideration of 3 phase four wire distribution systems • To estimate the cost of a domestic installation (Residential building or laboratory room or Drawing Hall etc) with concept of illumination design. TERI (The Energy Research Institute) recommendations on lighting schemes • To carryout wiring diagram of residential building, educational institute and Industry. Giving selection of appropriate wiring, list materials and accessories for given project. • To make wiring diagrams of motor control circuits for starting of a. 3 phase induction motor b. Wound Motor c. Synchronous motor	CO2
III	• To estimate the cost of industrial installation (Workshop, agriculture, flour mill etc). • To estimate the cost of underground service connection (single phase and three phase). • To estimate the cost of underground, distribution line. • To estimate the cost of overhead service connection (Single phase and three phase). • To estimate the cost of overhead, 440 V, 3-phase, 4 wire or 3 wire distribution line. • To estimate the cost of any one electrical appliance. • To estimate the cost of repairs and maintenance of any one domestic appliance.	CO3 & CO4
IV	• To estimate the cost of any new setup in Industry • To estimate the operating cost of any 5 star equipment with 3 start equipment • Prepare projects related to the Estimation Cost of electricity in Boys Hostel • Prepare projects related to the Estimation Cost of electricity in Girls Hostel • Prepare projects related to the Estimation Cost of electricity in Main Block of Campus	CO5 & CO6

References:

(i) Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi

(ii) Gupta J.B., A course in Electrical Installation, Estimating and Costing, SK Kataria and Sons, N. Delhi

(iii) Sharma B.R. and Rai H.M., Electrical Estimating and Costing

(iv) Uppal S.L., Electrical Wiring, Estimating and Costing

5th Semester	Engineering Aptitude - II				
AGAP-21502					
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**0**	**1**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Learn and practice Aptitude questions based on *"Problems on Ages"* and improve their skills in order to face the interview, competitive exams.
CO2	Understand the relationships among things or finite groups of things.
CO3	Outline the various formulas for calculating area, volume and surface area.
CO4	Use a calendar to determine a Date and Day.
CO5	Use a time schedule to determine ending time of a given event.
CO6	Find out missing part of an element by subsequent comparison.

Part	Content	CO
I	**Problem on Ages**: Shortcut method to simplify questions based on Age	CO1
	Venn Diagrams: Applications of Sets	CO2
II	**Area , volume and surface area** : Cuboid, Cube, Parallelepiped, Cylinder, Sphere	CO3
III	**Calendar and Time** :To find odd days in an ordinary year, Leap year, Days of week related to odd days	CO4
	Clocks : Hands of Clock, Angle Traced by Hands	CO5
IV	**Chain Rule** :Direct Proportion **,**Indirect Proportion	CO6

References:

(i) Quantitative Maths: Arihant Publishers.
(ii) Objective Mathematics: R S Aggarwal.
(iii) Quantitative Maths: TMH Publications

5th Semester	Summer Training				
AGEE-21509					
Internal Marks:	**60**		**L**	**T**	**P**
External Marks:	**40**		**0**	**0**	**0**
Total Marks:	**100**		**Credits**		**1**

Course Outcomes: After completion of this course, the students would be able to:	
CO1	Gain exposure to industrial environment and latest technology trends.
CO2	Understand organizational hierarchy.
CO3	Enhance technical and managerial skills
CO4	Draw electrical machines and wiring diagrams
CO5	Simulate/test simple electrical and electronics circuits using Simulation software
CO6	Prepare projects related to electrical and electronic circuits using AutoCAD Electrical software through hands on experience.

The summer internship should give exposure to the practical aspects of the discipline. Six weeks in an Industry in the area of Electrical Engineering during summer vacations after 4th semester. In addition, the student may also work on a specified task or project which may be assigned to him/her.
The outcome of the internship should be presented in the form of a report. The student will make a presentation based upon the Industry Internship attended.

The main objective of the Industrial Training is to experience and understand real life situations in industrial organizations and their related environments and accelerating the learning process of how student's knowledge could be used in a realistic way. In addition to that, industrial training also makes one understand the formal and informal relationships in an industrial organization so as to promote favorable human relations and teamwork. Besides, it provides the exposure to practice and apply the acquired knowledge "hands – on" in the working environment. Industrial training also provides a systematic introduction to the ways of industry and developing talent and attitudes, so that one can understand how Human Resource Development works. Moreover, students can gain hands-on experience that is related to the students majoring so that the student can relate to and widen the skills that have been learnt while being in university. Industrial training also exposes the students to the real career world and accustoms them to an organizational structure, business operation and administrative functions. Furthermore, students implement what they have learned and learn more throughout this training. Besides, students can also gain experience to select the optimal solution in handling a situation. During industrial training students can learn the accepted safety practices in the industry. Students can also develop a sense of responsibility towards society.

6th Semester

6th Semester	Electrical Power System – II			
AGEE-21601				
Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**3**	**1**	**0**
Total Marks:	**100**	**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Gain knowledge about Substation, Isolator and Fuses.
CO2	Gain knowledge about operation of Circuit Breaker in power system.
CO3	Study operation of various types of relays.
CO4	Gain Knowledge about protection of Feeders.
CO5	Study various protection schemes for Generator and Transformer.
CO6	Gain knowledge about protection against over voltage.

Part	Content	CO
I	**Sub-Station** Types, Main equipment in Substation, substation layout, Busbar-arrangements. **Isolators and Fuses** Isolating switches functions, Types, Rating and operation. Fuse-types, Rating, Selection, theory and characteristics, applications.	CO1
II	**Circuit Breakers** Need for Circuit Breakers, Arc phenomenon, Theory of Arc Interruption, Recovery Voltage and Restriking Voltage, Factors Affecting RRRV , Resistance Switching ,Various Types of Circuit Breakers. Principles and Constructional Details of Air Blast, Minimum Oil, SF6, Vacuum Circuit Breakers etc. **Protective Relays** Introduction, classification, Relay Operating Criteria, constructional features; and Characteristics of Induction, Thermal Overcurrent Relay, Directional relays, Distance relays, Differential, Translay, Negative sequence relay, introduction to static and up-based relays.	CO2 & CO3
III	**Protection of Feeders** Time graded protection, Differential and Distance protection of feeders, choice between Impedance, Reactance and Mho relays, Elementary idea about carrier current protection of lines. **Protection of Generators and Transformers** Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection, Reverse Power Protection. Types of fault on transformers, percentage differential protection, Gas relays.	CO4 & CO5
IV	**Protection against Over Voltage and Earthing** Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/Surge Absorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding.	CO6

References:

(i) Rao S., Switchgear and Protection, Khanna Publishers
(ii) Wadhawa C.L. , A Course in Electrical Power, New Age international Pvt. Ltd
(iii) Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., A Textbook on Power System Engineering, Dhanpat Rai and Co.
(iv) Badri Ram and Vishwakarma D.N., Power system Protection and Switchgear, Tata McGraw Hill
(v) Deshpande M.V., Switchgears and Protection, Tata McGraw Hill
http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/power-system/ui/TOC.htm

6th Semester	Advanced Control Systems				
AGEE-21602					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Study state variable techniques and to verify observability and controllability using state variable
CO2	Study different phase plane analysis method for second order system.
CO3	Focus on the study of different types of non-linearity and their effects on the system
CO4	Study Lyapunov stability method for stability of system and to find describing function of different non-linearities.
CO5	Study Z-transformation, inverse z-transformation and its application digital control system.
CO6	Estimate stability of digital control system.

Part	Content	CO
I	**STATE VARIABLE TECHNIQUES:** State variable representation of systems by various methods, solution of state variable model. Controllability and observability.	CO1
II	**PHASE PLANE ANALYSIS:** Singular points, Introduction to Non-Linear System-Basic Concept. Method of isoclines, delta method, phase portrait of second order nonlinear systems, limit cycle. Different Types of Non-Linearity & their Effect on System.	CO2 & CO3
III	**LYAPUNOV'S STABILITY METHOD:** Lyapunov's direct method, generation of Lyapunov's function by Krasovskii's and Variable Gradient methods. **SAMPLED DATA SYSTEMS:** Sampling process, mathematical analysis of sampling process, application of Laplace transform. Reconstruction of sampled signal.	CO4 & CO5
IV	Zero order, first order hold. Z- transform definition, evaluation of Z-transform, inverse Z-transform, pulse transfer function, limitations of Z-transform, solution of difference equations using z-transformation. Stability definition, Jury's test of stability, extension of Routh-Hurwitz criterion to discrete time systems.	CO6

References:

(i) Gopal M., *Digital Control and State Variable Methods*, Tata McGraw Hill
(ii) Nagrath I.J., Gopal M., *Control system engineering*, New Age Publications
(iii) Hsu J.C. and Meyer A.U., *Modern control principles and application*
(iv) Ogata K., *Modern control engineering*. Prentice Hall (India)
(v) Kuo B.C. and Golnaraghi F., *Automatic Control System, Wiley* Publications 6. Dorf R.V. and Bishop R.H., *Modern Control Systems*, Adison Wesley

6th Semester	Signal and Systems				
AGEE - 21603					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the various continuous time and discrete time signals and systems.
CO2	Analysis of continuous time signals using fourier series and fourier transform.
CO3	Understanding of the concept of PSD, ESD.
CO4	Analysis of discrete time signals using sampling and DTFT.
CO5	Introduction to linear time invariant continuous time systems.
CO6	To analyze linear time invariant discrete time systems and the concept of random signal theory.

Part	Content	CO
I	**CLASSIFICATION OF SIGNALS AND SYSTEMS**: Continuous time signals (CT signals), Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT signals - Periodic & aperiodic, Random & deterministic signals, Even & odd signals, Energy & power signals, Description of continuous time and discrete time systems.	CO1
II	**ANALYSIS OF CONTINUOUS TIME SIGNALS:** Fourier series analysis, Spectrum of CT signals, Fourier transform and its properties in signal analysis, Power spectral density and Energy spectral density.	CO2 & CO3
III	**ANALYSIS OF DISCRETE TIME SIGNALS**: Sampling of CT signals and aliasing, DTFT and its properties. **LINEAR TIME INVARIANT - CONTINUOUS TIME SYSTEMS:** Linear time invariant systems and their properties. Differential equation & block diagram representation, Impulse response, Convolution integral, Frequency response (Transfer function), Fourier transforms analysis.	CO4 & CO5
IV	**LINEAR TIME INVARIANT - DISCRETE TIME SYSTEM:** Difference equations, Block diagram representation, Impulse response, Convolution sum, LTI systems analysis using DTFT. **RANDOM SIGNAL THEORY:** Introduction to probabilities, Definition, Probability of random events, Joint and conditional probability.	CO6

References:

(i) Communication Signals & System by Simon Haykins, John Wiley & Sons.
(ii) Signal, System & Transforms, Phillips, Pearson Education.
(iii) Fundamentals of Signals and Systems by Edward W Kamen & Bonnie's Heck, Pearson Education.

