ARAVALI INSTITUTE OF TECHNICAL STUDIES

COURSE DESCRIPTION
BACHELOR OF TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING

ARAVALI INSTITUTE OF TECHNICAL STUDIES, UDAIPUR

Department of Electrical Engineering

Vision:

To strive continuously for excellence in education and research related to Electrical Engineering by nurturing human resource to contribute for sustainable development of industry and society.

Mission:

The department aims to realize the vision through the following mission:

M1. Empower students with fundamental knowledge of Electrical, Electronics and computational Technology.

M2. Develop the foundation to undertake research in systems involving emerging fields of Electrical Engineering.

M3. Enable professional skills and competence to become consultants in the field of Electrical Engineering.

M4. Evolve as a dynamic entrepreneurial human resources for the society.

B. Tech (EE) - PROGRAMME OUTCOMES (PO's)

Students in the first year of the engineering program should be in possession of:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: 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.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO.8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: 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.

PO12. Life-long learning: 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.

B. Tech (EE) - PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

PEO1. Able to utilize domain knowledge required for analyzing and resolving practical Electrical Engineering problems

PEO2. Equipped with theoretical and practical skills to investigate and undertake complex projects of inter-disciplinary nature with wide impact

PEO3. Imbibed with the state of the art knowledge to adapt, ever transforming technical scenario

PEO4. Acquire social and environmental ethics for sustainable development of the society

B. Tech (EE) - PROGRAM SPECIFIC OUTCOMES (PSO's)

Electrical Engineering graduates will have the:

PSO1. Ability to critically understand the generation, transmission & distribution concepts of Electrical Power Systems and its control

PSO2. Capability to understand various computational methods for design and analysis of Electrical Systems

PSO3. In-depth knowledge to handle/control various electrical machines/drives used in industry

Rajasthan Technical University Teaching & Examination Scheme
(B.Tech Electrical Engineering)

Ist Semester: B. Tech
Common to all branches of UG Engineering & Technology

SN	Category	Course Code	Course Title	Hours			Marks			Cr
				L	T	P	IA	ETE	Total	
1	BSC	1FY2-01	Engineering Mathematics-I	3	1	-	30	70	100	4
2	BSC	1FY2-02/ 1FY2-03	Engineering Physics/ Engineering Chemistry	3	1	-	30	70	100	4
3	HSMC	1FY1-04/ 1FY1-05	Communication Skills/ Human Values	2	-	-	30	70	100	2
4	ESC	1FY3-06/ 1FY3-07	Programming for Problem Solving/ Basic Mechanical Engineering	2	-	-	30	70	100	2
5	ESC	1FY3-08/ 1FY3-09	Basic Electrical Engineering/ Basic Civil Engineering	2	-	-	30	70	100	2
6	BSC	1FY2-20/ 1FY2-21	Engineering Physics Lab/ Engineering Chemistry Lab	-	-	2	60	40	100	1
7	HSMC	1FY1-22/ 1FY1-23	Language Lab/ Human Values Activities and Sports	-	-	2	60	40	100	1
8	ESC	1FY3-24/ 1FY3-25	Computer Programming Lab/ Manufacturing Practices Workshop	-	-	3	60	40	100	1.5
9	ESC	1FY3-26/ 1FY3-27	Basic Electrical Engineering Lab/ Basic Civil Engineering Lab	-	-	2	60	40	100	1
10	ESC	1FY3-28/ 1FY3-29	Computer Aided Engineering Graphics/ Computer Aided Machine Drawing	-	-	3	60	40	100	1.5
11	SODE CA	1FY8-00							100	0.5
									Total	20.5

L = Lecture, **T** = Tutorial,
P = Practical, IA=Internal Assessment, ETE=End Term Exam, Cr=Credits

II[nd] Semester: B. Tech
Common to all branches of UG Engineering & Technology

SN	Category	Course Code	Course Title	Hours			Marks			Cr
				L	T	P	IA	ETE	Total	
1	BSC	2FY2-01	Engineering Mathematics-II	3	1	-	30	70	**100**	**4**
2	BSC	2FY2-03/ 2FY2-02	Engineering Chemistry/ Engineering Physics	3	1	-	30	70	100	4
3	HSMC	2FY1-05/ 2FY1-04	Human Values/ Communication Skills	2	-	-	30	70	100	2
4	ESC	2FY3-07/ 2FY3-06	Basic Mechanical Engineering/ Programming for Problem Solving	2	-	-	30	70	100	2
5	ESC	2FY3-09/ 2FY3-08	Basic Civil Engineering/ Basic Electrical Engineering	2	-	-	30	70	100	2
6	BSC	2FY2-21/ 2FY2-20	Engineering Chemistry Lab/ Engineering Physics Lab	-	-	2	60	40	100	1
7	HSMC	2FY1-23/ 2FY1-22	Human Values Activities and Sports/ Language Lab	-	-	2	60	40	100	1
8	ESC	2FY3-25/ 2FY3-24	Manufacturing Practices Workshop/ Computer Programming Lab	-	-	3	60	40	100	1.5
9	ESC	2FY3-27/ 2FY3-26	Basic Civil Engineering Lab/ Basic Electrical Engineering Lab	-	-	2	60	40	100	1
10	ESC	2FY3-29/ 2FY3-28	Computer Aided Machine Drawing/ Computer Aided Engineering Graphics	-	-	3	60	40	100	1.5
11	SODECA	2FY8-00							**100**	**0.5**
									Total	**20.5**

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Teaching & Examination Scheme
B.Tech. : Electrical Engineering
2nd Year - III Semester

SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exm Hrs	IA	ETE	Total	
THEORY											
1	BSC	3EE2-01	Advance Mathematics	3	0	0	3	30	120	**150**	**3**
2	HSMC	3EE1-02/ 3EE1-03	Technical Communication / Managerial Economics and Financial Accounting	2	0	0	2	20	80	**100**	**2**
3	ESC	3EE3-04	Power generation Process	2	0	0	2	20	80	**100**	**2**
4	PCC	3EE4-05	Electrical Circuit Analysis	3	0	0	3	30	120	**150**	**3**
5		3EE4-06	Analog Electronics	3	0	0	3	30	120	**150**	**3**
6		3EE4-07	Electrical Machine - I	3	0	0	3	30	120	**150**	**3**
7		3EE4-08	Electromagnetic Field	2	0	0	2	20	80	**100**	**2**
			Sub Total	18	0	0		180	720	**900**	**18**
PRACTICAL & SESSIONAL											
8	PCC	3EE4-21	Analog Electronics Lab	0	0	2		30	20	**50**	**1**
9		3EE4-22	Electrical Machine-I Lab	0	0	4		60	40	**100**	**2**
10		3EE4-23	Electrical circuit design Lab	0	0	4		60	40	**100**	**2**
13	PSIT	3EE7-30	Industrial Training	0	0	2				**50**	**1**
14	SODECA	3EE8-00	Social Outreach, Discipline & Extra Curricular Activities							**25**	**0.5**
			Sub- Total	0	0	12		150	100	**325**	**6.5**
			TOTAL OF III SEMESTER	18	0	12		330	820	**1225**	**24.5**

L: Lecture, T: Tutorial, P: Practical, Cr: Credits
ETE: End Term Exam, IA: Internal Assessment

Teaching & Examination Scheme
B.Tech. : Electrical Engineering
2nd Year - IV Semester

THEORY												
SN	**Category**	**Course**		**Contact hrs/week**			**Marks**					**Cr**
		Code	**Title**	**L**	**T**	**P**	**Exm Hrs**	**IA**	**ETE**	**Total**		
1	BSC	4EE2-01	Biology	2	0	0	2	20	80	**100**		**2**
2	HSMC	4EE1-02/ 4EE1-03	Technical Communication / Managerial Economics and Financial Accounting	2	0	0	2	20	80	**100**		**2**
3	ESC	4EE3-04	Electronic Measurement & Instrumentation	2	0	0	2	20	80	**100**		**2**
4	PCC	4EE4-05	Electrical Machine - II	3	0	0	3	30	120	**150**		**3**
5		4EE4-06	Power Electronics	3	0	0	3	30	120	**150**		**3**
6		4EE4-07	Signals & Systems	3	0	0	3	30	120	**150**		**3**
7		4EE4-08	Digital Electronics	2	0	0	2	20	80	**100**		**2**
			Sub Total	17	0	0		170	680	**850**		**17**
PRACTICAL & SESSIONAL												
8	PCC	4EE4-21	Electrical Machine - II Lab	0	0	4		60	40	**100**		**2**
9		4EE4-22	Power Electronics Lab	0	0	4		60	40	**100**		**2**
10		4EE4-23	Digital Electronics Lab	0	0	2		30	20	**50**		**1**
11		4EE3-24	Measurement Lab	0	0	2		30	20	**50**		**1**
13	SODE CA	4EE8-00	Social Outreach, Discipline & Extra Curricular Activities							**25**		**0.5**
			Sub- Total	0	0	12		180	120	**325**		**6.5**
			TOTAL OF IV SEMEESTER	17	0	12		350	800	**1175**		**23.5**

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ETE: End Term Exam, **IA:** Internal Assessment

Teaching & Examination Scheme
B.Tech. : Electrical Engineering
3rd Year V - Semester

THEORY											
SN	**Category**	**Course**		**Contact hrs/week**			**Marks**				**Cr**
		Code	**Title**	**L**	**T**	**P**	**Exm Hrs**	**IA**	**ETE**	**Total**	
1	ESC	5EE3-01	Electrical Materials	2	0	0	2	20	80	**100**	**2**
2	PCC/ PEC	5EE4-02	Power System - I	3	0	0	3	30	120	**150**	**3**
3		5EE4-03	Control System	3	0	0	3	30	120	**150**	**3**
4		5EE4-04	Microprocessor	3	0	0	3	30	120	**150**	**3**
5		5EE4-05	Electrical Machine Design	3	0	0	3	30	120	**150**	**3**
6		Professional Elective I (any one)		2	0	0	2	20	80	**100**	**2**
		5EE5-11	Restructured Power System.								
		5EE5-12	Electromagnetic Wave.								
		5EE5-13	Digital ControlSystem.								
		Sub Total		**16**	**0**	**0**		**160**	**640**	**800**	**16**
PRACTICAL & SESSIONAL											
7	PCC	5EE4-21	Power System - I Lab	0	0	2	2	30	20	**50**	**1**
8		5EE4-22	Control System Lab	0	0	2	2	30	20	**50**	**1**
9		5EE4-23	Microprocessor Lab	0	0	2	2	30	20	**50**	**1**
10		5EE4-24	System ProgrammingLab	0	0	2	2	30	20	**50**	**1**
11	PSIT	5EE7-30	Industrial Training	0	0	1		75	50	**125**	**2.5**
12	SODECA	5EE8-00	Social Outreach, Discipline & Extra Curricular Activities						25	**25**	**0.5**
		Sub Total		**0**	**0**	**9**		**195**	**155**	**350**	**7**
		TOTAL OF V SEMESTER		**16**	**0**	**9**		**355**	**795**	**1150**	**23**

L: Lecture, **T:** Tutorial, **P:** Practical, **Cr:** Credits

ETE: End Term Exam, **IA:** Internal Assessment

Teaching & Examination Scheme
B. Tech.: Electrical Engineering
3rd Year – VI Semester

THEORY											
SN	**Category**	**Course**		**Contact hrs/week**			**Marks**				**Cr**
		Code	**Title**	**L**	**T**	**P**	**Exm Hrs**	**IA**	**ETE**	**Total**	
1	ESC	6EE3-01	Computer Architecture	2	0	0	2	20	80	**100**	**2**
2	PCC/ PEC	6EE4-02	Power System - II	3	0	0	3	30	120	**150**	**3**
3		6EE4-03	Power SystemProtection	3	0	0	3	30	120	**150**	**3**
4		6EE4-04	Electrical Energy Conversion and Auditing	3	0	0	3	30	120	**150**	**3**
5		6EE4-05	Electric Drives	3	0	0	3	30	120	**150**	**3**
6		Professional Elective II (any one)		3	0	0	3	30	120	**150**	**3**
		6EE5-11	Power SystemPlanning.								
		6EE5-12	Digital Signal Processing.								
		6EE5-13	Electrical and Hybrid Vehicles.								
			Sub Total	**17**	**0**	**0**	**17**	**170**	**680**	**850**	**17**
PRACTICAL & SESSIONAL											
7	PCC	6EE4-21	Power System - II Lab	0	0	4	3	60	40	**100**	**2**
8		6EE4-22	Electric Drives Lab	0	0	4	3	60	40	**100**	**2**
9		6EE4-23	Power SystemProtection Lab	0	0	2	2	30	20	**50**	**1**
10		6EE4-24	Modelling and simulation lab	0	0	2	2	30	20	**50**	**1**
11	SODECA	6EE8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0			25	**25**	**0.5**
			Sub- Total	**0**	**0**	**12**		**180**	**145**	**325**	**6.5**
		TOTAL OF VI SEMESTER		**17**	**0**	**12**		**350**	**825**	**1175**	**23.5**

L: Lecture, **T:** Tutorial, **P:** Practical, **Cr:** Credits

ETE: End Term Exam, **IA:** Internal Assessment

Teaching & Examination Scheme
B. Tech.: Electrical Engineering
4th Year - VII Semester

SN	Course Type	Course		Hours per Week			Marks				Cr
		Code	Name	L	T	P	Exm Hrs	IA	ETE	Total	
1	PEC	7EE5-11	Wind and Solar Energy Systems	3	0	0	3	30	120	**150**	**3**
2		7EE5-12	Power Quality and FACTS								
3		7EE5-13	Control System Design.								
4	OE		Open Elective-I	3	0	0	3	30	120	**150**	**3**
			SUB TOTAL	**6**	**0**	**0**		**60**	**240**	**300**	**6**
PRACTICAL & SESSIONAL											
5	PCC	7EE4-21	Embedded Systems Lab	0	0	4	2	60	40	**100**	**2**
6	PCC	7EE4-22	Advance control system lab	0	0	4	2	60	40	**100**	**2**
7	PSIT	7EE7-30	Industrial Training	1	0	0		75	50	**125**	**2.5**
8		7EE7-40	Seminar	2	0	0		60	40	**100**	**2**
9	SODCA	7EE8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0		0	25	**25**	**0.5**
			SUB TOTAL	**3**	**0**	**8**		**255**	**195**	**450**	**6**
			TOTAL OF VII SEMESTER	**9**	**0**	**8**		**315**	**435**	**750**	**15**

L: Lecture, T: Tutorial, P: Practical, Cr: Credits
ETE: End Term Exam, IA: Internal Assessment

Teaching & Examination Scheme
B. Tech. : Electrical Engineering
4th Year - VIII Semester

THEORY											
SN	**Course Type**	**Course**		**Hours per Week**			**Marks**				**Cr**
		Course Code	**Course Name**	**L**	**T**	**P**	**Exm Hrs**	**IA**	**ETE**	**Total**	
1	PEC	8EE4-11	HVDC Transmission System.	3	0	0	3	30	120	**150**	**3**
2		8EE4-12	Line Commutated and active rectifiers.								
3		8EE4-13	Advanced Electric Drives.								
4	OE		Open Elective-II	3	0	0	3	30	120	**150**	**3**
				6	**0**	**0**		**60**	**240**	**300**	**6**
PRACTICAL & SESSIONAL											
			SUB TOTAL	**6**	**0**	**0**		**60**	**240**	**300**	**6**
5	PCC	8EE4-21	Energy Systems Lab	0	0	4	3	60	40	**100**	**2**
6	PSIT	8EE7-50	Project	3	0	0		210	140	**350**	**7**
7	SODCA	8EE8-00	SODECA	0	0	0			25	**25**	**0.5**
			SUB TOTAL	**3**	**0**	**4**		**270**	**205**	**475**	**9.5**
			TOTAL OF VIII SEMESTER	**9**	**0**	**4**		**330**	**445**	**775**	**15.5**

L: Lecture, **T:** Tutorial, **P:** Practical, **Cr:** Credits
ETE: End Term Exam, **IA:** Internal Assessment

List of Open Electives for Electrical Engineering				
Subject Code	**Title**		**Subject Code**	**Title**
Open Elective - I			**Open Elective - II**	
7AG6-60.1	Human Engineering and Safety		8AG6-60.1	Energy Management
7AG6-60.2	Environmental Engineering and Disaster Management		8AG6-60.2	Waste and By-product Utilization
7AN6-60.1	Aircraft Avionic System		8AN6-60.1	Finite Element Methods
7AN6-60.2	Non-Destructive Testing		8AN6-60.2	Factor of Human Interactions
7CH6-60.1	Optimization Techniques		8CH6-60.1	Refinery Engineering Design
7CH6-60.2	Sustainable Engineering		8CH6-60.2	Fertilizer Technology
7CR6-60.1	Introduction to Ceramic Science & Technology		8CR6-60.1	Electrical and Electronic Ceramics
7CR6-60.2	Plant, Equipment and Furnace Design		8CR6-60.2	Biomaterials
7CE6-60.1	Environmental Impact Analysis		8CE6-60.1	Composite Materials
7CE6-60.2	Disaster Management		8CE6-60.2	Fire and Safety Engineering
7CS6-60.1	Quality Management/ISO 9000		8CS6-60.1	Big Data Analytics
7CS6-60.2	Cyber Security		8CS6-60.2	IPR, Copyright and Cyber Law of India
7EC6-60.1	Principle of Electronic communication		8EC6-60.1	Industrial and Biomedical applications of RF Energy
7EC6-60.2	Micro and Smart System Technology		8EC6-60.2	Robotics and control
7ME6-60.1	Finite Element Analysis		8ME6-60.1	Operations Research
7ME6-60.2	Quality Management		8ME6-60.2	Simulation Modeling and Analysis
7MI6-60.1	Rock Engineering		8MI6-60.1	Experimental Stress Analysis
7MI6-60.2	Mineral Processing		8MI6-60.2	Maintenance Management
7PE6-60.1	Pipeline Engineering		8PE6-60.1	Unconventional Hydrocarbon Resources
7PE6-60.2	Water Pollution control Engineering		8PE6-60.2	Energy Management & Policy
7TT6-60.1	Technical Textiles		8TT6-60.1	Material and Human Resource Management
7TT6-60.2	Garment Manufacturing Technology		8TT6-60.2	Disaster Management

SYLLABUS
1FY2-01: ENGINEERING MATHEMATICS-I

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	Course Code	Course Outcomes
1	CO11201.1	Learner will be skilled to estimate volume and surface area of the solid formed by revolutionof different curves. Also workout definite integral through Beta and Gamma functions.
2	CO11201.2	Students will be familiar with the concept of sequence, monotonic sequence, Cauchy's sequence and infinite series. Also workout various method to test convergence and divergenceof sequence and infinite series.
3	CO11201.3	Learner will be competent to express a function in term of a series of sine and cosine.
4	CO11201.4	Students will be able to estimate maxima and minima of multivariable functions using the concept of partial differentiation. Further workout limit, continuity and differentiability of twovariable functions.
5	CO11201.5	Learner will be skilled in the technique to evaluate double and triple integration and able to apply the knowledge to determine area, volume, centre of mass and centre of gravity. Further workout vector differentiation and vector integration.

SN	CONTENTS	Hours
1	**Calculus:** Improper integrals (Beta and Gamma functions) and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	8
2	**Sequences and Series:** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.	6
3	Fourier Series: Periodic functions, Fourier series, Euler‟s formula, Change of intervals, Half range sine and cosine series, Parseval‟s theorem.	6
4	**Multivariable Calculus (Differentiation):** Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	10
5	**Multivariable Calculus (Integration):** Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Centre of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	10
TOTAL		**40**

Suggested Readings:

1. Thomas' Calculus, George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Pearson Educations.
2. Calculus with Early Transcendental Functions, James Stewart, Cengage LerningPublication.
3. Engineering Mathematics, C.B. Gupta, S.R. Singh and Mukesh Kumar, McGrawHill Education.
4. Engineering Mathematics, S. Pal and S.C. Bhunia, Oxford UniversityPress.
5. Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education.

SUBJECT : 1FY2-02 ENGINEERING MATHEMATICS-II

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	Course Code	Course Outcomes
1	CO11201.1	Able to calculate rank of matrix, characteristic equation & characteristic roots & use theapplicability of Caylay Hamilton Theorem to find inverse of matrix which is very important in many engineering application.
2	CO11201.2	Students understand various methods to solve ordinary differential equation of first andHigher order. Which place important role in all branches of Engineering.
3	CO11201.3	Students understand various methods to solve ordinary differential equation of second order with variable coefficient which is useful for solving the practical problems whicharise in the industry.
4	CO11201.4	To Understand the concept of PDE, including formation and solution of linear and nonlinear PDE. Further discussion about Lagrange's method, standard form and Charpit method to solve PDE.
5	CO11201.5	To understand the classification of second order PDE including the solution of one dimensional wave and Hear equation by method of separation of variables with boundarycondition.

SN	CONTENTS	Hours
1	**Matrices:** Rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.	10
2	**First order ordinary differential equations:** Linear and Bernoulli‟s equations, Exact equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut‟s type.	6
3	**Ordinary differential equations of higher orders:** Linear Differential Equations of Higher order with constant coefficients, Simultaneous Linear Differential Equations, Second order linear differential equations with variablecoefficients: Homogenous and Exact forms, one part of CF is known, Change of dependent and independent variables, method of variation of parameters, Cauchy- Euler equation; Power series solutions including Legendre differential equation and Bessel differential equations.	12
4	**Partial Differential Equations – First order:** Order and Degree, Formation; Linear Partial differential equations of First order, Lagrange‟s Form, Non Linear Partial Differentialequations of first order, Charpit‟s method, Standard forms.	6
5	**Partial Differential Equations– Higher order:** Classification of Second order partial differential equations, Separation of variables method to simple problems in Cartesian coordinates including two dimensional Laplace, one dimensional Heat and one dimensional Wave equations.	6
TOTAL		**40**

Suggested Readings:

1. Advanced Engineering Mathematics, Peter O Neil, Cengage Learning Publication.
2. Advanced Engineering Mathematics, 4th Edition, Dennis G. Zill, Warren S. Wright, Jones & Bartlet Publications.
3. Engineering Mathematics, S. Pal and S.C. Bhunia, Oxford University Press.
4. Engineering Mathematics, C.B. Gupta, S.R. Singh and Mukesh Kumar, McGrawHill Education.
5. Advanced Engineering Mathematics, Jain and Iyengar, Narosa Publications.
6. Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education.

1FY2-02/ 2FY2-02: ENGINEERING PHYSICS

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	Course Code	Course Outcomes
1	CO12201.1	Understand the concept of interference and diffraction to explain various wave optical phenomena
2	CO12201.2	To develop the concept of quantum mechanics and apply the knowledge to 1D and 3D potential box problem
3	CO12201.3	Understand the concept of coherence in source of light and basics of an optical fibre: working principle and construction, NA and acceptance angle of an Optical Fibre
4	CO12201.4	Understand the working of a LASER and basics of material science & characterization of materials
5	CO12201.5	Understanding Electromagnetism with the help of Maxwell's equation and formulate the electromagnetic energy transformation theorem.