6th Semester	MICROCONTROLLER, PLC & SCADA				
AGEE - 21604A					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the basics of microcontrollers and how they differ from microprocessor.
CO2	Develop logic so that they are able to develop their programming skills and make assembly language programs.
CO3	Understand different types of instructions of 8051 and basics of arduino concepts.
CO4	Introduction to timers and counters, serial communication and interrupts of 8051.
CO5	Interface external devices with 8051 microcontroller and able to analyse how they interact with each other.
CO6	Understand PLC's, develop simple applications using ladder logic in PLC and basics of scada.

Part	Content	CO
I	**INTRODUCTION:** Microprocessors, Microcontrollers and their comparison, Overview of the 8051 family. **THE 8051 ARCHITECTURE:** Introduction, 8051 microcontroller hardware, Input / output pins, Ports and circuits, External memory, 8051 PSW register, Addressing modes, ROM memory space allocation, Data types and directives. **8051 ASSEMBLY LANGUAGE PROGRAMMING:** The mechanics of programming, Assembly language programming process, Programming tools and techniques, Introduction to the use of assemblers and simulators.	CO1 & CO2
II	**8051 INSTRUCTIONS SET AND ARDUINO:** Instruction set (Data moving, Logical operations, Arithmetic operations, Jump and call instructions), Input / output programming, Stack (Push and pop) instructions, Single bit instructions and programming. Introduction of arduino board, Pin description and specifications.	CO3
III	**MICROCONTROLLER APPLICATIONS:** 8051 Counters and timers, Serial data input / output, Interrupts, Interfacing keyboards, Displays, Digital to Analog (D / A) and Analog to Digital (A / D).	CO4 & CO5
IV	**PROGRAMMABLE LOGIC CONTROLLERS (PLC):** Introduction, Operation and architecture of PLC, Difference between PLC and hardwired system, Difference between PLC and computer, Relay logic and ladder logic, Basic symbols, Ladder rungs, Ladder diagram for various logic gates. **SUPERVISORY CONTROL AND DATA ACQUISITION:** Objectives, benefits, functions and architecture of scada system, Remote terminal unit (RTU) details, Control center details, Communication between control centers and RTU.	CO6

References:

(i) Mazidi M. A. and Mazidi J. G., The 8051 Micro - controller and Embedded System, Pearson Education.
(ii) Udayashankara V. and Mallikarjunaswamy M.S., 8051 Microcontroller Hardware, Software and Applications, TataMcGraw Hill Education Pvt. Ltd., (2010).
(iii) Dunning Gary, Introduction to PLCs, Tata McGraw Hill.
(iv) Kumar Rajesh, Module on PLCs and their Applications, NITTTR Chandigarh.
(v) Kenneth J Ayola, The 8051 Micro Controller - Architecture, Programming and Application, Penram International Publication.

6th Semester	Embedded System Design				
AGEE-21604B					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Make understand the students about the major components that constitute an embedded system
CO2	Get familiarize with PIC microcontroller.
CO3	Make understand the interfacing with controller.
CO4	Develop familiarity with software development in an embedded environment.
CO5	Make understand the concept of the debugging tools.
CO6	Understand the real time operating system.

Part	Content	CO
I	**Introduction:** Review of Embedded Hardware: Terminology, Gates, Timing Diagram, Memory, Microprocessor Buses, Direct Memory Access, Interrupts, and Built instructions on the Microprocessor. Conventions used on Schematic, Interrupts, Microprocessor Architecture, Interrupt Basic.	CO1
II	**PIC Micro controller and Interfacing:** Introduction, CPU Architecture, Registers, Instruction Sets, Addressing Modes, Programs, Interfacing Methods, Parallel I/O Interface, Parallel Port Interface, Memory Interfacing, High Speed I/O Interfacing, Interrupt, Interrupt Service Routine, features of Interrupts, Interrupt vector and Priority, Timing Generation and Measurements, Input Capture, Output Compare, Frequency Measurement, Serial I/O Device RS232, RS845, Analog Interfacing, Applications.	CO2 & CO3
III	**Software Development and Tools:** Embedded System Evolution Trends, Round – Robin, Robin with Interrupts, Introduction to assembler, Compiler and Cross compilers and Integrated Development Environment (IDE), Object Oriented Interfacing, Recursion, Debugging Strategies, Simulators. Introduction to ARM processor and its registers.	CO4 & CO5
IV	**Real Time Operating Systems (RTOS):** Task And Task States, Tasks and Data, Semaphores and shared data, operating system services, Message queues, Timer Function, Events, Memory Management, Interrupt Routines in an RTOS Environment, Basic Design Using RTOS.	CO6

References:

(i) Gajski D.D., Vahid F., Gong J., Narayan S., *Specification and Design of Embedded Systems*, Prentice Hall.

(ii) Steve Heath, Newnes *Embedded systems Design*, Prentice Hall.

(iii) Balarin F., Chiodo, *Hardware Software Co-design of Embedded Systems*, Academic Publishers.

6th Semester	Robotics and Automation				
AGEE-21604C					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able :	
CO1	Understand basic concept of robotics.
CO2	Analyze direct and inverse kinematics.
CO3	know about the various solutions and methods used in kinematics
CO4	know about the differential manipulator
CO5	know about the Static Analysis-Force and moment Balance.
CO6	Design and implement the robotic system and path planning

Part	Content	CO
I	. BASIC CONCEPTS Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues-Various manipulators–Sensors-work cell-Programming languages.	CO1
II	DIRECT AND INVERSE KINEMATICS Mathematical representation of Robots-Position and orientation– Homogeneous Transformation-Various Joints-Representation using the Denavit Hattenberg parameters-Degrees of freedom-Direct KinematicsInverse kinematics-SCARA robots-Solvability–Solution Methods-Closed form solution**.**	CO2 & CO3
III	MANIPULATOR DIFFERENTIAL MOTION AND STATICS Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse-Wrist and arm singularity-Static Analysis-Force and moment Balance.	CO4 & CO5
IV	PATH PLANNING AND ROBOTICS SYSTEM DESIGN Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique-Parametric Descriptions-Straight line and circular paths-Position and orientation planning Running Code on Microcontroller-Voltage, Current and power-ARM Corte M-Software Design-Battery and Voltage Regulation-GPIO-Interfacing Input and Output.	CO6

References:

(i) Introduction to Robotics by S.Saha McGraw Hill Education India Pvt Ltd
(ii) Robotics experiments by evil genius by Myke Predko,Tab Electronics; Pck edition
(iii) Introduction to Autonomous Mobile Robots 2e by Roland Siegwart, Illah R. Nourbakhsh, Davide Scaramuzza ,MIT Press; 2nd Revised edition edition
(iv) Robotics byAppuu K.K. Kuttan , I K International Publishing House Pvt. Ltd
(v) Introduction To Robotics by Saeed B. Niku ,WILEY INDIA PVT. LTD.-NEW DELHI

6th Semester	Digital Signal Processing				
AGEE - 21604D					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the various discrete time signals and systems.
CO2	Understanding the concept of convolution, correlation and autocorrelation, difference equations and various LTI properties.
CO3	Analysis of discrete time signals using DFT and FFT.
CO4	Understanding of the concept of z - transform and its properties.
CO5	Structures of discrete time system and designing of digital filters.
CO6	Introduction to DSP processors and applications of DSP.

Part	Content	CO
I	**INTRODUCTION:** Limitations of analog signal processing, Advantages of digital signal processing and its applications, Some elementary discrete time sequences and systems, Basic elements of digital signal processing such as convolution, correlation and autocorrelation, Concepts of stability, causality, linearity, difference equations.	CO1 & CO2
II	**DFT:** DFT and its properties, Linear periodic and circular convolution, Linear filtering methods based on DFT, Fast fourier Transform algorithm using decimation in time and decimation frequency techniques, Goertzel algorithm.	CO3
III	**THE Z - TRANSFORM:** Introduction, Z - transform, Region of convergence, Inverse z - transform methods, properties of z - transform.	CO4
IV	**STRUCTRES OF DISCRETE TIME SYSTEM:** Structures of realization of discrete time system, direct form, cascade form, parallel form structure of FIR and IIR systems. **DESIGN OF DIGITAL FILTERS:** Linear phase FIR filters, Design methods for FIR filters using window and frequency sampling method, IIR filter design by impulse invariance, Bilinear transformation, Matched z - transformation, Analog and digital transformation in the frequency domain. **DSP PROCESSORS:** Architectures of ADSP and TMS series of processor. Applications of DSP processors, Applications of DSP in the field of speech processing, image processing and bio - medical engineering.	CO5 & CO6

References:

(i) Digital Signal Processing Dr. Sanjay Sharma, S. K. Kataria & Sons.
(ii) Discrete - Time Signal Processing Alan V Oppenheim, Ronald W Schafer, John R Back 2nd 2008, Prentice Hall.
(iii) Digital Signal Processing S. Salivahan, A Vallavaraj, Gnanpiya 1st 2008 Tata McGraw Hill.
(iv) Digital Signal Processing - A computer based approach S. K. Mitra 1st 2006 Tata McGraw Hill.
(v) Jervis, "Digital Signal Processing", Pearson Education India.
(vi) Introduction to Digital Signal Processing Johny R . Johnson 1st 2006, Prentice Hall.

6th Semester	AutoCAD Electrical				
AGEE-21605					
Internal Marks:	30		L	T	P
External Marks:	20		1	0	4
Total Marks:	50		Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the practical issues related to practical implementation of electrical circuits and choose appropriate components, software and hardware platforms.
CO2	Use various symbols and notations in electrical and electronics engineering drawings.
CO3	Draw various electrical and electronics circuits according to standard practices using AutoCAD Electrical software.
CO4	Draw electrical machines and wiring diagrams
CO5	Simulate/test simple electrical and electronics circuits using Simulation software
CO6	Prepare projects related to electrical and electronic circuits using AutoCAD Electrical software through hands on experience.