SN	CONTENTS	Hours
1	**Wave Optics:** Newton‟s Rings, Michelson‟s Interferometer, Fraunhofer Diffraction from a Single Slit. Diffraction grating: Construction, theory and spectrum, Resolving power and Rayleigh criterion for limit of resolution, Resolving power of diffraction grating, X-Ray diffraction and Bragg‟s Law.	9
2	**Quantum Mechanics:** Introduction to quantum Mechanics, Wave-particle duality, Matter waves, Wave function and basic postulates, Time dependent and time independent Schrodinger‟s Wave Equation, Physical interpretation of wave function and its properties, Applications of the Schrodinger‟s Equation: Particle in one dimensional and three dimensional boxes.	6
3	**Coherence and Optical Fibers:** Spatial and temporal coherence: Coherence length; Coherence time and „Q‟ factor for light, Visibility as a measure of Coherence and spectral purity, Optical fiber as optical wave guide, Numerical aperture; Maximum angle of acceptance and applications of optical fiber.	4
4	**Laser:** Einstein‟s Theory of laser action; Einstein‟s coefficients; Properties of Laser beam, Amplification of light by population inversion, Components of laser, Construction and working of He-Ne and semiconductor lasers, Applications of Lasers in Science, engineering and medicine.	6
5	**Material Science & Semiconductor Physics:** Bonding in solids: covalent and metallic bonding, Energy bands in solids: Classification of solids as Insulators, Semiconductors and Conductors, Intrinsic and extrinsic semiconductors, Fermi dirac distribution function and Fermi energy, Conductivity in semiconductors, Hall Effect: Theory, Hall Coefficient and applications.	7
6	**Introduction to Electromagnetism:** Divergence and curl of electrostatic field, Laplace‟s and Poisson‟s equations for electrostatic potential, Bio-Savart law, Divergence and curl of static magnetic field, Faraday‟s law, Displacement current and magnetic field arising from time dependent electric field, Maxwell‟s equations, Flow of energy and Poynting vector.	8

TOTAL	40

Suggested Readings:

1. Engineering Physics: Malik and Singh (Tata McGraw Hill)
2. Engineering Physics: Naidu (Pearson)
3. Optics : Ajay Ghatak (Tata McGraw Hill)
4. Concept of Modern Phyiscs: A. Baiser (Tata McGraw Hill)
5. Fundamental of Optics : Jetkins and White (Tata McGraw Hill)
6. Material Science: Smith (McGraw Hill)

1FY2-03/ 2FY2-03: ENGINEERING CHEMISTRY

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**

3L+1T+0P **End Term Exam: 3 Hours**

SN	Course Code	Course Outcomes
1	CO11203.1	Differentiation between hard and soft water, solve the related numerical problemson water treatment; and its application in industries and daily life
2	CO11203.2	Comprehension of various types of fuel, instrumental techniques for analysis andsolve the numerical problems related to it
3	CO11203.3	Identification of corrosion and application of its knowledge to protect the metal
4	CO11203.4	Developing basic knowledge of Inorganic Engineering materials viz. cement, glass, lubricants
5	CO11203.5	basic knowledge of organic reaction mechanism and introduction of drugs

SN	CONTENTS	Hours
1	Water: Common impurities, hardness, determination of hardness by complexometric (EDTA method), Degree of hardness, Units of hardness Municipal water supply: Requisite of drinking water, Purification of water; sedimentation, filtration, disinfection, breakpoint chlorination. Boiler troubles: Scale and Sludge formation, Internal treatment methods, Priming and Foaming, Boiler corrosion and Caustic embrittlement Water softening; Lime-Soda process, Zeolite (Permutit) process, Demineralization process. Numerical problems based on Hardness, EDTA, Lime-Soda and Zeolite process.	10
2	**Organic Fuels:** Solid fuels: Coal, Classification of Coal, Proximate and Ultimate analyses of coal and its significance, Gross and Net Calorific value, Determination of Calorific value of coal by Bomb Calorimeter. Metallurgical coke, Carbonization processes; Otto-Hoffmann by- product oven method. Liquid fuels : Advantages of liquid fuels, Mining, Refining and Composition of petroleum, Cracking, Synthetic petrol, Reforming, Knocking, Octane number, Anti-knocking agents, Cetane number Gaseous fuels; Advantages, manufacturing, composition and Calorific value of coal gas and oil gas, Determination of calorific value of gaseous fuels by Junker‟s calorimeter, Numerical problems based on determination of calorific value (bomb calorimeter/Junkers calorimeter/Dulongs formula, proximate analysis & ultimate and combustion of fuel.	10
3	**Corrosion and its control:** Definition and significance of corrosion, Mechanism of chemical (dry) and electrochemical (wet) corrosion, galvanic corrosion, concentration corrosion and pitting corrosion. Protection from corrosion; protective coatings-galvanization and tinning, cathodic protection, sacrificial anode and modifications in design.	3
4	annealing, Types and properties of soft glass, hard glass, borosilicate glass, glass wool, safetyglass Lubricants: Classification, Mechanism, Properties; Emulsification and steam emulsion number.	10
5	**Organic reaction mechanism and introduction of drugs:** Organic reaction mechanism: Substitution; SN1, SN2, Elecrophilic aromatic substitution in benzene, free radical halogenations of alkanes, Elimination; elimination in alkyl halides, dehydration of alcohols, Addition: electrophilic and free radical addition in alkenes, nucleophilic addition in aldehyde and ketones, Rearrangement; Carbocation and free radical rearrangements Drugs : Introduction, Synthesis, properties and uses of Aspirin, Paracetamol	7

TOTAL	**40**

Suggested Readings:

1. Engineering Chemistry by Monica Jain and P C Jain, Dhanpat Rai Publishing Company (P) Ltd, NewDelhi.
2. Engineering Chemistry Wiley, India.
3. The Chemistry and Technology of Coal, by J G Speigh, CRC Press.
4. The Chemistry and Technology of Petroleum, by J G Speigh, CRC Press.
5. Polymer Chemistry: An Introduction, Malcolm P. Stevens, Oxford University Press.
6. Lubricants and Lubrication, Theo Mang, Wilfried, Wiley-VCH.

1FY1-04/ 2FY1-04: COMMUNICATION SKILLS

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Course Code	Course Outcomes
1	CO11104.1 & CO12104.1	Students will be able to understand and develop communication skills and techniques which will felicitate their ability to work collaboratively with others.
2	CO11104.2 & CO12104.2	Students will be able to use English grammar accurately that will increase theirconfidence in English writing and speaking.
3	CO11104.3& CO12104.3	Students will be able to invent, draft, organize, abstract, elaborate and synthesize theirown and other's ideas in formatted way.
4	CO11104.4 & CO12104.4	Students will be able to understand literary devices after reading stories and also leranabout parts of speech and vocabulary..
5	CO11104.5 & CO12104.5	Students will be able to understand literary devices and figure of speech after readingpoems and also apprecaite art in all forms.

SN	CONTENTS	Hours
1	**Communication:** Meaning, Importance and Cycle of Communication. Media and Types of Communication. Verbal and Non-Verbal Communication. Barriers to communication. Formal and Informal Channels of Communication (Corporate Communication). Divisions of Human Communication and Methods to improve Interpersonal Communication. Qualities of good communication.	5
2	**Grammar:** Passive Voice. Reported Speech. Conditional Sentences. Modal Verbs. Linking Words(Conjunctions)	5
3	**Composition:** Job Application and Curriculum-Vitae Writing. BusinessLetter Writing. Paragraph Writing. Report Writing.	5
4	**Short Stories:** "Luncheon" by Somerset Maugham."How Much Land Does a Man Need?" by Count LeoTolstoy. "The Night Train at Deoli" by Ruskin Bond.	5
5	**Poems:** "No Men are Foreign" by James Kirkup. "If" by Rudyard Kipling. "Where the Mind is withoutFear" by Rabindranath Tagore.	5
TOTAL		**25**

Suggested Readings:

1. Communication Skills, Pushplata & Sanjay Kumar, Oxford UniversityPress, India.
2. The Written Word, Vandana Singh, Oxford University Press, India.
3. Current English Grammar and Usage with Composition, R. P. Sinha, Oxford University Press, India.
4. Rodriques M. V., 'Effective Business Communication', Concept PublishingCompany, New Delhi, 1992 reprint (2000).
5. Bansal, R K and Harrison J B, 'Spoken English' Orient Longman, Hyderabad.
6. Binod Mishra & Sangeeta Sharma, 'Communication Skills for Engineers and Scientists, PHI LearningPrivate Ltd, New Delhi, 2011.
7. Gartside L. 'Modern Business Correspondence, Pitman Publishing, London.

1FY1-05/ 2FY1-05: HUMAN VALUES

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Course Code	Course Outcomes
1	CO11105.1	Students will understand the importance oF Happiness Through Identification OfHuman Values and Skills.
2	CO11105.2	Students will understand the role of basic human aspirations in self and people aroundthem.
3	CO11105.3	Students will understand about the harmony in family, in society and practically understand the importance of trust and respect as foundational value of relationship
4	CO11105.4	Students will understand the interconnectedness among the four orders of nature, recyclability, coexistence and harmony at all level of existence
5	CO11105.5	Students will understand to be prepared for humanistic education, professionalcompetence with ethics and humanistic universal order.

S N	CONTENTS	Hours
1	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education:** Understanding the need, basic guidelines, Self Exploration - its content and process; „Natural Acceptance‟ and Experiential Validation, Continuous Happiness and Prosperity- Human Aspirations, Right understanding, Relationship and Physical Facilities,Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels	5
2	**Understanding Harmony in the Human Being - Harmony in Myself** Understanding human being as a co-existence of the sentient „I‟ and the material „Body‟Understanding the needs of Self („I‟) and „Body‟ - Sukh and Suvidha Understanding the Body as an instrument of „I‟,Understanding the characteristics and activities of „I‟ and harmony in „I‟ Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.	5
3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship;** Understanding harmony in the Family, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) , meaning of Vishwas; Difference between intention and competence, meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, harmony in the society , Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals ,Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family.	5
4	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment amongthe four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all pervasive Space. Holistic perception of harmony at all levels of existence	5

5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics. Natural acceptance of human values** Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, (b) Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems, technologies and management models. Strategy for transition from the present state to Universal Human Order: (a). At the level of individual: as socially and ecologically responsible engineers, technologists and managers. (b). At the level of society: as mutually enriching institutions and organization. Case studies related to values in professional life and individual life.	**5**

Suggested Readings:

1. R R Gaur, R Sangal, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, ExcelBooks, 2009. ISBN: 978-9-350-62091-5
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
3. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs,Britain.
4. R. Subramanian, Professional Ethics includes Human Values, Oxford Univ. Press.
5. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
6. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth Club of Rome's report, Universe Books.
7. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
8. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
9. A N Tripathy, 2003, Human Values, New Age International Publishers.
10. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
11. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
12. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
13. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
14. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008

1FY3-06/ 2FY3-06: PROGRAMMING FOR PROBLEM SOLVING

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Course Code	Course Outcomes
1	CO11306.1	To get the basic knowledge of computer & problem solving through algorithms &flowchart.
2	CO11306.2	To translate the algorithms to programs & execution (in C language).
3	CO11306.3	To implement conditional branching, iteration.
4	CO11306.4	To decompose a problem into functions and to develop modular reusable code.
5	CO11306.5	To use arrays, pointers and structures to develop algorithms and programs.

SN	CONTENTS	Hours
1	**Fundamentals of Computer:** Stored program architecture of computers, Storage device- Primary memory, and Secondary storage, Random, Direct, Sequential access methods, Concepts of High-level, Assembly and Low-level languages, Representing algorithms through flowchart and pseudo code.	8
2	**Number system:** Data representations, Concepts of radix and representation of numbers in radix r with specialcases of r=2, 8, 10 and 16 with conversion from radix r1 to r2, r"s and (r-1)"s complement, Binary addition, Binary subtraction, Representation of alphabets.	8
3	**C Programming:** Problem specification, flow chart, data types, assignment statements, input output statements, developing simple C programs, If statement, for loops, while loops, do-while loops, switch statement, break statement, continue statement, development of C programs using above statements, Arrays, functions, parameter passing, recursion, Programming in C using these statements, Structures, files, pointers and multi file handling.	12
TOTAL		**28**

Suggested Readings:

1. Fundamental of Computers By R. Thareja**,** Oxford University Press.
2. Programming in ANSI C by E Balagurusamy, Tata McGraw-Hill Education.
3. The C Programming Language by Brian W. Kernighan and Dennis M. Ritchie, PHI.
4. C:The Complete Reference by Herbert Schildt, McGraw-Hill Education.
5. Let us C by Yashavant P. Kanetkar, bpb publications
6. Programming in C by Thareja, Oxford University Press
7. Graphics Under C by Yashavant P. Kanetkar, bpb publications.

1FY3-07/ 2FY3-07: BASIC MECHANICAL ENGINEERING

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Course Code	Course Outcomes
1	CO11307.1 & CO12307.1	Students will be able to understand the introduction of mechanical engineering anddevlop knowledge about steam boilers, steam turbines and power plants.
2	CO11307.2 & CO12307.2	Students will be able to conclude basics of centrifugal, reciprocation pumps and InternalCombustion Engine. Students will be able to create knowledge of various types of refrigeration and air conditioning systems with their applications.
3	CO11307.3 & CO12307.3	Students will be able to analyze basics of different types power tranmission systems suchas belt, rope, gears and gear trains
4	CO11307.4 & CO12307.4	Students will be able to illustrate working of different manufacturing processes
5	CO11307.5 & CO12307.5	Students will be able to identify different engineering materials their, properties andvarious types of heat treatment processes

SN	CONTENTS	Hours
1	**Fundamentals:** Introduction to mechanical engineering, concepts of thermal engineering, mechanical machine design, industrial engineering and manufacturing technology. Steam Boilers classification and types of steam boilers and steam turbines. Introduction andClassification of power plants.	5
2	**Pumps and IC Engines:** Applications and working of Reciprocating and Centrifugal pumps. Introduction, Classification of IC Engines, Main Components of IC Engines, Working of IC Engines and its components.	5
3	**Refrigeration and Air Conditioning:** Introduction, classification and types of refrigeration systems and air-conditioning. Applications of refrigeration and Air-conditioning.	5
4	**Transmission of Power:** Introduction and types of Belt and Rope Drives, Gears.	3
5	**Primary Manufacturing Processes:** Metal Casting Process: Introduction to Casting Process, Patterns, Molding, Furnaces. Metal Forming Processes: Introduction to Forging, Rolling, Extrusion, Drawing. Metal Joining Processes: Introduction to various types of Welding, Gas Cutting, Brazing, and Soldering.	5
6	**Engineering Materials and Heat Treatment of Steel:** Introduction to various engineering materials and their properties.	5
		28

Suggested Readings:

1. G. Shanmugam and S Ravindran, Basic Mechanical Engieering, Mc Graw hill, fourth edition.
2. K Venu Gopal and Prabhu Raja V, Basic Mechanical Engineering, Anuradha agencies pub, Chennai.

1FY3-08/ 2FY3-08: BASIC ELECTRICAL ENGINEERING

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Course Code	Course Outcomes
1	CO12308.1	Ability to solve circuit using different kind of methods and theorems.
2	CO12308.2	Ability to know the behaviors of basic electrical elements like resistor, inductor andcapacitor.
3	CO12308.3	Students will be able to know the behaviors of transformer.
4	CO12308.4	Students will be able to know the behaviors of AC and DC machines.
5	CO12308.5	Students can use electronics components in the circuit after understanding its properties.Ability to know the behavior of LT switchgear, earthing and electricalpower measurement

SN	CONTENTS	Hours
1	**DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Series-Parallel circuits, Node voltage method, Mesh current method, Superposition, Thevenin‟s, Norton‟s and Maximum power transfer theorems.	5
2	**AC Circuits:** Representation of sinusoidal waveforms, peak and r.m.s values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single- phase AC circuits consisting of R, L, C, RL, RC and RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	4
3	**Transformers:** Ideal and practical transformer, EMF equation, equivalent circuit, losses in transformers, regulation and efficiency.	4
4	**Electrical Machines:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Starting and speed control of induction motor, single- phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited DC motor. Construction and working of synchronous generators.	7
5	**Power Converters:** Semiconductor PN junction diode and transistor (BJT). Characteristics of SCR, power transistor and IGBT. Basic circuits of single phase rectifier with R load, Singlephase Inverter, DC-DC converter.	4
6	**Electrical Installations:**Layout of LT switchgear: Switch fuse unit (SFU), MCB, ELCB, MCCB, Type of earthing. Power measurement, elementary calculations for energy consumption.	4
TOTAL		**28**

Suggested Readings:

1. Basic Electrical and Electronics Engineering by Sukhija and Nagsarkar, Oxford Publication
2. Basic Electrical & Electronics Engineering by Kothari, Nagrath, TMH
3. Basic Electrical & Electronics Engineering by V. Jagathesan, K. Vinod Kumar & R. Saravan Kumar,Wiley India.
4. Basic Electrical & Electronics Engineering by Prasad/Sivanagraju, Cengage learning IndianEdition
5. Basic Electrical and Electronics Engineering by Muthusubrmaniam,TMH
6. Fundamentals of Electrical and Electronics Engineering by Ghosh, Smarajit, PHI India

1FY3-09/ 2FY3-09: BASIC CIVIL ENGINEERING

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Course Code	Course Outcomes
1	CO12309.1	Role of civil engineer and impact of infrastructure on society will be understood to student.
2	CO12309.2	Principles of surveying and leveling will be known to student.
3	CO12309.3	Student will be able to understand about foundation and parts of building
4	CO12309.4	Importance of traffic engineering will be known to students.
5	CO12309.5	Students will understand about problem related to environment.

SN	CONTENTS	Hours
1	**Introduction to objective, scope and outcome the subject**	1
2	**Introduction:** Scope and Specialization of Civil Engineering, Role of civil Engineer in Society, Impact ofinfrastructural development on economy of country.	2
3	**Surveying:** Object, Principles & Types of Surveying; Site Plans, Plans& Maps; Scales & Unit of different Measurements. Linear Measurements: Instruments used. Linear Measurement by Tape, Ranging out Survey Lines and overcoming Obstructions; Measurements on sloping ground; Tape corrections, conventional symbols. Angular Measurements: Instruments used; Introduction to Compass Surveying, Bearings and Longitude & Latitude of a Line, Introduction to total station. Levelling: Instrument used, Object of levelling, Methods of levelling in brief, Contour maps	8
4	**Buildings:** Selection of site for Buildings, Layout of Building Plan, Types of buildings, Plinth area, carpet area, floor space index, Introduction to building byelaws, concept of sun light and ventilation. Components of Buildings & their functions, Basic concept of R.C.C., Introduction to types of foundation.	3
5	**Transportation:** Introduction to Transportation Engineering; Traffic and Road Safety: Types andCharacteristics of Various Modes of Transportation; Various Road Traffic Signs, Causes of Accidents and Road Safety Measures.	2
6	**Environmental Engineering:** Environmental Pollution, Environmental Acts and Regulations, Functional Concepts of Ecology, Basics of Species, Biodiversity, Ecosystem, Hydrological Cycle; Chemical Cycles: Carbon, Nitrogen& Phosphorus; Energy Flow in Eco- systems. Water Pollution: Water Quality standards, Introduction to Treatment & Disposal of Waste Water. Reuse and Saving of Water, Rain Water Harvesting. Solid Waste Management: Classification of Solid Waste, Collection, Transportation and Disposal of Solid. Recycling of Solid Waste: Energy Recovery, Sanitary Land fill, On-Site Sanitation. Air& Noise Pollution: Primary and Secondary air pollutants, Harmful effects of Air Pollution, Control of Air Pollution. . Noise Pollution Harmful Effects of noise pollution, control of noise pollution, Global warming & Climate Change, Ozone depletion, Green House effect	4
TOTAL		**28**

Suggested Readings:

1. Palancharmy, Basic Civil Engineering, McGraw Hill publishers.
2. Satheesh Gopi, Basic Civil Engineering, Pearson Publishers.
3. Ketki Ranwala Dalal, Essentials of Civil Engineering, Charotar Publishing House.

1FY2-20/ 2FY2-20: ENGINEERING PHYSICS LAB

Credit: 1 **Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P

SN	Course Code	Course Outcomes
1	CO11220.1 & CO12220.1	Student will be able to measure the wavelength of light using Michelson's Interferometer, Newton's Ring and Diffraction Grating, dispersive power of a prism, numerical aperture of an optical fibre, coherence length as well as coherence time of a He-Ne LASER using Michelson's Interferometer and thereby learn the optical phenomena of classical and quantum wave optics.
2	CO11220.2 & CO12220.2	Student will be able to measure the bandgap of a semiconductor material and Hall coefficient of a semiconductor by measuring it's Hall voltage and thereby learn the experimental technique to measure energy band gap and Hall coefficient of a semiconductor and learn to identify the type of semiconductor (p-type or n-type)
3	CO11220.3 & CO12220.3	Student will be able to measure the height of a distant object using Sextant and hencelearn the use of a sextant to measure angle of inclination as well as learn the use of trigonometric ratios to find various distances.
4	CO11220.4 & CO12220.4	Student will be able to measure the time constant of a RC circuit, specific resistance of a wire by Carry Foster's bridge and hence learn the charging and discharging behaviorof a capacitor.

1. To determine the wave length of monochromatic light with the help of Michelson‟s interferometer.
2. To determine the wave length of sodium light by Newton‟s Ring.
3. To determine the wave length of prominent lines of mercury by plane diffraction grating with thehelp of spectrometer.
4. Determination of band gap using a P-N junction diode.
5. To determine the height of given object with the help of sextant.
6. To determine the dispersive power of material of a prism with the help of spectrometer.
   To study the charge and discharge of a condenser and hence determine the same constant (bothcurrent and voltage graphs are to be plotted.
8. To determine the coherence length and coherence time of laser using He – Ne laser.
9. To measure the numerical aperture of an optical fibre.

1FY2-21/ 2FY2-21: ENGINEERING CHEMISTRY LAB		
Credit: 1	**Max. Marks: 50 (IA:30, ETE:20)**	
0L+0T+2P		
S. No	**Course Code**	**Course Outcomes**
1	CO11122.1 & CO12122.1	students will learn to pronounce and transcribe words after learning various phonetic symbols. They can also use thesephonetics to improve their pronunciation.
2	CO11122.1 & CO12122.2	students will get a revised knowledge of synonyms , antonymsand word formation.
3	CO11122.1 & CO12122.3	students will be able to give seminar presentation on differenttopics and have a knowledge of group discussion.