Part	Content	CO
I	Introduction to fundamental concepts and features of AutoCAD Electrical	CO1
II	Knowledge of AutoCAD Blocks and Attributes, Create a New Project, Edit the Project Drawing List, Navigating the Project, Use Basic Editing Tools, Use Electrical Audit and Drawing Audit, Generate Schematic Reports • To draw and modify simple geometrical figure with CAD tools • To draw cross sectional elevation of XLPE cable. • To draw the half sectional elevation of pin insulator.	CO2 & CO3
III	• To develop a DC lap winding for a DC machine. • To develop a DC wave winding for a DC machine. • To draw the line diagram of DOL starter. • To draw the line diagram of STAR DELTA starter. • To develop AC lap winding for three phase machine double layer full pitched. • To draw electrical wiring layout	CO4
IV	• Electrical Lighting Layout and demand calculation. • Solar Electric Power System Design • Lightning Protection & Earthing Layout • Load Schedule & Single Line Diagram • Any other project of their choice.	CO5 & CO6

References:

(i) AutoCAD Electrical 2022 Black Book by Gaurav Verma, Matt Weber.
(ii) AutoCAD Electrical 2023: A Tutorial Approach, 4th Edition by Prof. Sham Tickoo
(iii) Get started with AutoCAD Electrical by James Richardson.

6th Semester	Power System Lab				
AGEE-21606					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Perform Various Parameters of a Transmission Line and its Protection
CO2	Study and Perform the Characteristics of Fuse and Circuit Breaker
CO3	Study and perform the characteristics of Relay.
CO4	Gain knowledge about strength of transformer oil
CO5	Prepare Projects Related to Power System Operation
CO6	Prepare Projects Related to Power System Protection

Part	Content	CO
I	• To study the performance of a transmission line. Also compute its ABCD parameters. • Study of Characteristics of over current and earth fault protection. • To find the earth resistance using three spikes	CO1
II	• To study the operating characteristics of fuse. (HRC or open type) • To study the characteristics of bimetal mini circuit breakers.	CO2
III	• To study over current static relay. • Study of Characteristics of over current and earth fault protection. • To study the performance of under voltage and over voltage relay. • To study the characteristics of Distance Relay. • To find the breakdown strength of transformer oil	CO3 & CO4
IV	• To construct various types of relay demonstration • To demonstrate protection of power system. • To construct various types of circuit breakers demonstration • To prepare star- delta starters and draw electrical connection diagram • Prepare Projects related to Power System Operation and Control • Prepare Projects related to Protection of Power System from overload or Short Circuit	CO5 & CO6

References:

(i) Rao S., Switchgear and Protection, Khanna Publishers
(ii) Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., A Textbook on Power System Engineering, Dhanpat Rai and Co.
(iii) Wadhawa C.L. , A Course in Electrical Power, New Age international Pvt. Ltd
(iv) Badri Ram and Vishwakarma D.N., Power system Protection and Switchgear, Tata McGraw Hill
(v) Deshpande M.V., Switchgears and Protection, Tata McGraw Hill

6th Semester	MICROCONTROLLER, PLC & SCADA LAB				
AGEE - 21607A					
Internal Marks:	30		L	T	P
External Marks:	20		0	0	2
Total Marks:	50		Credits		1

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the basic features and functions of 8051 microcontroller.
CO2	Understand assembly language programs of addition, subtraction and multiplication operation of two 8 - bit numbers using 8051 kit and simulator.
CO3	Develop program for division of two 8 - bit numbers, addition of natural numbers and finding complement of 8 - bit number using 8051 kit and simulator.
CO4	Develop program for splitting of a number using 8051 kit and simulator, displaying any name on LCD using 8051, studying the 8051interrupt structure and PLC and Scada based experiments.
CO5	Implementation of different minor projects using microcontroller, PLC and Scada.
CO6	Implementation of different minor projects using Arduino board.

Part	Content	CO
I	• Study of 8051 / 8031 microcontroller kits. • Write a program to add two numbers lying at two memory locations and display the result. • Write a program to subtract two numbers lying at two memory locations and display the result. • Write a program for multiplication of two numbers lying at memory location and display the result. • Write a program for multiplication of two numbers using repeated addition and display the result.	CO1 & CO2
II	• Write a program to divide two numbers lying at two memory locations and display the result. • Write a program to add the first ten natural numbers and display the result. • Write a program to find 2's complement of a number.	CO3
III	• Write a program to split a hexadecimal number into two nibbles and display the result. • Write a program to display any name on LCD. • Study of interrupt structure of 8051 / 8031 microcontrollers. • PLC interfaced with scada status read / command transfer operation. • Parameter reading of PLC in scada. • Alarm annunciation using scada.	CO4
IV	• Smart car parking system using arduino board. • Design temperature and humidity sensor using arduino board. • Implementation of different gates using PLC. • Temperature sensing using scada. • Any other project of their choice.	CO5 & CO6

References:

(i) Kenneth J Ayola, The 8051 Micro Controller - Architecture, Programming and Application, Penram International Publication.
(ii) Mazidi M. A. and Mazidi J. G., The 8051 Micro - controller and Embedded System, Pearson Education.
(iii) Dunning Gary, Introduction to PLCs, Tata McGraw Hill.

6th Semester	Embedded System Design Lab				
AGEE-21607B					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Study ARM7 processor with LED and interrupts.
CO2	Perform interfacing of the ARM with ADC, stepper motor.
CO3	Perform interfacing of ARM with LCD display, DAC.
CO4	Perform interfacing of ARM with ZIGBEE, DC motor.
CO5	Prepare projects related to the LED / LCD display with embedded system control
CO6	Prepare projects related to the embedded system.

Part	Content	CO
I	• Study of ARM7 & ARM9 Bit Processor Architecture and Pin Diagram. • Study of Interrupt structure in ARM Processors • Write ARM Processor program to Flash LED	CO1
II	• Interfacing of an LCD Display • Write a program to interface an ADC • Write a program to generate a Ramp waveform using DAC interface • Write a program to control a Stepper Motor	CO2 & CO3
III	• Write a program to control the speed of DC motor • Interface relays and write a program to control them • Interface ZIGBEE with ARM to control more external devices	CO4
IV	• Implement Traffic light control using embedded system • Design Temperature sensor using embedded system. • Project related with embedded system.	CO5 & CO6

References:

(i) Gajski D.D., Vahid F., Gong J., Narayan S., *Specification and Design of Embedded Systems*, Prentice Hall.

(ii) Steve Heath, Newnes *Embedded systems Design*, Prentice Hall.

6th Semester	Robotics and Automation Lab				
AGEE-21607C					
Internal Marks:	30		L	T	P
External Marks:	20		0	0	2
Total Marks:	50		Credits		1

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the kinematics and coordinate transformation of robot
CO2	Differentiate between open-loop and feedback control for motion (position and velocity) for the robot.
CO3	Design appropriate simple robotic systems to accomplish a specific task
CO4	Implement and analyze 3-degree-of-freedom manipulator
CO5	Prepare projects related to robotics
CO6	Prepare projects related to automation

Part	Content	CO
I	• To study and analyse DOF Manipulator Kinematic Diagram and Coordinate Transformation.	CO1
II	• To study and analyse DC motors Torque/Speed Control • To analyse and study the Control Velocity of the Joints.	CO2 & CO3
III	• To analyse Speed, Stability, and Accuracy in a Control Algorithm of Robot • To analyse the Open-Loop and Feedback Control to Set the Position of the End Effector.	CO4
IV	• Projects can be made in robot technology in any of the below mentioned applications. • a. Hello World • b. Controlling a Relay • c. LED Bar Graph Display • d. Playing Music • e. Simple Counter • f. Controlling a Servo • g. IR Remote Controller • h. 3-axis Accelerometer • i. 4x4 Matrix Keypad	CO5 & CO6

References:

(i) Introduction to Autonomous Mobile Robots 2e by Roland Siegwart, Illah R. Nourbakhsh, Davide Scaramuzza ,MIT Press; 2nd Revised edition edition

(ii) Introduction to Robotics by S.Saha McGraw Hill Education India Pvt Ltd

6th Semester	Digital Signal Processing Lab				
AGEE - 21607D					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the generation basic elementary signal, sequences and apply basic operations on signals.
CO2	Implement convolution and correlation using matlab.
CO3	Find z - transform, DFT and IDFT of discrete time signal using matlab.
CO4	Find response, spectral density of a system, plotting pole - zero plot, designing filters and study of DSP kit.
CO5	Implement different simulative projects based on signals using matlab Simulink.
CO6	Implement different practical life simulative projects using matlab Simulink and filter designing on DSP kit.

Part	Content	CO
I	• To develop elementary signal function modules (m-files) for unit sample, unit step, exponential and unit ramp sequences. • Write a program in matlab to generate standard sequences. • Generation of even and odd signals in discrete time domain. • To develop program modules based on operation on sequences like signal shifting, signal folding, signal addition and signal multiplication.	CO1
II	• Write a program in matlab to verify linear convolution. • Write a program in matlab to verify the circular convolution. • To develop program for discrete correlation. • To develop program for computing inverse z - transform. • To develop program for computing DFT and IDFT.	CO2 & CO3
III	• To develop program for finding magnitude and phase response of LTI system described by system function H(z). • To develop program for finding response of the LTI system described by the difference equation. • To write a matlab Program for pole - zero plot from the given transfer function of a discrete time causal system in s - domain and z - domain along with checking the stability criteria in the z - plane. • Write a program in matlab to compute power density spectrum of a sequence. • To develop program for designing FIR filter. • To develop program for designing IIR filter. • To study TMS3200C6713 digital signal processing kit (DSK).	CO4
IV	• Design and simulation of discrete time sine and cosine wave using matlab simulink. • Design FIR filter using TMS320C6713 digital signal processing kit (DSK). • Design IIR filter using TMS320C6713 digital signal processing kit (DSK). • Removal of background from image using matlab. • Any other project of their choice**.**	CO5 & CO6

References:

(i) Digital Signal Processing Dr. Sanjay Sharma, S. K. Kataria & Sons.
(ii) Discrete - Time Signal Processing Alan V Oppenheim, Ronald W Schafer, John R Back 2nd 2008, Prentice Hall.
(iii) Jervis, "Digital Signal Processing", Pearson Education India.
(iv) Introduction to Digital Signal Processing Johny R . Johnson 1st 2006, Prentice Hall.

6th Semester	Signal And Systems Lab				
AGEE - 21608					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the basic commands of MATLAB.
CO2	Implement continuous and discrete time sine and cosine signals using MATLAB.
CO3	Generation of sinc and rectangular pulse using MATLAB.
CO4	Generate unit impulse, unit step, rising and decaying exponential signal using MATLAB.
CO5	Implement different simulative projects based on signals using MATLAB Simulink.
CO6	Implement different practical life simulative projects using MATLAB Simulink.