1. Determination the hardness of water by EDTA method
2. Determination of residual chlorine in water
3. Determination of dissolved oxygen in water
4. Determination of the strength of Ferrous Ammonium sulphate solution with the help of K2Cr2O7 solution by using diphenyl amine indicator
5. Determination of the strength of CuSO4 solution iodometrically by usinghypo solution
6. Determination of the strength of NaOH and Na2CO3 in a given alkali mixture Proximate analysis of Coal
7. Determination of the flash & fire point and cloud & pour point of lubricating oil
8. Determination of the kinematic viscosity of lubricating oil by Redwood viscometer no.

At different temperature 2. Synthesis of Aspirin/ Paracetamol

1FY2-22/ 2FY2-22: LANGUAGE LAB		
Credit:1		**Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P		
S. No	**Course Code**	**Course Outcomes**
1	CO11123 & CO12123.1	Students will understand the importance of happiness and prosperity throughidentification of human values and skills.
2	CO11123 & CO12123.2	Students will understand the role of basic human aspirations, about harmony infamily, society and the importance of trust and respect.
3	CO11123 & CO12123.3	Students will understand about the interconnectedness among the four orders ofnature, recyclability, coexistence, professional ethics and competence.

1. Phonetic Symbols and Transcriptions.
2. Extempore.
3. Group Discussion.
4. Dialogue Writing.
5. Listening comprehension.

Suggested Readings:

1. Technical Communication: principles and Practice, Meenakshi Raman & Sangeeta Sharma, OxfordUniversity Press, India.
2. Effective Technical Communication, Barun K. Mitra, Oxford University Press, India.
3. Binod Mishra & Sangeeta Sharma, 'Communication Skills for Engineers and Scientists, PHI Learning Private Ltd, New Delhi, 2011.
4. Communication Skills, Pushplata & Sanjay Kumar, Oxford UniversityPress, India.
5. Bhattacharya, Indrajit, An Approach to Communication Skills, Dhanpat Rai & Co. (Pvt) Ltd., New Delhi.
6. Wright, Crissy, Handbook of Practical Communication Skills, Jaico Publishing House, Mumbai.
7. Gimson, A C, 'An Introduction to the Pronunciation ofEnglish', ELBS.

1FY1-23/ 2FY1-23: HUMAN VALUES ACTIVITIES AND SPORTS	
Credit: 1	**Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P	
CO12105.1	Students will understand the importance oF Happiness Through Identification Of Human Values and Skills.
CO12105.2	Students will understand the role of basic human aspirations in self and people around them.
CO11105.3	Students will understand about the harmony in family, in society and practically understand the importance of trust and respect as foundational value of relationship
CO11105.4	Students will understand the interconnectedness among the four orders of nature, recyclability, coexistence and harmony at all level of existence
CO11105.5	Students will understand to be prepared for humanistic education, professional competence with ethics and humanistic universal order.

PS 1:
Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your salient achievements and shortcomings in your life? Observe and analyze them.

PS 2:
Now-a-days, there is a lot of talk about many techno-genic maladies such as energy and material resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. - all these seem to be manmade problems, threatening the survival of life Earth - What is the root cause of these maladies & what is the way out in opinion?
On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, breakdown of relationships, generation gap, depression & suicidal attempts etc. - what do you think, is the root cause of these threats to human happiness and peace - what could be the way out in your opinion?

PS 3:
1. Observe that each of us has the faculty of „Natural Acceptance", based on which one can verify what is right or not right for him. (As such we are not properly trained to listen to our „Natural Acceptance" and may a time it is also clouded by our strong per-conditioning and sensory attractions).
Explore the following:
(i) What is Naturally Acceptable" to you in relationship the feeling of respect or disrespect foryourself and for others?
(ii) What is „naturally Acceptable" to you - to nurture or to exploit others? Is your living in accordance with your natural acceptance or different from it?

3. Out of the three basic requirements for fulfillment of your aspirations - right understanding, relationship and physical facilities - observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

PS 4:
1. a. Observe that any physical facility you use, follows the given sequence with time:
Necessary and tasteful - unnecessary but still tasteful - unnecessary and tasteless - intolerable

b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If not acceptable, you want it continuously and if not acceptable, you do not want it any moment!
2. List down all your important activities. Observe whether the activity is of „I" or of Body or with the participation of both or with the participation of both „I" and Body.
Observe the activities within „i". Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

PS 5. Write a narration in the form of a story, poem, skit or essay to clarify a salient Human Value to the children.
2. Recollect and narrate an incident in your life where you were able to exhibit willful adherence to values in a difficult situation.

PS 6:
List down some common units (things) of Nature which you come across in your daily life and classify them in the four orders of Nature. Analysis and explain the aspect of mutual fulfillment of each unit with other orders.

PS 7:
Identify any two important problems being faced by the society today and analyze the root cause of these problems. Can these be solved on the basic of natural acceptance of human values? If so, how should one proceed in this direction from the present situation?

PS 8:
1. Suggest ways in which you can use your knowledge of Science/Technology/Management etc. for moving towards a universal human order.
2. Propose a broad outline for humanistic Constitution at the level of Nation.
Project:
3. Every student required to take-up a social project e.g. educating children in needy/weaker section; services in hospitals, NGO's and other such work i.e. social work at villages adopted by respective institute/ college

Sports:
a) Planning in Sports,
b) Sports & Nutrition
c) Yoga and Life style
d) Measures Physical Education & Sports for CWSN (Children with Special needs Divyang)
e) Children & Sports
f) Women & Sports
g) Test & Measurement in Sports
h) Physiology & Sports
i) Sports Medicine
j) Kinesiology, Biomechanics & Sports
k) Psychology & Sports
l) Training in Sports

1FY3-24/ 2FY3-24: COMPUTER PROGRAMMING LAB		
Credit: 1.5	**Max. Marks: 75 (IA:45, ETE:30)**	
0L+0T+3P		
SN	**Course Code**	**Course Outcomes**
1	CO11324.1 & CO12324.1	To Design, implement, test and debug programs in C
2	CO11324.2 & CO12324.2	To implement and learn conditional statements.
3	CO11324.3 & CO12324.3	To implement the different types of array and its applications.
4	CO11324.4 & CO12324.4	To imply practical applications of structure and union.
5	CO11324.5 & CO12324.5	To implement the concept of File Handling.

1. To learn about the C Library, Preprocessor directive, Input-outputstatement
2. Programs to learn data type, variables, If-else statement
3. Programs to understand nested if-else statement and switch statement
4. Programs to learn iterative statements like while and do-while loops
5. Programs to understand for loops for iterative statements
6. Programs to learn about array and string operations
7. Programs to understand sorting and searching using array
8. Programs to learn functions and recursive functions
9. Programs to understand Structure and Union operation
10. Programs to learn Pointer operations
11. Programs to understand File handling operations
12. Programs to input data through Command line argument

1FY3-25/ 2FY3-25: MANUFACTURING PRACTICES WORKSHOP

Credit: 1.5	Max. Marks: 75 (IA:45, ETE:30)
0L+0T+3P	

SN	Course Code	Course Outcomes
1	CO11325.1 &CO12325.1	Student will be able to understand the basic tools and operations of carpentry shop with preparation of a simple joint
2	CO11325.2 &CO12325.2	Student will be able to understand the basics of foundry shop withpreparation of sand mould and casting of simple pattern
3	CO11325.3 &CO12325.3	Students will be able to describe the basic tools used in welding shopwith preparation of lap and butt joint
4	CO11325.4 &CO12325.4	Students will be able to learn about various parts and operations on Lathe machine with preparation of job
5	CO11325.5 &CO12325.5	Students will be able to understand the various tools and operations of fitting shop with preparation of job

Carpentry Shop

1. T – Lap joint
2. Bridle joint

Foundry Shop

3. Mould of any pattern
4. Casting of any simple pattern

Welding Shop

5. Lap joint by gas welding
6. Butt joint by arc welding
7. Lap joint by arc welding
8. Demonstration of brazing, soldering & gas cutting

Machine Shop Practice

9. Job on lathe with one step turning and chamfering operations

Fitting and Sheet Metal Shop

10. Finishing of two sides of a square piece by filing
11. Making mechanical joint and soldering of joint on sheet metal
12. To cut a square notch using hacksaw and to drill a hole and tapping

1FY3-26/ 2FY3-26: BASIC ELECTRICAL ENGINEERING LAB

Credit: 1		**Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P		
SN	**Course Code**	**Course Outcomes**
1	CO12326.1	Students can identify basic electrical component and able to test and measure electricalquantities using digital and analog meters.
2	CO12326.2	Students gets basic information about transformer.
3	CO12326.3	Student will be able to understand about star Delta connection of 3 phase transformer.
4	CO12326.4	Students get complete information about AC & DC machine by cut out section.
5	CO12326.5	Students get knowledge of design of different converters and LT switch gears

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.

   Transformers: Observation of the no-load current waveform on an oscilloscope. Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

3. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line line voltage, phase-to-neutral voltage, line and phase currents).Phase-shifts between the primary and secondary side.
4. Demonstration of cut-out sections of machines: dc machine (commutator- brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement)and single-phase induction machine.
5. Torque Speed Characteristic of separately excited dc motor.
6. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform
   (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

1FY3-27/ 2FY3-27: BASIC CIVIL ENGINEERING LAB		
Credit: 1	**Max. Marks: 50 (IA:30, ETE:20)**	
0L+0T+2P		
SN	**Course Code**	**Course Outcomes**
1	CO11327 & CO12327.1	To understand the linear measurement with the help of tape andchain include ranging and laying offset method.
2	CO11327 & CO12327.2	Measurement of bearing of line with help of compass.
3	CO11327 & CO12327.3	To be aware of the of levelling instruments during making of longitudinal and cross section of road and also able to take the measurements using the Total Station.
4	CO11327 & CO12327.4	Determine various water and waste water quality parameter like pH, hardness, and turbidity and solids.
5	CO11327 & CO12327.5	Describe the various water supplies and sanitary fitting.

1. Linear Measurement by Tape:
   a) Ranging and Fixing of Survey Station along straight line and across obstacles.
   b) Laying perpendicular offset along the survey line
2. Compass Survey: Measurement of bearing of linesusing Surveyor's and Prismatic compass
3. Levelling: Using Tilting/ Dumpy/ Automatic Level
   a) To determine the reduced levels in closed circuit.
   b) To carry out profile levelling and plot longitudinal and cross sections for road by Height ofInstrument and Rise & Fall Method.
4. To study and take measurements using various electronic surveying instruments like EDM, TotalStation etc.
5. To determine pH, hardness and turbidity of the given sample of water.
6. To study various water supply Fittings.
7. To determine the pH and total solids of the given sample of sewage.
8. To study various Sanitary Fittings.

1FY3-28/ 2FY3-28: COMPUTER AIDED ENGINEERING GRAPHICS

Credit:1.5		**Max. Marks: 75 (IA:45, ETE:30)**
0L+0T+3P		
S N	**Course Code**	**Course Outcomes**
1	CO11328 & CO12328.1	Use the drawing instruments effectively and able to dimension the given figure.
2	CO11328 & CO12328.2	Understand the systematic approach for projection of points & lines.
3	CO11328 & CO12328.3	Able to draw the basic vews related to projection of lines & planes.
4	CO11328 & CO12328.4	Understand the theory of section of solid & projection of Section of solid includng cylinders , cones, prism.
5	CO11328 & CO12328.5	Understand the fundamentals of computer graphics.

Introduction: Principles of drawing, lines, type of lines, usage of Drawing instruments, lettering, Conic sections including parabola, hyperbola, Rectangular Hyperbola (General method only); Scales-Plain, Diagonaland Vernier Scales.

Projections of Point & Lines: Position of Point, Notation System, Systematic Approach for projections of points, front view & Top view of point, Position of straight lines, line parallel to Both the RPs, Line perpendicular to either of the RPs, Line inclined to one RP and parallel to the other, Line inclined to Both theRPs, Traces of a line (One drawing sheet, one assignment in sketch book).

Projection of Planes: Positions of planes, Terms used in projections of planes, plane parallel to RP, plane inclined to one RP and perpendicular to the other RP, plane perpendicular to Both the RPs, plane Inclined to Both the RPs, True shape of the plane, Distance of a point from plane, Angle between two planes.

Projections of Regular Solids: frustum and truncated solids, those inclined to both the Planes-Auxiliary Views.

Section of Solids: Theory of sectioning, section of prisms and cubes, section of pyramids and Tetrahedron section of Cylinders, section of cones, section of spheres (One drawing sheet, one assignment in sketch book)**Overview of Computer Graphics :** Covering theory of CAD software [such as: The menu System, Toolbars(standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.: Isometric Views of lines, Planes, Simple and compound Solids.

Suggested Readings:

1. Engineering Drawing Geometrical Drawing P.S.Gill , S.K.Katara & Sons
2. Engineering Drawing,Dhanarajay A Jolhe ,Tata McGraw Hill.
3. Engineering Drawing, Basant Agarwal & CM Agarwal ,Tata McGraw Hill
4. Engineering Drawing, N.D.Bhatt, Charotar Publishing House Pvt. Ltd.
5. Engineering Drawing with an introduction to AutoCAD, Dhananjay A Jolhe
6. Engineering Drawing with AutoCAD, B.V.R. Gupta and M. Rajaroy
7. AutoCAD 2017 for Engineers & Designers (Basic and Intermediate), Sham Tickoo,

1FY3-29/ 2FY3-29: COMPUTER AIDED MACHINE DRAWING

Credit:1.5		**Max. Marks: 75 (IA:45, ETE:30)**
0L+0T+3P		
SN	**Course Code**	**Course Outcomes**
1	CO11329 & CO12329.1	Use the drawing instruments effectively and able to dimension the given figure.
2	CO11329 & CO12329.2	Understand the systematic approach for projection of points & lines.
3	CO11329 & CO12329.3	Able to draw the basic vews related to projection of lines & planes.
4	CO11329 & CO12329.4	Understand the theory of section of solid & projection of Section of solid includng cylinders , cones, prism.
5	CO11329 & CO12329.5	Understand the fundamentals of computer graphics.

Introduction: Principles of drawing, conventional representation of machine components and materials, lines,types of lines, dimensioning types, rules of dimensioning.

Conversion of pictorial views into orthographic views: (1 drawing sheet) Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing view problems covering Principles of Orthographic Projections.

Sectional views of mechanical components: (1 drawing sheet) Introduction, cutting plane line, type of sectional views-full section, half section, partial or broken section, revolved section, removed section, offset section, sectioning conventions-spokes, web rib, shaft, pipes, different types of holes, conventions of sectionlines for different metals and materials.

Fasteners and other mechanical components: (Free hand sketch) Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints. Riveted joints, rivets and riveting, type of rivets, types of riveted joints etc. Bearing: Ball, roller, needle, footstep bearing. Coupling: Protected type, flange, and pin type flexible coupling. Other components: Welded joints, belts and pulleys, pipes and pipe joints, valves etc.

Overview of Computer Graphics: (2 drawing sheets) Covering theory of CAD software such as: The menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Command Line (Where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.: Isometric Views of Lines, Planes, Simple and compound Solids.

II YEAR CURRICULUM

III SEMESTER

SUBJECT: 3EE2-01: Advance Mathematics

CO23201.1	To demonstrate the concept of difference operator and interpolation and to understand of numerical methods over exact/analytical methods.
CO23201.2	To provide the basic idea of Laplace transform and their application to solve ordinary and partial differential equation with boundary conditions
CO23201.3	To provide the concept of complex transform including the sine and cosine transform and their application. To solve wave and diffusion equation using Fourier transforms.
CO23201.4	Explain the concept of Z transform and state the use of it in time varying signals able to expand the given periodic function defined in the given range
CO23201.5	To identify the functions in engineering problems as analytic function and their study as a functions of a complex variables. To solve Engineering problems using complex variable techniques.

Credit-3 **Max. Marks : 150 (IA:30,ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Numerical Methods**: Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Solution of polynomial and transcendental equations-Bisection method, Newton Raphson method and Regula Falsi method.	14
2	**Transform Calculus:** Laplace Transform: Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Fourier Transform: Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem. Z-Transform: Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.	20
3	**Complex Variable:** Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	6
	TOTAL	**40**

Suggested Book:

1 Millman Halkias, Integrated Electronics, TMH 2011

2 R. L. Boylestad, Louis Nashelsky, Electronic devices & circuits theory, Pearson Education 2009

SUBJECT: 3EE1-03: Technical communication

CO23102.1	Understand the meaning and importance of technical communication and different technical styles
CO23102.2	practice the unique qualities of professional rhetoric and writing style, such as sentence conciseness, clarity, accuracy, honesty, avoiding wordiness or ambiguity, using direct order organization, readability, coherence and transitional devices
CO23102.3	recognize, explain, and use the formal elements of specific genres of organizational communication: white papers, memorandums, web pages, wikis, blogs, business letters, and promotional documents.
CO23102.4	recognize, explain, and use the formal elements of specific genres of organizational communication: white papers, recommendation and analytical reports, proposals
CO23102.1	Understand the meaning and importance of technical communication and different technical styles

Credit-2 **Max. Marks : 100 (IA:20,ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Introduction to Technical Communication-** Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication.	3
3	**Comprehension of Technical Materials/Texts and Information Design & development-** Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media.	6
4	**Technical Writing, Grammar and Editing**- Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings.	8
5	**Advanced Technical Writing**- Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, mstructure and formats of technical articles.	8
	TOTAL	26

Suggested Readings:

1. Effective business communication by Asha Kaul
2. Technical writing by Tata McGraw Hill

SUBJECT : 3EE3-04: POWER GENERATION PROCESSES

CO23304.1	To study the Conventional Energy Generation methods and New Energy Sources
CO23304.2	To study the Loads and Load Curves for generation processes
CO23304.3	To gain the knowledge of Power Factor Improvement
CO23304.4	Various aspects of Power Plant Economics
CO23304.5	To study the Tariff and Selection of Power Plants in generation processes

Credit: 2 **Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

UNIT NO.	CONTENTS	HOURS
1	**Conventional Energy Generation Methods** : Thermal Power plants: Basic schemes and working principle. (ii) Gas Power Plants: open cycle and closed cycle gas turbine plants, combined gas & steam plants-basic schemes. Hydro Power Plants: Classification of hydroelectric plants. Basic schemes of hydroelectric and pumped storage plants. (iv) Nuclear Power Plants: Nuclear fission and nuclear fusion. Fissile and fertile materials. Basic plant schemes with boiling water reactor, heavy water reactor and fast breeder reactor. Efficiencies of various power plants.	**6**
2	**New Energy Sources** : Impact of thermal, gas, hydro and nuclear power stations on environment. Green House Effect (Global Warming).Renewable and nonrenewable energy sources. Conservation of natural resources and sustainable energy systems. Indian energy scene. Introduction to electric energy generation by wind, solar and tidal.	**6**
3	**Loads and Load Curves** ; Types of load, chronological load curve, load duration curve, energy load curve and mass curve. Maximum demand, demand factor, load factor, diversity factor, capacity factor and utilization.	**2**
4	**Power Factor Improvement** : Causes and effects of low power factor and advantages of power factor improvement. Power factor improvement using shunt capacitors and synchronous condensers	**3**
5	**Power Plant Economics ;** Capital cost of plants, annual fixed and operating costs of plants, generation cost and depreciation. Effect of load factor on unit energy cost. Role of load diversity in power system economics. Calculation of most economic power factor when (a) kW demand is constant and (b) kVA demand is constant. (iii) Energy cost reduction: off peak energy utilization, co-generation, and energy conservation.	**5**
6	**Tariff :** Objectives of tariffs. General tariff form. Flat demand rate, straight meter rate, block meter rate. Two part tariff, power factor dependent tariffs, three part tariff. Spot (time differentiated) pricing.	**3**
7	**Selection of Power Plants:** Comparative study of thermal, hydro, nuclear and gas power plants. Base load and peak load plants. Size and types of generating units, types of reserve and size of plant. Selection and location of power plants.	**4**

Suggested Readings:

1. Digambar M. Tagare · 2011
2. Paul Breeze · 2005
3. Pradip Chanda, Suparna Mukhopaddhyay · 2016
4. B. Ravindranath, M. Chander · 1977

SUBJECT: 3EE3-05: ELECTRICAL CIRCUIT ANALYSIS

CO23305.1	Apply the concepts/characteristics of electrical circuit elements and study & analyze the behavior of DC networks;
CO23305.2	Solve and analyze first and second order circuits having some excitation signal and be able to analyze the transient response.
CO23305.3	Analysis of Single Phase and three phase AC Circuits, the representation of alternating quantities, mutually coupled circuit and ideal transformer.
CO23305.4	Acquire the knowledge of Laplace transform and apply it on electrical circuit analysis. Study and analysis of transfer function, poles, zeroes and frequency response
CO23305.5	Analysis of various two port networks with their connection, interrelationships and interconnection of two port networks.

Credit-3 **Max. Marks : 150 (IA:30,ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Network Theorems** Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks	10
2	**Solution of First and Second order networks** Solution of first and second order differential equations for Series and parallel R-L, R-C, RL- C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response	8
3	**Sinusoidal steady state analysis** Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer	8
4	**Electrical Circuit Analysis Using Laplace Transforms** Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances	8
5	**Two Port Network and Network Functions** Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.	6
	TOTAL	40

Suggested Readings:

1 Van Valkenburg, Network Analysis, PHI 2013
2 Hayt & Kemmerly, Engineeirng Circuit Analysis, 6/e (TMH) 2012

SUBJECT: 3EE4-06: Analog Electronics

CO23406.1	Students will able to Understand the Diode circuits and its characteristics.
CO23406.2	Students will able to know the behaviors of BJT circuits, amplifier circuit, MOSFET circuits and its different configuration with its characteristics.
CO23406.3	Student will be able to know the behavior of Differential, multi-stage and operational amplifiers with different characteristic equations.
CO23406.4	Student will be able to know the behaviors of Linear applications of op-amp circuit with different types of controller, oscillators and conversion.
CO23406.5	Students can understand Nonlinear applications of op-amp with different wave and shot..

Credit: 3 **Max. Marks: 150 (IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1.	**Diode circuits:** P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.	4
2.	**BJT circuits;** Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.	8
3.	**MOSFET circuits;** MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits-gain, input and output impedances, trans conductance, high frequency equivalent circuit.	8
4.	**Differential, multi-stage and operational amplifiers:** Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op- amp, non idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)	8
5.	**Linear applications of op-amp;** Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.	8
6.	**Nonlinear applications of op-amp:** Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector. Monoshot	6
	Total	42

Suggested Readings:

1 M. H. Rashid, Microelectronic Circuits Analysis and design, Cengage Learning.
2 David A. BELL, Electronic Devices and Circuits, Oxford university press.
3 Salivahnan, Electronics Devices and Circuits, ed. 3, TMH.