Part	Content	CO
I	• Introduction to matlab commands.	CO1
II	• Generation of continuous and discrete time sine signals. • Generation of continuous and discrete time cosine signals. • To generate continuous time sinc pulse. • To generate continuous time rectangular pulse signal.	CO2 & CO3
III	• To generate continuous time unit impulse signal. • Generation of unit step signal, exponential rising signal and exponential decaying signal.	CO4
IV	• Design and simulation of sine wave using simulink. • Design and simulation of cosine wave using simulink. • Simulative analysis of bouncing ball using integrator block. • Simulative analysis of room temperature using simulink. • Any other project of their choice**.**	CO5 & CO6

References:

(i) Communication Signals & System by Simon Haykins, John Wiley & Sons.
(ii) Fundamentals of Signals and Systems by Edward W Kamen & Bonnie's Heck, Pearson Education.

6th Semester	Functional English - III				
AGFE-21603					
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**0**	**1**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Self-Introduction and Body Language to prepare students to face one to one interaction.
CO2	Spoken Activity such as Group Discussion to hone spoken skills and interpersonal communication of students.
CO3	Vocabulary based session to improve language proficiency of students.
CO4	Resume writing and cover letter writing to make students proficient in English correspondence.
CO5	Book reading to improve reading skills of students.
CO6	Corporate Profile Report to make students aware of companies of their stream and their selection criteria.

Part	Content	CO
I	Mock interview to provide one (students) with an opportunity to practice one's interviewing skills in an environment similar to an actual interview.	CO1
II	This section includes Group discussion is a task, which is generally aimed at understanding and evaluating candidate's behavior in a group.	CO2
	This section includes word power, analogies, sentence correction and verbal reasoning.	CO3
III	Resume writing and cover letter writing to make students proficient in English correspondence.	CO4
IV	Rich Dad Poor Dad shall be prescribed for honing reading skills and comprehension in depth.	CO5
	Corporate Profile Report to make students aware of companies of their stream and their selection criteria.	CO6

References:

(i) English Grammar by Wren and Martin
(ii) www.Indiabix.com
(iii) www.freshersworld.com
(iv) www.alison.com

6th Semester	Engineering Aptitude - III				
AGAP-21603					
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**0**	**1**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Enhance the logical thinking of students
CO2	How likely events could happen and so the risks could be determined and resolved professionally
CO3	Understand he time taken by an individual or a group of individuals to complete a piece of work
CO4	Understand different relations among the members of a family
CO5	Determine if a system of linear equations has no solution, one solution, or infinitely many solutions
CO6	Use Quadratic equations in real life

Part	Content	CO
I	**Odd man out series:** Concept of odd man out series with different Types	CO1
	Probability: Definition, Formulas, Examples ,Events ,Equally Likely Events, Complementary Events	CO2
II	**Time & Work** :Concept, Tricks and Formulas	CO3
III	**Blood Relations:** How is A related to B Blood Relation? Are husband and wife blood related? What is Generation in blood relation?	CO4
IV	**Linear Equations:** Substitution Method, Elimination Method.	CO5
	Quadratic Equations: Important Formulas ,Roots of Quadratic Equation, Nature of Roots Solving Quadratic Equations.	CO6

References:

(i) Quantitative Maths: Arihant Publishers.
(ii) Objective Mathematics: R S Aggarwal.
(iii) Quantitative Maths: TMH Publications

7th

Semester

7th / 8th Semester	Power System Analysis				
AGEE-21701					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO1	Create computational models for analysis of power systems and able to understand per unit system.
CO2	Understand different methods to solve Impedance and Admittance matrices.
CO3	Perform load flow computations and analyze the load flow results using different methods.
CO4	Understand positive sequence, negative sequence & zero sequence transformation components.
CO5	Analyze unsymmetrical fault in power system network under symmetrical conditions.
CO6	Understand basic concepts on power system stability and analyze steady state and transient stability of power systems.

Part	Content	CO
I	**POWER SYSTEM MODELLING:** Power system modelling of synchronous machines, transformers, loads etc., per unit system, single line diagram of electrical networks, single phase impedance and reactance diagrams, Formation of bus admittance matrix and bus impedance matrix for the electrical networks.	**CO1 & CO2**
II	**LOAD FLOW ANALYSIS:** Data for the load flow studies, Formulation of power flow equations, Load flow solution using Gauss-Seidal method, Newton Raphson Method and Fast decoupled method, Comparison of load flow methods.	**CO3**
III	**FAULT ANALYSIS:** Transient on a Transmission Line, Algorithm for short circuit studies, Symmetrical Component transformation, construction of sequence networks of power systems, Symmetrical analysis of unsymmetrical Line-to-ground (LG), Line-to line (LL), double line to ground (LLG) faults using symmetrical components.	**CO4 & CO5**
IV	**POWER SYSTEM STABILITY:** Concepts of types of stability limits, Steady state stability analysis, Transient stability analysis, Power angle equations, Numerical solution of swing equation, Equal area criterion, Critical clearing angle and time.	**CO6**

References:

(i) Elgerd O.I., Electric Energy Systems Theory, Tata McGraw Hill
(ii) Nagrath I.J., Kolthari D.P., Modern Power System Analysis, Tata McGraw Hill
(iii) Stevenson W.D., Elements of Power System Analysis, McGraw Hill
(iv) Nagrath I.J. and Kothari D.P., Power System Engineering, Tata McGraw Hill
(v) Arrillaga J. and Arnold C.P., Computer Analysis of Power Systems, John Wiley & Sons
(vi) Stagg Glenn W. and Ei-Abiad Ahmed H., Computer Methods in Power System Analysis, Tata McGraw Hill
(vii) Kusic G.L., Computer Aided Power System analysis, Prentice Hall, India

7th / 8th Semester	Smart Grids: Basic To Advanced Technologies				
AGEE-21702A					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the features of Smart Grid.
CO2	Assess the role of automation and digitization in the Transmission and Distribution
CO3	Analyze Smart grids and Distributed energy resources (DER) with evolutionary algorithms
CO4	Understand the operation and importance of data acquisition devices and their location in Voltage and Frequency control.
CO5	Understand communication technologies used in smart grid.
CO6	Study different concepts used in smart cities.

Part	Content	CO
I	**Introduction to Smart Grid** Basics of power systems, the definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India. **Smart Grid Architecture** Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system, and advanced metering infrastructure. The fundamental component of Smart Grid designs, Transmission Automation, Distribution Automation, and Renewable Integration.	**CO1 & CO2**
II	**Tools and Techniques for Smart Grid** Computational Techniques – Static and Dynamic Optimization Techniques for power applications such as Economic load dispatch – Computational Intelligence Techniques – Evolutionary Algorithms in the power system – Artificial Intelligence techniques and applications in power system. **Distribution Generation Technologies** Introduction to Distribution Energy Sources, Renewable Energy Technologies – Microgrids – Storage Technologies –Electric Vehicles and plug – in hybrids – Environmental impact and Climate Change – Economic Issues.	**CO3 & CO4**
III	**Communication Technologies in Smart Grid** Introduction to Communication Technology, Two Way Digital Communications Paradigm, Synchro- Phasor Measurement Units (PMUs) – Wide Area Measurement Systems (WAMS)- Introduction to Internet of things (IoT)- Applications of IoT in Smart Grid.	**CO5**
IV	**Smart-cities** Smart city pilot projects, essential elements of smart cities, active distribution networks, micro grids, distribution system automation, Reliability, and resiliency studies, and decentralized operation of a power network.	**CO6**

References:

(i) S. Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press, 1st Edition, 2013.

(ii) G. Masters, "Renewable and Efficient Electric Power System", Wiley–IEEE Press, 2nd Edition, 2013.'

(iii) Smart power grids by A Keyhani, M Marwali.

(iv) Computer Relaying for Power Systems by Arun Phadke

(v) .Microgrids Architecture and control by Nikos Hatziargyriou

(vi) Renewable Energy Systems by Fang Lin Luo, Hong Ye

(vii) Voltage-sourced converters in power systems_ modeling, control, and applications by Amirnaser Yazdani, Reza Iravani"

(viii) A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2nd Edition, 2017.

(ix) T. Ackermann, "Wind Power in Power Systems", Hoboken, N J, USA, John Wiley, 2nd Edition,2012.

7th / 8th Semester	Electrical Distribution System Analysis				
AGEE-21702B					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Introduce the concepts and phenomenon of different Load modeling.
CO2	Give an idea about the fundamental concepts of electrical power distribution
CO3	Ability to discuss functions of Substation.
CO4	Formulate distribution networks for necessary variable calculation
CO5	Analyze the various concept Protective Devices
CO6	Understand the Power factor improvement and voltage control methods.

Part	Content	CO
I	**GENERAL CONCEPTS** Introduction to distribution systems, Load modeling and characteristics - Coincidence factor, contribution factor loss factor, Relationship between the load factor and loss factor - Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics **DISTRIBUTION FEEDERS** Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.	**CO1 & CO2**
II	**SUBSTATIONS** Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations. **SYSTEM ANALYSIS** Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.	**CO3 & CO4**
III	**PROTECTION**: Objectives of distribution system protection, types of common faults and procedure for fault calculations - Protective Devices: Principle of operation of Fuses, Circuit Reclosures, line sectionalizes, and circuit breakers. Coordination: Coordination of Protective Devices: General coordination procedure**.**	**CO5**
IV	**COMPENSATION FOR POWER FACTOR IMPROVEMENT**: Capacitive compensation for power-factor control - Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation - Economic justification - Procedure to determine the best capacitor location **VOLTAGE CONTROL**: Voltage Control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation	**CO6**

References:

(i) S. Sivanagaraju, V.Sankar, "Electrical Power Distribution and Automation", Dhanpat Rai & Co.
(ii) V. Kamaraju, "Electrical Power Distribution Systems", Right Publishers.
(iii) Turan Gonen, "Electric Power Distribution system, Engineering", Mc Graw-hill Book Company
(iv) A.S. Pabla ,"Electric Power Distribution", Tata Mc Graw-hill Publishing company.

7th / 8th Semester	Economic Operations and Control of Power Systems				
AGEE-21702C					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Review the basics of optimization and problem formulation using dynamic programming
CO2	Formulate the problem of economic dispatch and its methods
CO3	Understand the concept of power flow in AC and DC networks
CO4	Understand unit commitment problem and hydro thermal scheduling
CO5	Analyze the problem related to power and energy interchange
CO6	Understand the concepts of generation control, advanced distribution system management and challenges in electric vehicles

Part	Content	CO
I	**INTRODUCTION:** Evolution and control of Indian Power System, Fundamentals of Optimization, Types of Optimization Problems, equality and inequality constraints, Linear programming, Simplex method. Dynamic Programming-Problem formulation, forward and backward approach **ECONOMIC DISPATCH OF THERMAL UNITS** – without and with transmission line effects, Lagrange multiplier approach, base point and participation factors, economic dispatch with linear programming, Lambda iteration method, Gradient method, Newton's method	**CO1 & CO2**
II	**POWER FLOW ON AC AND DC NETWORK:** Formulation of DC and AC Power Flow, Decoupled Power Flow, Calculation of Transmission Losses, Economic Dispatch using Dynamic Programming **UNIT COMMITMENT:** Introduction, Unit Commitment using Dynamic Programming and Lagrange Relaxation **HYDROTHERMAL SCHEDULING:** Hydrothermal Scheduling, Transmission System Effects Introduction to Production Cost Model, using Load duration curves, probabilistic computations, Economic Scheduling with Unserved Load Method, Expected Cost Method	**CO3 & CO4**
III	**POWER AND ENERGY INTERCHANGE:** Wheeling, Multiple Utility Interchange Transactions, Power Pools, Energy broker, Transmission Effects and Issues Real-Time Case Study on Reactive Power Dispatch, Power System Security, Optimal Power Flow, State Estimation	**CO5**
IV	**CONTROL OF GENERATION**: Short-Term Demand Forecasting, Pumped Storage	**CO6**

	& Gravity Storage, Energy Storage **ADVANCED DISTRIBUTION SYSTEM MANAGEMENT**: Introduction, architecture, technology, SCADA, EV Opportunities, Challenges and Impact in Indian Power Sector	

References:

(i) Power Generation Operation and Control, by Allen J. Wood, Bruce F. Wollenberg.

(ii) Power System Stability and Control by P Kundur.

(iii) Power System Analysis by Hadi Saadat – TMH Edition

(iv) Chakrabarti & Haldar, "Power System Analysis: Operation and Control", Prentice Hall of India, Edition.

(v) Robert Miller, James Malinowski, 'Power System Operation', Tata McGraw Hill Publishing Com Ltd, New Delhi.

(vi) C.L.Wadhwa, 'Power System Analysis', New Age International.

7th / 8th Semester	Advances in UHV Transmission and Distribution				
AGEE-21702D					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Study about UHV Transmission and Distribution
CO2	Gain knowledge about present status and future growth of UHV
CO3	Study about Various Components of Transmission line.
CO4	Gain Knowledge about General Design Criteria for overhead transmission lines
CO5	Gain knowledge about UHV Transmission and its Up-gradation
CO6	Gain knowledge about design of UHV substations

Part	Content	CO
I	**Introduction to UHV Transmission and Distribution** Brief Introduction to the development of Power Transmission and Distribution, Recent advances in UHV power transmission and distribution systems; present status and future growth, Importance in basic Insulation Design Principle, Critical elements and issues related to UHV Transmission and Distribution.	**CO1 & CO2**
II	**Design of Overhead Transmission line** Components of Transmission Line**:** Insulators, Conductors, Towers and Foundations, Earth wire, Hardware fittings/ Accessories. General Design Criteria for overhead transmission lines: Methodologies, reliability, wind/ice loading etc. types of conductor configurations.	**CO3 & CO4**
III	**UHV Transmission and its Up-gradation** Towers for UHV transmission: calculations of clearances for power frequency, switching and lightning surges, right of way(ROW)etc. Selection of insulators for light, medium and heavy polluted areas. Up-gradation of existing transmission.	**CO5**
IV	**Design of UHV substations** Design consideration of UHV substations, Comparison of AIS, Hybrid-AIS and GIS electric and magnetic fields. Insulation coordination for UHV systems. Earthling and safety measures for UHV substation	**CO6**

References:

(i) Rakosh Das Begamudre, " Extra High Voltage AC Transmission Engineering", New Age International(P) Ltd, New Delhi, 2000.
(ii) E Kuffel, W S Zaengl and J Kuffel, "High Voltage Engg. Fundamentals", textbook published by Newness publishers, second edition, 2000.
(iii) IEC-60826, International standard, "Design criteria of overhead transmission lines", 2003.
(iv) Outdoor Insulators – Ravi gorur, Edward Cherney & Jeffery Burnham Text book

7^{th} / 8^{th} Semester		Modeling, Analysis and Estimation of Three Phase Unbalanced Power Network			
AGEE-21702E					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Study about Structure of Power System.
CO2	Gain knowledge about fundamental Transmission line
CO3	Study about Various Line Parameters of Transmission line.
CO4	Gain Knowledge about Performance of Transmission Line.
CO5	Gain knowledge about Transformer Modeling.
CO6	Gain knowledge about Load Flow Analysis.

Part	Content	CO
I	**Three Phase Transmission Line** Introduction, Structure of power systems, Growth of power systems–Indian overview, Interconnections and their advantages. Carson's line, Choice of voltage and frequency, Types of conductor, Tension and sag calculations, Factors affecting Sag, Stringing charts, Vibrations and vibration damper. Insulator types, Types of Conductors, Supporting Structure, String efficiency, Improvement of String Efficiency, Insulator arc Failure, Arcing horns, Armored rods and Bushing. Transposition of Transmission Line	**CO1 & CO2**
II	**Transmission Line Parameters and Performance** Introduction to line parameters, Resistance of transmission line, inductance of single phase two wire line, Inductance of three phase line, capacitance of 1- phase and 3-phase lines, Impedance of Transmission line, Sequence Impedance of Transmission line , Representation of short transmission line, medium length line (nominal T & II circuits). Power flow through transmission lines, ABCD constants.	**CO3 & CO4**
III	**Transformer Modeling** Introduction, single phase transformer model, three phase transformer connections, per phase analysis, normal systems, per unit normalization, per unit three phase quantities, change of base, per unit analysis of normal system, regulating transformers for voltage and phase angle control, auto transformers, transmission line and transformers.	**CO5**
IV	**Load Flow Study** Revision of Load flow studies by using Newton Raphson method (polar and rectangular). Contingency evaluation, concept of security monitoring, Techniques of contingency evaluation, Decoupled load flow and fast decoupled load flow. Three phase load flow problem notation, specified variables, derivation of equations.	**CO6**

References:

(i) Elgerd O.L., Electrical Energy System Theory - An introduction, Tata McGraw-Hill Publication
(ii) Gupta B.R., Power System Analysis & Design, Wheeler Publishing.
(iii) Nagrath I.J. and Kothari D.P., Power System Analysis Tata McGraw-Hill Publication
(iv) Stevenson Jr. W.D., Elements of Power System Analysis, Tata McGraw-Hill Publication
(v) Wadhwa C.L., Course in Electrical Power, New Age International (P) Ltd.

7th / 8th Semester	Electrical Vehicle Technology				
AGEE-21702F					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Explain the working of electric vehicles and recent trends.
CO2	Analyze different power converter topology used for electric vehicle application.
CO3	Develop the electric propulsion unit and its control for application of electric vehicles
CO4	Design converters for battery charging and explain transformer less topology
CO5	Study about Importance of control system in Electric Vehicle
CO6	Explain about electric vehicle battery fast charging and electric vehicle battery discharging

Part	Content	CO
I	**ELECTRIC AND HYBRID ELECTRIC VEHICLES:** History and benefits of electric Vehicles, Fundamentals of Electric Vehicles. Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. **ENERGY STORAGE FOR EV AND HEV:** Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modeling of PEMFC, Supercapacitors.	**CO1 & CO2**
II	**ELECTRIC PROPULSION:** EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives. **DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES:** Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, and design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design.	**CO3**
III	**POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING:** Charging methods for battery, Termination methods, classification based on charging levels (region-wise), charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z- converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology. Importance of control system in Electric Vehicle, Study of Control Architecture in electric vehicles.	**CO4**
IV	**ELECTRIC VEHICLE BATTERY FAST CHARGING:** On-board & off-board charging, The Fast-Charging Process, Fast Charging Strategies, The Fast Charger Configuration, Using Equalizing/Leveling Chargers, Inductive Charging—Making Recharging Easier, Range Testing of Electric Vehicles Using Fast Charging, Electric Vehicle Speedometer Calibration. Wireless Charging. **ELECTRIC VEHICLE BATTERY DISCHARGING**: Definition of NiMH Battery Capacity, Discharge Capacity Behavior, Discharge Characteristics of Li-ion Battery, Discharge of an Electric Vehicle Battery Pack, Cold-Weather Impact on Electric Vehicle Battery Discharge	**CO5 & CO6**

References:

(i) Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design M. Ehsani, Y. Gao, S. Gay and Ali Emadi CRC Press 2005
(ii) Electric and Hybrid Vehicles: Design Fundamentals Iqbal Husain CRC Press 2003
(iii) Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles Sheldon S. Williamson Springer 2013
(iv) Modern Electric Vehicle Technology C.C. Chan and K.T. Chau Oxford University 2001
(v) Hybrid Electric Vehicles Principles and Applications with Practical Perspectives Chris Mi, M. Abul Masrur, David Wenzhong Gao Wiley Publication 2011

7th / 8th Semester	Sensor Technologies				
AGEE-21702G					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Study about Sensor and Material used.
CO2	Gain knowledge about various Sensor Parameters
CO3	Study about Physics od Sensors
CO4	Solve various Numerical Problems related to Sensors
CO5	Gain knowledge about Sensor Fabrication and Characterization Techniques
CO6	Gain knowledge about Sensor Systems and Circuits

Part	Content	CO
I	**Basics of Sensors** Sensors and Transducers – Basics, Introduction to Sensors, Materials for sensors, Multidisciplinary Aspects of Sensors, Introduction to Sensor Parameters, Sensor Parameters-II, Sensor Parameters-III, Sensor Parameters-IV, Sensor Parameters-V, Numerical Examples	**CO1 & CO2**
II	**Physics of Sensors** Introduction: Physics of Sensors, Capacitive Sensor Architecture, Different Types of Capacitive Sensors, Thermal Sensors Basics, Dynamic Condition of Thermal Sensors, Classification of Thermal Sensors, Chemical Sensor Basics, Electrochemical Sensors, Impedimetric Sensors, Numerical Examples, Physics of Optical Sensors, Physics of Magnetic Sensors, Physics of Acoustic Sensors, Physics of Microfluidic Sensors, Various Sensor Geometries and Example	**CO3 & CO4**
III	**Sensor Fabrication and Characterization Techniques** Microfabrication Technologies, Deposition Techniques, Physical Vapor Deposition, Chemical Vapor Deposition, Patterning Techniques, Lithography Techniques, Basics of Etching Techniques, Dry Etching Techniques, Optical and Electron Microscopy, Other Microscopy Techniques	**CO5**
IV	**Basics of Sensor Systems and Circuits** Sensor System: Basic Circuits, Amplifier Circuits, Instrumentation Amplifier, Filter Circuits, Sensor System: Experimental Demonstration	**CO6**

References:

(i) Sensors and Transducers, I.R. Sinclair, Third Edition, Newnes Oxford, 2001.
(ii) Measurement Systems: Application & Design, E.A. Doebelin, McGraw Hill, 1990.
(iii)Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw-Hill Int. Edition, 2001.
(iv)A. Paul, M. Bhattacharjee, R. Dahiya, Solid-State Sensors, Wiley+IEEE, 2023.