SUBJECT : 3EE4-07: Electrical Machine-I

CO23407.1	Learn basics of magnetic circuit & conversion of mechanical energy to electrical energy & vice versa. Visualization of magnetic flux line and various laws related to magnetic and electrical circuit and its application.
CO23407.2	Learn electromagnetic force and torque B-H curve relationship, flux-linkage v/s current characteristic of magnetic circuits.
CO23407.3	Learn DC machines basic construction, their magnetic structure and principle of dc generator and motor.
CO23407.4	Learn DC machines characteristics & various tests on dc motor. Calculate Losses in DC machine. Perform load testing and back-to-back testing on DC machines.
CO23407.5	Learn construction and principle of transformer, its complete phasor diagram at various loading conditions. Learn types of three phase connections, phase sequence, harmonic & its effect on operation of transformer. Learn three to six phase conversion, excitation phenomenon in transformer and switching currents in transformer

Credit: 3 **Max. Marks: 150 (IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

S.NO.	CONTENTS	HOURS
1	**Magnetic fields and magnetic circuits** Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines	6
2	**Electromagnetic force and torque** B-H curve of magnetic materials; flux-linkage v/s current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples – galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency	9
3	**DC machines** Basic construction of a DC machine, magnetic structure stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction	8
4	**DC machine - motoring and generation** Armature circuit equation for motoring and generation, Types of field excitations separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage.	7

	Losses, load testing and back-to-back testing of DC machines.	
5	**Transformers** Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase. transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.	**12**
	Total	**42**

Suggested Readings:

1 A. E. Fitzgerald, C. Kingsley Jr and Umans, Electric Machinery, 6th Edition McGraw Hill, International Student Edition. 2002

2 Kothari & Nagrath, Electric Machines, 3/e, TMH 2004

3EE4-08: Electromagnetic Fields

CO23408.1	To introduce the basic mathematical concepts related to electromagnetic vector fields.
CO23408.2	To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
CO23408.3	To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
CO23408.4	To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations.
CO23408.5	To describe time varying fields, propagation of electromagnetic waves in different media, pyonting theorem, their sources & effects a

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

S.NO.	CONTENTS	HOURS
1	**Review of Vector Calculus:** Vector algebra- addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another	4
2	**Static Electric Field:** Coulomb’s law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.	4
3	**Conductors, Dielectrics and Capacitance:** Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson’s equation, Laplace’s equation, Solution of Laplace and Poisson’s equation, Application of Laplace’s and Poisson’s equations.	4
4	**Static Magnetic Fields:** Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.	4
5	**Magnetic Forces, Materials and Inductance:** Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.	4
6	**Time Varying Fields and Maxwell’s Equations:** Faraday’s law for Electromagnetic induction, Displacement current, Point form of Maxwell’s equation, Integral form of Maxwell’s equations, Motional Electromotive forces. Boundary Conditions.	4
7	**Electromagnetic Waves:** Derivation of Wave Equation, Uniform Plane Waves, Maxwell’s equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem	4

Suggested Readings:

1. Sadiku, Electromagnetic Field Theory, Oxford .(2000)
2. Mahapatra, Principles of Electromagnetics, TMH.(2011)
3. Kshetrimeyum – Electromagnetic field theory, Cengage learning 2012
4. Hayt, Engineering Electromagnetics, TMH 2007

3EE4-21: Analog Electronics Lab

CO23421.1	Students can able to plot different characteristics waveform of different types of amplifiers in lab.
CO23421.2	Students can able to study various regulation and measurement parameters in lab.
CO23421.3	Students can able to study different types of bridge oscillators and observes its effect in lab
CO23421.4	Students can able to Record, observe and analyse the effect of variation of C on oscillator frequency for Hartley and Colpitts oscillator.
CO23421.5	Students can able to Record, observe and analyse the characteristics of UJT and UJT as a relaxation oscillator.

Credit: 1 **Max. Marks: 50 (IA:30, ETE:20)**

0L+0T+2P

S.No.	Content	CO map
1	Plot gain-frequency characteristics of BJT amplifier with and without negative feedback in the emitter circuit and determine bandwidths, gain bandwidth products and gains at 1 kHz with and without negative feedback.	CO23421.1
2	Study of series and shunt voltage regulators and measurement of line and load regulation and ripple factor.	CO23421.2
3	Plot and study the characteristics of small signal amplifier using FET.	CO23421.1
4	Study of push pull amplifier. Measure variation of output power & distortion with load.	CO23421.1
5	Study Wein bridge oscillator and observe the effect of variation in R & C on oscillator frequency.	CO23421.3
6	Study transistor phase shift oscillator and observe the effect of variation in R & C on oscillator frequency and compare with theoretical value.	CO23421.3
7	Study the following oscillators and observe the effect of variation of C on oscillator frequency: Hartley (b) Colpitts.	CO23421.4
8	To plot the characteristics of UJT and UJT as relaxation.	CO23421.5

3EE4-22: Electrical Machines-I Lab

CO23422.1	Determine the parameters of equivalent circuit for transformer for different tests (open circuit & short circuit test, sumpner's back to back test) and its performance parameters i.e. voltage regulation and efficiency. Apply direct loading method on single phase transformer and determine its efficiency and voltage regulation.
CO23422.2	Determine the parameters of equivalent circuit for delta-delta connected three phase transformer through heat run test. Verify the condition of parallel operation of transformer for load sharing analysis.
CO23422.3	Convert three phase to two phase supply using scott connection.
CO23422.4	Control the speed of dc shunt motor for above the base speed and below the base speed using field current control and armature voltage control methods respectively and plot their performance characteristic(speed versus field current/ armature voltage).
CO23422.5	Determine the efficiency of dc shunt machine considering motoring mode by Swinburne's test. Feed generator output to motor at various loads & obtain efficiencies of both in Hopkinson test.

Credit-2 **Max. Marks :100 (IA:60,ETE:40)**
0L+0T+4P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	1) To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency.	CO23422.1
2	2) To perform sumpner's test on two identical 1-phase transformers and find their efficiency & parameters of the equivalent circuit	CO23422.5
3	3) To determine the efficiency and voltage regulation of a single-phase transformer by direct loading	CO23422.3
4	4) To perform the heat run test on a delta/delta connected 3-phase transformer and determine the parameters for its equivalent circuit.	CO23422.4
5	5) To perform the parallel operation of the transformer to obtain data to study the load sharing	CO23422.5
6	6) Separation of no load losses in single phase transformer	CO23422.2
7	7) To study conversion of three-phase supply to two-phase supply using Scott-Connection.	CO23422.3
8	8) Speed control of D.C. shunt motor by field current control method & plot the curve for speed verses field current.	CO23422.2
9	9) Speed control of D.C. shunt motor by armature voltage control method & plot the curve for speed verses armature voltage.	CO23422.5
10	10) To determine the efficiency at full load of a D.C shunt machine considering it as a motor by performing Swinburne's test.	CO23422.2
11	11) To perform Hopkinson's test on two similar DC shunt machines and hence obtain their efficiencies at various loads	CO23422.3

3EE4-23: Electrical Circuit Design Lab

CO23423.1	Students can able to introduce about data sheet reading and soldering and desoldering process in lab.
CO23423.2	Students can able to Simulate characteristic of different-different switches and circuit Validate on Bread Board or PCB with different –different mode in lab.
CO23423.3	Students can able to introduce with different types of sensors with measure real time quantities and their implementation in different processes and hardware implementation of control circuit on by sensors in lab.
CO23423.4	Students can able to Hardware implementation of different control circuit on Bread Board or PCB in lab.
CO23423.5	Students can able to Simulate different circuits (frequency divider, battery voltage level indicator, buck-boost circuit) and validate their characteristic on breadboard or PCB.

Credit-2 **Max. Marks :100 (IA:60,ETE:40)**
0L+0T+4P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Introduction to Datasheet Reading.	CO23423.1
2	Introduction to Soldering - Desoldering process and tools.	CO23423.1
3	Simulate characteristic of BJT and UJT. Validate on Bread Board or PCB.	CO23423.2
4	Simulate Bridge Rectifier Circuit and validate on Bread Board or PCB. a) Half Bridge. b) Full Bridge.	
5	Simulate Regulated Power Supply and validate on Bread Board or PCB. a) Positive Regulation (03 Volt to 15 Volt). b) Negative Regulation (03 Volt to 15 Volt). c) 25 Volt, 1–10 A Power Supply.	CO23423.2
6	Simulate Multivibrator circuit using IC 555 and BJT separately. Validate on Bread Board or PCB. a) Astable Mode. b) Bistable Mode. c) Monostable Mode.	CO23423.2
7	Introduction to Sensors to measure real time quantities and their implementation in different processes. (Proximity, Accelerometer, Pressure, Photo-detector, Ultrasonic Transducer, Smoke, Temperature, IR, Color, Humidity, etc.).	CO23423.3
8	Hardware implementation of temperature control circuit using Thermistor.	CO23423.4
9	Simulate Frequency divider circuit and validate it on Bread Board or PCB.	
10	Hardware implementation of 6/12 V DC Motor Speed Control (Bidirectional)	CO23423.4
11	Simulate Buck, Boost, Buck-Boost circuit and validate on Bread Board or PCB.	CO23423.5
12	Simulate Battery Voltage Level Indicator Circuit and validate on Bread Board or PCB	CO23423.5

IV SEMESTER

SUBJECT: 4EE2-01: Biology

CO24201.1	Improve the overall scenario by learning the correlation of Biology with engineering majors, as biological systems are considered to be very much efficient.
CO24201.2	Use the disciplinary skills towards designing or improving the biological systems and engineering systems in future by getting a basic understanding of genetics and classifications.
CO24201.3	Assist to the development of new systems like nanotechnology, bioelectronics, smart electronics and artificial intelligence by having an understanding of fundamentals of biology in relation to biomolecules, enzymes, Proteins etc.
CO24201.4	Develop an understanding of analogies between biological and electronic substrates, information processes and transport mechanisms.
CO24201.5	Explore biomolecules and DNA based finite state machines for conducting simple computing logics by understanding the basics of Biological information theory

Credit-2 **Max. Marks : 100 (IA:20,ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	Introduction: Objective, scope and outcome of the course.	**1**
2	Introduction: Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Whitened to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.	**1**
3	Classification: Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure prokaryotes or eukaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotripsy (d) Ammonia excretion- amino telic, uricotelic, ureotelic (e) Habitata acquatic orterrestrial (e) Molecular taxonomy- three major kingdoms of life. A givenorganism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli,S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus	**3**

4	Genetics: Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences". Mendel's laws, Concept of segregation andindependent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.	**3**
5	Biomolecules: Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one canimagine. Molecules of life. In this context discuss monomeric units andpolymeric structures. Discuss about sugars, starch and cellulose. Aminoacids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	**3**
6	Enzymes: Purpose: To convey that without catalysis life would not have existed on earth. Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic	**3**
7	Information Transfer: Purpose: The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	**3**
8	Macromolecular analysis: Purpose: To analyse biological processes at there ductionistic level. Proteins- structure and function. Hierarch in proteinstructure. Primary secondary, tertiary and quaternary structure. Proteinsas enzymes, transporters, receptors and structural elements	**4**
9	Metabolism: Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	**4**
10	Microbiology: Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics	**3**
	Total	**40**

Suggested Readings:

1. Russel.P.J., 1998. Genetics. The Benjamin/Cumming Publishing company. Prescott. H. and Klein. 2000. Microbiology. McGraw Hill.
2. Karp, G. 2010. Cell and Molecular biology. John Wiley and sons.