7^{th} / 8^{th} Semester	Design of Photovoltaic Systems				
AGEE-21702H					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Review Semiconductor Physics and understand the basics of solar energy
CO2	Understand the basics of dye sensitized solar cells
CO3	Analyze the solar cell modeling
CO4	Understand the basics of Bulk Heterojunction (BHJ) Solar Cells
CO5	Understand the basics of Perovskite Solar Cells
CO6	Understand the Photovoltaic system engineering

Part	Content	CO
I	Review of Semiconductor Physics, Charge carrier generation and recombination, p-n junction model and depletion capacitance, Current voltage characteristics in dark and light. Device Physics of Solar Cells, Principle of solar energy conversion, Conversion efficiency, Single, tandem multi-junction solar cells, Numerical solar cell modeling	**CO1**
II	Introduction to Dye Sensitized Solar Cells, Fabrication of Dye Sensitized Solar Cells, Design of novel dyes, Design of solid electrolytes materials, Counter electrode engineering. Numerical solar cell modeling, Crystalline silicon and III-V solar cells, Thin film solar cells: Amorphous silicon, Quantum Dot solar cells,	**CO2 & CO3**
III	Introduction to Organic Solar Cells, Physics of Bulk Heterojunction (BHJ) Solar Cells, Morphology and charge separation in BHJ, Design of low bandgap polymers. Perovskite Solar Cells, Fabrication of perovskite solar cells, Photophysics in perovskite solar cells, Stability in perovskite solar cells, Lead free perovskite solar cells	**CO4 & CO5**
IV	Photovoltaic system engineering, Thermo- Photovoltaic generation of electricity, Concentration and storage of electrical energy, Photovoltaics modules, system and application, Green energy building. Nanomaterials for photovoltaics	**CO6**

References:

(i) Jasprit Singh, "Semiconductor Devices, Basic Principles". Wiley, 2001.
(ii) Jenny Nelson, "The Physics of Solar Cells", Imperial College Press, 2003.
(iii) Stephen J.Fonash, "Solar Cell Device Physics", 2nd edition, Academic Press, 2003
(iv) A.Luque and S.Hegedus, :Handbook of Photovoltaic Science &Engineering"., Wiley Tsakalakos, L.; "Nanotechnology for Photovoltaics", CRC

7th / 8th Semester	Air Pollution and Control			
AGOE 21701				
Internal Marks:	40	L	T	P
External Marks:	60	3	0	0
Total Marks:	100	Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Identify the impacts of air pollutionon humans, animals, water bodies, and soil.
CO2	Analyse the lapse rate and air quality monitoring.
CO3	Understand the emissions inventory and applications of remote sensing.
CO4	Understand indoor air pollution, its sources, types, and health impacts.
CO5	Know air pollution controldevices and equipment.
CO6	Know the emerging technologies and strategies to mitigate air pollution.

Part	Content	CO No.
I	**Air Pollution:** Introduction and impacts of air pollution on human health, vegetation, animals, building materials, structures, and atmosphere, soil and water bodies. Sources, classification and formation/transformation of air pollutants: Meteorology and Atmospheric Stability. **Lapse Rate,** Plume Behaviour, and Air Quality Monitoring, Air Quality Index (AQI). Air Quality Modelling, Gaussian dispersion models: point, line, and area source models	CO1 & CO2
II	**Emissions Inventory:** Transport, Industrial, Agricultural, Residential and Commercial sectors. Application of Remote sensing/Satellite data in emission inventory and source apportionment using receptor modelling.	CO3
III	**Indoor air pollution:** sources, types and health impacts. Sampling, assessment and evaluation of Indoor air quality. Global and regional environmental issues of air pollution: Ozone depletion, Climate change, Global warming, Acid rain. **Air pollution control devices, and equipment.** Air pollution emission standards, National and international policies, acts, rules, and regulations.	CO4 & CO5
IV	**Emerging technologies and strategies** to mitigate air pollution, Current challenges and way forward. Lab-based measurements of air pollutants.	CO6

References:

(i) Wark, K., Warner, C.F., and Davis, W.T., "Air Pollution: Its Origin and Control", Addison-Wesley Longman. 1998.
(ii) Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., "Fundamentals of Air Pollution", Academic Press. 2005.
(iii) Seinfeld, J.H., Pandis, S.N., "Atmospheric Chemistry and Physics", John Wiley. 2006.
(iv) Lodge, J.P. (Ed.), "Methods of Air Sampling and Analysis", CRC Press. 1988.
(v) Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), "Air Pollution: Health and Environmental Impacts", CRC Press. 2010.

7th / 8th Semester	Disaster Management			
AGOE 21702				
Internal Marks:	40	L	T	P
External Marks:	60	3	0	0
Total Marks:	100	Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Students will be able to understand different level of disasters in various regions.
CO2	To able to understand the prevent and preparedness against the disaster.
CO3	To be able to understand the risk and management for disaster.
CO4	Know about the various government and non-government agencies role in management.
CO5	To be able to understood the various tools and techniques to identify the level of disaster.
CO6	To be able to understand about the method of dissemination and learn from experiences.

Part	Content	CO No.
I	**Introduction to Disaster Management:** Define and describe disaster, hazard, emergency, vulnerability, risk and disaster management; Identify and describe the types of natural and non-natural disasters. Important phases of Disaster Management Cycle. **Disaster Mitigation and Preparedness:** Natural Hazards: causes, distribution pattern, consequences and mitigation measures for earth quake, tsunami, cyclone, flood, landslide drought etc. **Man-madehazards:** causes, consequences mitigation measures for various industrial hazards/disasters, Preparedness for natural disasters in urban areas.	CO1 & CO2
II	**Hazard and Risk Assessment:** Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems. **Emergency Management Systems (EMS):** Emergency medical and essential public health services, response and recovery operations, reconstruction and rehabilitation.	CO3
III	**Capacity Building:** Gender sensitive disaster management approach and inculcate new skills and sharpen existing skills of government officials, voluntary activists, development of professional and elected representative for effective disaster management, role of media in effective disaster management, overview of disaster management in India, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines. **Application of Geoinformatics and Advanced Techniques:** Use of Remote Sensing Systems (RSS) and GIS in disaster Management, role of knowledge based expert systems in hazard scenario, using risks-time charts to plan for the future, early warning systems.	CO4 & CO5
IV	**Integration of public policy**: Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management. **Case Studies:** Lessons and experiences from various important disasters with specific reference to Civil Engineering.	CO6

References:

(i) Natural Hazards in the Urban Habitat by Iyengar, C.B.R.I., Tata McGraw Hill.Pub
(ii) Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leiceste

7^{th} / 8^{th} Semester	Product Design and Development				
AGOE 21703					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Describe the product design and role of designer in product design.
CO2	Explain the basic principle of value engineering in product design.
CO3	Discuss the various types of fasteners and joining details.
CO4	Classify various design tools and understand the concept of ergonomics in product design.
CO5	Explain the design guidelines, manufacturing and economics aspects.
CO6	Develop proficiency in 3D printing techniques and identify real-world applications of 3D printing.

Part	Content	CO No.
I	Introduction to product design: Introduction to course, product life-cycle, product policy of an organization. selection of a profitable product, product design process, product analysis. Value engineering and functional analysis: Value engineering in product design; advantages, applications in product design, problem identification and selection, anatomy of function, functional analysis system technique (FAST).	**CO1 & CO2**
II	**Product detailing:** Standard fastening and joining details in different materials, temporary and permanent joints, detailing for plastic products and fabricated products in sheet metal.	**CO3**
III	Product design tools: Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA, ergonomics in product design. Design guidelines: DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc.	**CO4 & CO5**
IV	Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS.	**CO6**

References:

(i) W.H. Mayal, Industrial Design for Engineers, London Liifee Books Ltd.
(ii) Huchingson R. Dale, New Horizons for Human Factors in Design, McGraw Hill.
(iii) N.L. Svensson, Engineering Design, London: Pitman.
(iv) R. Matousek, Engineering Design, Blackie & Son.
(v) K.J. Mccormick (Ed), Human Factor Engineering, McGraw Hill.

7th / 8th Semester	Material Management				
AGOE 21704					
Internal Marks:	40		L	T	P
External Marks:	60		3	0	0
Total Marks:	100		Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Describe the concept of material management.
CO2	Explain the basic techniques of material planning.
CO3	Identify and analyze the key factors that influence consumer purchase decisions.
CO4	Provide students with a comprehensive understanding of fundamental principles and concepts of inventory control and management.
CO5	Familiarize students with inventory management tools that aid in monitoring of physical inventory.
CO6	Design efficient storage layouts to maximize space utilization and improve workflow in warehouses.

Part	Content	CO No.
I	**Introduction:** Meaning, definition, functions of materials management, concept of integrated material management, relationship of material management with other organizational functions. **Material planning & budgeting:** Need for material planning, factors affecting material planning, techniques of material planning, material classification, codification and standardization, material budgeting - meaning and need, techniques of material budgeting.	CO1 & CO2
II	**Purchasing:** Purchasing principles, procedures and systems, functions of purchasing, make-or-buy decision, vendor development and vendor rating, factors affecting purchase decisions, legal aspects of purchasing, documentation and procedure for import.	CO3
III	**Inventory control:** Need and meaning of inventory, types of inventory, functions of inventory control, inventory costs. **Physical control of inventory:** fixed order, two bin and Kardex systems - material requirement planning (MRP-I), spare parts control for maintenance purposes, evaluation of inventory control performance. concept of just-in-time (JIT), use of computers for inventory control.	CO4 & CO5
IV	**Storage:** Functions and importance of store keeping, types of stores, store accounting and store verification, legal aspects of store keeping, management of surplus, scrap and obsolete items, importance of material handling in store keeping, handling equipment.	CO6

References:

(i) M.M. Verma, Materials Management, S. Chand and Co.
(ii) Gopal Krishnan and Sundaresan, Material Management - An Integrated Approach, Prentice Hall
(iii) Dobbler and Burt, Purchasing and materials management, Tata McGraw Hill
(iv) M. Starr and D. Miller, Inventory control, Prentice Hall.

7th / 8th Semester	Non - Conventional Energy Sources				
AGOE-21705					
Internal Marks:	40		L	T	P
External Marks:	60		3	0	0
Total Marks:	100		Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Focus on the non - conventional resources that are available for electric power generation.
CO2	Study principle, types and application of MHD generator.
CO3	Study principle, types and application of thermoelectric generator.
CO4	Explore photovoltaic effect and solar collector, solar furnaces and its application.
CO5	Study principle, description, types and application of fuel cell.
CO6	Application and description of various sources like geothermal, wind power, tidal.

Part	Content	CO No.
I	**INTRODUCTION:** Limitation of conventional energy sources, need and growth of alternative energy source, basic scheme and application of direct energy conservation. **MHD GENERATORS:** Basic principles, gaseous, conduction and hall effect, generator and motor effect, different types of magneto - hydro - dynamic (MHD) generator, types of MHD material, conversion effectiveness, analysis of constant area MHD generator, practical MHD generator, application and economic aspects.	CO1 & CO2
II	**THERMO - ELECTRIC GENERATORS:** Thermoelectric effects, Seeback effect, Peltier effect, Thomson effect, thermoelectric converters, figures of merit, properties of thermoelectric material, brief description of the construction of thermoelectric generators, application and economic aspect.	CO3
III	**PHOTOVOLTAIC EFFECT AND SOLAR ENERGY:** Photovoltaic effect, different types of photovoltaic cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency, solar batteries, application, solar radiation analysis, solar energy in India, solar collectors, solar furnaces and applications.	CO4
IV	**FUEL CELLS:** Principle of action, Gibb's free energy, general description of fuel cells, types, construction, operational characteristics and application. **MISCELLANEOUS SOURCES:** Geothermal system, hydro - electric plants, wind power, tidal energy, Bio -mass energy.	CO5 & CO6

References:

(i) Gupta B. R., Generation of Electrical Energy, S. Chand.
(ii) Rai, G.D., Non Conventional Energy Sources, Khanna Publishers (2005).
(iii) Rao, S. and Parulekar, B.B., Energy Technology: Non Conventional, Renewable and Conventional, Khanna Publishers (2005).

7^{th} / 8^{th} Semester	Electrical Power Utilization				
AGOE-21706					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand various types of industrial drives and PLC based drives.
CO2	Identify the various traction systems.
CO3	Use various welding and heating techniques in real life.
CO4	Explore the knowledge gained for project work related to design of lighting schemes.
CO5	Use techniques, skills related to refrigeration system for engineering practice.
CO6	Understand the applications of different motors and drives in industries and domestic life.

Part	Content	CO
I	**Electric Drives:** Electrical drives and Mechanical drives, Concept of electrical drives, Basic features of industrial drives, review of operating and starting characteristics of different types of electric motors for various drives (AC and DC motors). Estimation of rating and heating of motors, Load equalization (Fly wheel effect), Drives for particular services.	**CO1 & CO2**
II	**Electric Traction:** Introduction to Indian railways system, Electric Locomotive Classes, Various types of Traction system, single phase feeding arrangement prevalent in India. Substation. arrangements, Different Types of Catenary construction and line insulation, Span and dropper design Calculations. **Electric Heating and Welding:** Methods of electric heating, types of electric heating, constructional details and performance of resistance heating furnace. Dielectric heating. Alternating current (AC).and Direct current (DC) Welding, Resistance and Arc Welding. Electric Beam Welding, Laser Welding. Typical construction of electrical welding AC and DC set.	**CO3 & CO4**
III	**Illumination:** Production of light by different methods, terms used, laws of illumination, Different Artificial light sources, their construction and operating principles, Design of lighting schemes and equipment used for indoor, industrial and flood lighting.	**CO5**
IV	**Refrigeration and Air conditioning:** Refrigeration system, Domestic refrigeration, Air conditioner, Comfort Air conditioning, Effective temperature. **Electrolysis:** Laws of Electrolysis, Process voltage, current, energy, efficiency, Applications of electrolysis.	**CO6**

References:

(i) Partab H., *Modern Electric Traction*, Dhanpat Rai
(ii) De N.K. and Sen P.K., *Electric Drives*, PHI publication
(iii) Berde M.S., *Electric Motor Drives*, Khanna Publishers
(iv) Gupta J.B., *Utilization of Electric Power and Electric Traction*, S.K. Kataria and Sons
(v) Tripathy S. C., *Electric Energy Utilization and Conservation*, Tata McGraw Hill
(vi) Taylor E.O., *Utilization of Electric Energy,* Orient Blackswan
(vii) Hughes Austin, *Electric Motors and Drives: Fundamentals, Types and Applications*, Newnes, (2005)

7th / 8th Semester	Software Engineering Methodologies				
AGOE-21707					
Internal Marks:	40		L	T	P
External Marks:	60		3	0	0
Total Marks:	100		Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Understand the processes and models involved in SDLC lifecycle.
CO2	Understand software requirements specification and design.
CO3	Understand the role of project management planning.
CO4	Implement different coding standards and software testing approaches such as unit testing and integration testing.
CO5	Understand the basics software quality strategies.
CO6	Understand the role of project risk management, ethical and professional issues.

Part	Content	CO No.
I	Evolution and impact of Software engineering, introduction to agile software development, software life cycle models: Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study.	CO1
II	Functional and Non-functional requirements, Requirements gathering, Requirements analysis and specification. Function-oriented software design: DFD and Structure chart, Object modeling using UML, Object-oriented software development, user interface design, Basic issues in software design, modularity, cohesion, coupling and layering. Coding standards and Code review techniques and tools. Integrated development environments (IDEs). Software project management, Project planning and control, size and cost estimation, project scheduling using PERT and Gantt chart.	CO2 & CO3
III	Fundamentals of testing, White-box, and black-box testing, test case design techniques, bug tracking system, mutation testing,Automated build and deployment tools, Tool: Selenium. Static and dynamic analysis, verification and validation, Software reliability metrics, reliability growth modelling. Software quality assurance: quality concepts, quality control, quality assurance, SQA activities, Software reviews, Formal Technical Reviews, Review guidelines. Quality Assurance Standards: ISO 9000, 9001:2000, CMM, TQM and Six Sigma.	CO4 & CO5
IV	Introduction to SCM, Version Control and Change Management, Risk Mitigation, Monitoring and Management (RMM), Computer aided software engineering, software maintenance, Integrated Change Control, software reuse, Component-based software development. Software engineering ethics and professionalism- ethical and legal issues in software engineering, intellectual property rights and plagiarism, professional code of conduct, social and economic impact of software.	CO6

References:

(i) Roger Pressman, "Software Engineering: A Practitioners Approach, (6th Edition), McGraw Hill, 1997.Sommerville," Software Engineering, 7th edition", Adison Wesley, 1996.

(ii) Watts Humphrey," Managing software process", Pearson education, 2003.

(iii) James F. Peters and Witold Pedrycz, "Software Engineering – An Engineering Approach",

Wiley.

(iv) Mouratidis and Giorgini. “Integrating Security and Software Engineering–Advances and Future”,

(v) IGP. ISBN – 1-59904-148-0.

(vi) Pankaj Jalote, “An integrated approach to Software Engineering”, Springer/Narosa.

7th / 8th Semester	Fundamentals of Information Security				
AGOE-21708					
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO1	Elucidate the CIA triad of Confidentiality, Integrity and Availability and various encryption techniques.
CO2	Implement symmetric and asymmetric encryption systems, public key cryptography and RSA.
CO3	Implement the various authentication protocols used for the protection of information.
CO4	Understand the concept of network security and security architecture.
CO5	Illustrate the concept of web security and SET.
CO6	Implement system security concepts.

Part	Content	CO No.
I	Symmetric Ciphers - Overview: Services, Mechanisms and Attacks, the OSI Security Architecture, A Model of Network Security. Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography. Block Cipher and the Data Encryption Standard: Simplified DES, Block Cipher Principles, the DES, the Strength of DES, Differential and Linear Cryptanalysis. Symmetric Ciphers: Triple DES, Blowfish. Confidentiality using Conventional Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation.	**CO1 & CO2**
II	Public Key Encryption, Number Theory, Prime Numbers Formats and Eulers Theorems, Testing for Primality. Public Key Cryptography and RSA: Principles of Public Key Cryptosystems, The RSA Algorithm, Key Management.	**CO3**
III	Authentication Protocols - Message Authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes, MD5 Message Digest Algorithms, Digital Signatures and Authentication Protocols: Digital Signatures, Authentication Protocols, Digital Signature Standards.	**CO4 & CO5**
IV	Network Security - Authentication Applications: Kerberos, X.509 Directory Authentication Service. IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulation Security Payload. Web Security: Web Security Requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction. System Security- Intruders, Malicious Software, Viruses and Related Threats, Counter Measures, Firewalls and its Design Principles.	**CO6**

References:

(i) William Stallings, Network Security Essentials, Applications and Standards Pearson Education.

(ii) William Stallings, Cryptography and Network Security Principles and practice. 2nd Edition, PearsonEducation.

(iii) Bishop, Matt, Introduction to Computer Security. Addison-Wesley, Pearson Education, Inc.

(iv) Michael. E. Whitman and Herbert J. Mattord Principles of Information Security, Cengage Learning.

7^{th} / 8^{th} Semester	Management of Human Resources				
AGOE-21709					
Internal Marks:	40		L	T	P
External Marks:	60		3	0	0
Total Marks:	100		Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Develop the understanding of the concept of human resource management and HRP to understand its relevance in organizations.
CO2	Understand the concept of Recruitment and take systematic steps for adoption of Selection and Training process.
CO3	Analyse the strategic issues and strategies required to select and develop manpower resources.
CO4	Develop necessary skill set for application of various HR issues by Motivating and handling cordial relations among employees. .
CO5	Integrate the knowledge of HR concepts to manage Industrial disputes and take correct business decisions.
CO6	Acquaintance with the fundamental contracts of Human Resource Management and understands future challenges in HRM.

Part	Content	CO No.
I	**Introduction to Human Resource Management** and its definition, functions of Human Resource Management & its relation to other managerial functions. Nature, Scope and Importance of Human Resource Management in Industry, Procurement and Placement: Need and Process of Human Resource Planning. **Methods of Recruitment;** Psychological tests and interviewing; Meaning and Importance of Placement and Induction, The Contract Labour (Regulation & Abolition) Act 1970.Training & Development: Difference between training and Development; Principles of Training	CO1 & CO2
II	**Employee Development**; Promotion-Merit v/s seniority Performance Appraisal, Career Development &Planning. Job analysis & Design: Job Analysis: Job Description & Job Specification and Job Satisfaction	CO3
III	**Motivation,** Factors affecting motivation, and its Theories, Workers ' Participation, Quality of work life. The Compensation Function: Basic concepts in wage administration, company's wage policy. Job Evaluation, Issues in wage administration, Bonus & Incentives, Payment of Wages Act-1936,Minimum Wages Act-1961,Human Relations and Industrial Relations, Factors required for good Human Relation Policy in Industry. **Employee, Employer relationship** Causes and Effects of Industrial disputes; EmployeGrievances &their Redressal, Absenteeism, Labour Turnover, Changing face of the Indian work force and their environment, Importance of collective Bargaining;	CO4 & CO5
IV	**Role of Trade unions** in maintaining cordial Industrial Relations, Fringe &retirement terminal benefits, administration of welfare amenities. **Meaning and Importance of Employee Safety**, Accidents-Causes & their Prevention, Safety Previsions under the Factories Act 1948;Welfare of Employees and its Importance, Social security, Family Pension Scheme, ESI act 1948, Workmen's Gratuity Act 1972, Future challenges for Human Resource Management	CO6

References:

(i) Lowin B. Flippo – Principles of personnel Management (Mc Graw-Hill)T.N.Chhabra-
(ii) Human Resource Management (Dhanpat Rai & Co.)Strength of Materials: Rajput

7th / 8th Semester	Basics of Management			
AGOE-21710				
Internal Marks:	40	L	T	P
External Marks:	60	3	0	0
Total Marks:	100	Credits		3

Course Outcomes: After studying the course, students will be able to:	
CO1	Describe Evolution and fundamental concepts of management. Role and responsibility of managers and various approaches of management.
CO2	To learn about the functions of management including planning and its concepts, Different approaches of management such as MBO and decision making.
CO3	To analyze various organizational structure, departmentalization and teamwork.
CO4	To understand the importance of staffing, recruitment, concept of directing and motivation.
CO5	Explain about authority and responsibility and the concept of centralization vs decentralization
CO6	To understand the various controlling techniques in management.

Part	Content	CO No.
I	**INTRODUCTION:** Meaning, Definition, Nature, Scope, Importance, Functions & Principles of management, Managerial roles and skills. Evolution of management thought: Contribution of F.W. Taylor and Henry Fayol. Quantitative approach, behavioral approach, system approach, contingency approach. **PLANNING:** Meaning, Need & Importance, Types of Plans, Steps in Planning process. MBO: concept and process. Decision Making: meaning, types and process.	CO1 & CO2
II	**ORGANIZING:** Concept, Importance, Process, Formal VS Informal organizing, Organizational Structure, Types of organizational structure, factors affecting organization structure, features of good organization. **DEPARTMENTALIZATION:** concept and basis. Teamwork: meaning, types and stages of team building. **STAFFING:** Nature & Scope of Staffing, Recruitment, Selection, Training & development and performance management. Directing: Meaning, Nature & Scope. Motivation: Meaning, Importance and motivational theories.	CO3 & CO4
III	**AUTHORITY & RESPONSIBILITY:** Definition, types, responsibility and accountability, delegation, decentralization v/s centralization, determinants of effective decentralization.	CO5
IV	**CONTROLLING:** Need, Nature, Process, Techniques of controlling and significance. Trends and challenges of management in global scenario, emerging issues in management: Introduction to Total Quality Management (TQM), Just in Time (JIT), Business process reengineering (BPR).	CO6

References:

(i) Principles and practices of management: L.M. PRASAD (S. Chand publishers)
(ii) Essentials of Management: Koontz H. & Weihrich H. (Tata Mc Graw Hill Publishers)
(iii) Management: Stephen Robbins (Pearson publishers)
(iv) VSP Rao & V H Krishna, Management, Excel books.

(v) Harold Koontz, and Heinz Weihrich, Essentials of Management: An International Perspective, New Delhi, McGraw-Hill, 2010.
(vi) Richard L Daft, The New Era of Management, New Delhi, Thomson, 2007 Stephen P Robbins, Mary Coulter and Neharika Vohra, Management, New Delhi, Pearson, 2011.

7th / 8th Semester	Power System Analysis Lab.				
AGEE-21703					
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO1	Get the knowledge of software's like MATLAB and E-TAP
CO2	Draw single line diagrams using soft tools
CO3	Get the knowledge for formation of Y and Z buses using soft tools.
CO4	Perform load flow analysis using soft tools
CO5	Perform fault analysis using soft tools
CO6	Do any one project related to Part-I of Syllabus

Part	Content	CO
I	• Introduction to MATLAB and E-TAP software	**CO1**
	• Single line diagram of 4-bus and 8-bus system	**CO2**
	• Formation of Y-BUS • Formation of Z-BUS	**CO3**
	• Load Flow Analysis using Gauss Seidal (GS) Method. • Load Flow Analysis using Newton-Raphson (NR) Method. • Load Flow Analysis using Fast Decoupled (FD) Method.	**CO4**
	• Fault analysis for line-to-line (L-L) fault • Fault analysis for Line-to-Ground (L-G) fault • Fault analysis for 3-phase fault	**CO5**
II	• To obtain power system stability on High Voltage Alternating current (HVAC) system with the help of Flexible Alternating Current Transmission Systems (FACTS) devices. • Optimal Capacitor placement on a system having variable reactive power and low voltage profile. • To obtain relay co-ordination on a power system. • To obtain optimal generator pricing on hydro-thermal and renewable energy systems. • To find synchronous reactance (Transient, sub-transient) during fault analysis. • **Any other Project related to Part-I of Syllabus**	**CO6**

7th / 8th Semester	Project				
AGEE-21704					
Internal Marks:	60		L	T	P
External Marks:	40		0	0	4
Total Marks:	100		Credits		2

Course Outcomes: After studying the course, students will be able to:	
CO1	Identify problems based on societal /research needs.
CO2	Apply Knowledge and skill to solve societal problems in a group.
CO3	Develop interpersonal skills to work as member of a group or leader
CO4	Draw the proper inferences from available results through theoretical/ experimental/ simulations.
CO5	Analyze the impact of solutions in societal and environmental context for sustainable development.
CO6	Excel in written and oral communication and Demonstrate project management principles during project work

Major Project -Topic Selection and Approval Guidelines

1. The group may be of maximum FOUR (04) students.
2. Students should propose project ideas & finalize the project idea in consultation with guide/ HOD. Students should select a problem which addresses some real life applications.
3. Students should identify different components/ devices, instruments, simulation/emulations software tools required for the project.
4. Students should submit implementation plan in the form of Report, which will cover weekly activity of project.
5. A log-book to be prepared by each group to record the work progress in terms of milestones per week by students. Weekly comment, remarks to be put by guiding faculty

Application Domains:

List of key application domains from where students are encouraged to derive Major Projects topics (but not limited to):

1) Smart Agriculture solutions
2) Power converter applications in various Applications
3) IoT based applications in power systems
4) AI/ML applications in disaster management
5) Renewable Energy
6) Energy Conservation
7) Energy Storage
8) Battery Charging and Protection
9) Fire Safety
10) Electrical System Protection
11) Lighting Control
12) Wireless Power Transfer
13) Electrical Components Testing
14) Electrical Parameters Measurement
15) Non-conventional Electricity Generation
16) Laboratory Equipment
17) E-Mobility / Electric Vehicles
18) Video Surveillance Systems
19) Robotics for Hazardous applications
20) Waste Management System
21) Smart City Solutions
22) Smart Classrooms and learning Solutions
23) Design of Electrical Equipment

24) PLC based automation system
25) Power system Monitoring System

Students can identify the Major project topic either from above suggested domains or any other relevant electrical engineering domains. The inter-disciplinary nature of the project is also desirable.

Guidelines for Assessment of Major Project: Term Work

♣ The review/ progress monitoring committee shall be constituted by head of departments of institute. The progress of major project to be evaluated on continuous basis, minimum two reviews in each semester.

♣ In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

♣ Distribution of Term work marks for Major Project shall be as below:

Marks awarded by guide/supervisor based on log book : 40 %

Marks awarded by review committee : 40 %

Quality of Project reports : 20%

Review/progress monitoring committee may consider following points for assessment as mentioned in general guidelines. Two reviews shall be conducted based on presentation given by students group based on the following criteria:

Assessment criteria of Major Project:

Major Project shall be assessed based on following criteria:

1. Quality of literature survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Effective use of skill sets
9. Effective use of standard engineering norms
10. Contribution of an individual's as member or leader
11. Clarity in written and oral communication

8th Semester

7th / 8th Semester	INDUSTRIAL TRAINING				
AGEE-21801					
Internal Marks:	**300**		**L**	**T**	**P**
External Marks:	**200**		**0**	**0**	**0**
Total Marks:	**500**		**Credits**		**12**

Course Outcomes: After studying the course, students will be able to:	
CO1	Identify industry engineering problems and economic solution.
CO2	Apply the knowledge to mitigate industry problems.
CO3	Demonstrate the skills and attitudes of an engineer.
CO4	Communicate with engineers and the community at large in written and oral forms.
CO5	Acquire "Hands on" training and practice use of various tools.
CO6	Undertake problem identification, formulation and solution by considering ethical responsibility.

Part	**Training Activity**
	Interaction with HR and communicate the details of the supervisors to the department.
	General layout of Industry/Organization site.
	Participation in assigned task (Ethical & Repair or Maintenance)
	Descriptions of Machines/Equipment/Tools/Software used during training.
	Analyze the scope of training received towards his/her career goals.
	Report writing on the Industrial Project/Training.