SUBJECT: 4EE1-03: Managerial Economics and Financial Accounting

CO24103.1	Understand the Economic Concepts and Conventions and will Realize the Need for managerial concepts.
CO24103.2	Understand the practical application of demand and supply.
CO24103.3	Will be able to analyze the how to increase demand of different companies
CO24103.4	Students will be able to Identify economic problems in competitive market.
CO24103.5	Students will be able to understand the concept of financial accounting

Credit-2 **Max. Marks : 100 (IA:20,ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Basic economic concepts-** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement	3
3	**Demand and Supply analysis-** Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	5
4	**Production and Cost analysis-** Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	5
5	**Market structure and pricing theory-** Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	4
6	**Financial statement analysis-** Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds- flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	8
	TOTAL	26

Suggested Books:

1. Aryasri: Managerial Economics and Financial Analysis, 2/e, TMH, 2009.
2. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2009.

SUBJECT: 4EE3-04: Electronic Measurement and Instrumentation

CO24304.1	Comprehend the working principle of measuring instruments, classify the instruments, list their applications, and analyze the testing and calibration of single-phase energy meter by phantom loading.
CO24304.2	Identify measuring instruments, their use, peculiar errors associated with instruments and list minimization techniques of such errors.
CO24304.3	Elaborate the working principle, constructional features and applications of DC and AC potentiometers.
CO24304.4	Categorize the various types of resistances used for measurement purposes and analyze their functional characteristics as well as differences.
CO24304.5	Elucidate the working principle, constructional features, design elements and characteristics of various AC bridges used for measurement purposes and describe their applications

Credit-2 **Max. Marks : 100 (IA:20,ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	**Measuring Instruments:** Moving coil, moving iron, electrodynamic and induction instruments-construction, operation, torque equation and errors. Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy. Errors in wattmeter and energy meter and their compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading.	4
3	**Polyphase Metering**: Blondel's Theorem for n-phase, p-wire system. Measurement of power and reactive kVA in 3-phase balanced and unbalanced systems: One-wattmeter, two-wattmeter and three-wattmeter methods. 3-phase induction type energy meter. Instrument Transformers: Construction and operation of current and potential transformers. Ratio and phase angle errors and their minimization. Effect of variation of power factor, secondary burden and frequency on errors. Testing of CTs and PTs. Applications of CTs and PTs for the measurement of current, voltage, power and energy	6
4	**Potentiometers: Construction**, operation and standardization of DC potentiometers– slide wire and Crompton potentiometers. Use of potentiometer for measurement of resistance and voltmeter and ammeter calibrations. Volt ratio boxes. Construction, operation and standardization of AC potentiometer in-phase and quadrature potentiometers. Applications of AC potentiometers.	5
5	**Measurement of Resistances**: Classification of resistance. Measurement of medium resistances – ammeter and voltmeter method, substitution method, Wheatstone bridge method. Measurement of low resistances – Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Price's Guardwire method. Measurement of earth resistance.	6
6	**AC Bridges**: Generalized treatment of four-arm AC bridges. Sources and detectors. Maxwell's bridge, Hay's bridge and Anderson bridge for selfinductance measurement. Heaviside's bridge for mutual inductance measurement. De Sauty Bridge for capacitance measurement. Wien's bridge for capacitance and frequency measurements. Sources of error in bridge measurements and precautions. Screening of bridge components. Wagner earth device.	6
	Total	**28**

Suggested Readings:

1 H. S. Kalsi, Electronic Inst. & Measurement, TMH 2004
2 Morris, Electrical Measurements & Instrumentation, ELSEVIER 1997

SUBJECT: 4EE4-05: Electrical Machines – II

CO24405.1	Students will able to Understand choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.
CO24405.2	Students will able to know the Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers.
CO24405.3	Student will be able to know the Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines
CO24405.4	Student will be able to know the Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods.
CO24405.5	Students can understand Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Credit:3 **Max.Marks:150(IA:30,ETE:120)**
3L+0T+0P **EndTermExam:3Hours**

SN	CONTENTS	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	4
2.	**Major Consideration for Design;** Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.	8
3.	**Transformers:** Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers	8
4.	**Induction Motors:** Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.	8
5.	**Synchronous Machines;** Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature de- sign, armature parameters, estimation of air gap length, design of ro- tor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.	8
6.	**Computer aided Design (CAD):** Limitations (assumptions) of traditional designs, need for CAD analy- sis, synthesis and hybrid methods, design optimization methods, va- riables, constraints and objective function, problem formulation. In- troduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.	6
	Total	41

Suggested Readings:

1 V.N.Mittel 2009
2 A.K.Sahani 2009
3 Siraj Ahmad 2011

SUBJECT 4EE4-06: Power Electronics

CO24406.1	Students will able to Understand the Power switching devices and its chracteristics.
CO24406.2	Students will able to know the behaviors of all types Thyristor rectifiers and its mathematical equations.
CO24406.3	Student will be able to know the behavior DC-DC buck converter and all its characteristics with mathematical equations.
CO24406.4	Student will be able to know the behaviors of DC-DC boost converter all its characteristics with mathematical equations..
CO24406.5	Students can understand all types of operations, waveforms and obtain mathematical equation of Single-phase voltage source inverter and Three-phase voltage source inverter.

Credit-3 **Max. Marks : 150 (IA:30,ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
SN	**CONTENTS**	
1	**Introduction:** Objective, scope and outcome of the course	**1**
2	**Power switching devices:** Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.	**5**
3	**Thyristor rectifiers:** Single-phase half-wave and full-wave rectifiers, Single-phase full- bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.	**6**
4	**DC-DC buck converter:** Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.	**5**
5	**DC-DC boost converter:** Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.	**5**
6	**Single-phase voltage source inverter;** Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.	**10**
7	**Three-phase voltage source inverter:** Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation.	**8**
	Total	**40**

Suggested Readings:

1 M. D. Singh and K. B. Khanchandani: Power Electronics 2/e, MGH. 2008
2 M. H. Rashid: Power Electronics, Circuits Devices and Applications, Pearson. 2011

SUBJECT: 4EE4-07: Signals and Systems

CO24407.1	Comprehend the objective of signals and systems', the scope and outcome of the course.
CO24407.2	Apply Signals and systems as seen in everyday life, and in various branches of engineering and science.
CO24407.3	Investigate Behavior of continuous and discrete (time) Linear Time Invariant systems.
CO24407.4	Grasp the knowledge of Fourier, Laplace and z- Transforms in continuous as well as in discrete time.
CO24407.5	Acquire the concept of Sampling and Reconstruction theorem.

Credit-3 **Max. Marks : 150 (IA:30,ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
SN	**CONTENTS**	
1	Introduction: Objective, scope and outcome of the course.	**1**
2	Introduction to Signals and Systems: Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.	**6**
3	Behavior of continuous and discrete-time LTI systems: Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multiinput, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.	**14**
4	Fourier, Laplace and z- Transforms: Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.	**12**
5	Sampling and Reconstruction: The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.	**8**
	Total	**41**

Suggested Readings:

1. Signals And Systems, Oppenheim, Willsky, Nawab, PHI.(1992)
2. Signals And Systems M J Roberts, Mc-Graw Hill.(2004)

SUBJECT: 4EE4-08: Digital Electronics

CO24408.1	Develop the understanding of number system and its application in digital electronics and compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.
CO24408.2	Develop and analyse of K-map to solve the Boolean function to the simplest form for the implementation of compact digital circuits and Design various combinational circuits using gates.
CO24408.3	Design various sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.
CO24408.4	Apply the fundamental knowledge of analog and digital electronics to get different types analog to digitalized signal and vice-versa converters in real world with different changing circumstances.
CO24408.5	Assess the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real world application

Credit-2 **Max. Marks : 100 (IA:20,ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	Introduction: Objective, scope and outcome of the course	1
2	Fundamentals of Digital Systems and logicfamilies: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic	4
3	Combinational DigitalCircuits: Standard representation for logic functions, Kmap representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, DeMultiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization	6
4	Sequential circuits and systems: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters	6
5	A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	4

6	A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	**7**
	TOTAL	**28**

Suggested Readings:

1 Herbert Taub, Donald L. Schilling, Digital Integrated Electronics, TMH 2008
2 M. Morris Mano, Digital Logic and Computer Design, Pearson Edu. 2014

SUBJECT: 4EE4-21: Electrical Machines - II Lab

CO24421.1	Students can able to Study two 3-phase induction motor in cascade and study their speed control.
CO24421.2	Students can able to Study no load and blocked rotor test on a 3-phase induction motor and determine the parameters of its equivalent circuits.
CO24421.3	Students can able to the voltage regulation of a 3-phase alternator by direct loading.
CO24421.4	Students can able to understand determine the voltage regulation of a 3-phase alternator by synchronous impedance method.
CO24421.5	Students can able to determine the voltage regulation of a 3-phase alternator by synchronous impedance method.

Credit-2 **Max. Marks :100 (IA:60,ETE:40)**
0L+0T+4P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Tostudyvarioustypesofstartersusedfor3phaseinductionmotor.	CO24421.1
2	To connect two 3-phase induction motor in cascade and study their speedcontrol.	CO24421.2
3	To perform load test on 3-phase induction motor and calculate torque, output power, input power, efficiency, input power factor and slip for various loadsettings	CO24421.3
4	To perform no load and blocked rotor test on a 3-phase induction motor and determine the parameters of its equivalentcircuits.	CO24421.2
5	Draw the circle diagram and compute the following (i) Max. Torque (ii) Current(iii)slips(iv)p.f.(v)Efficiency.	CO24421.4
6	Speedcontrolof3-ΦInductionMotor	CO24421.5
7.	ToplottheO.C.C.&S.C.C.ofanalternator.	CO24421.3
8.	To determine Zs , Xd and Xq by slip test, Zero power factor (ZPF)/Potier reactancemethod.	CO24421.4
9.	To determine the voltage regulation of a 3-phase alternator by direct loading.	CO24421.5
10	To determine the voltage regulation of a 3-phase alternator by synchronous impedancemethod.	CO24421.5
11	To synchronize an alternator across the infinite bus and control load sharing.	CO24421.2

4EE4-22: Power Electronics Lab

CO24422.1	Students can able to Study the comparison of following power electronics devices with various factors and Find V-I characteristics of different switches in lab.
CO24422.2	Students can able to Study and test different circuit parameter, test firing circuits for SCR-R, RC and UJT and draw waveforms in lab.
CO24422.3	Students can able to draw UJT static emitter characteristics, study the variation in peak point and valley point, and
CO24422.4	Students can able to understand working of different rectifier circuit and control circuit with waveform.
CO24422.5	Students can able to develop control the speed of a dc motor using single-phase half controlled bridge rectifier and full controlled bridge rectifier and plot armature voltage versus speed characteristics.

Credit: 2 **Max. Marks: 100(IA: 60, ETE: 40)**

0L+0T+4P

SN	NAME OF EXPERIMENT	CO Mapped
1	Study the comparison of following power electronics devices regarding ratings, performance characteristics and applications: Power Diode, Power Transistor, Thyristor, Diac, Triac, GTO, MOSFET, MCT and SIT.	CO24422.1
2	Determine V-I characteristics of SCR and measure forward breakdown voltage, latching and holding currents.	CO24422.1
3	Find V-I characteristics of TRIAC and DIAC.	CO24422.1
4	Find output characteristics of MOSFET and IGBT.	CO24422.1
5	Find transfer characteristics of MOSFET and IGBT.	CO24422.1
6	Find UJT static emitter characteristics and study the variation in peak point and valley point.	CO24422.3
7	Study and test firing circuits for SCR-R, RC and UJT firing circuits.	CO24422.2
8	Study and test 3-phase diode bridge rectifier with R and RL loads. Study the effect of filters.	CO24422.4
9	Study and obtain waveforms of single-phase half wave controlled rectifier with and without filters. Study the variation of output voltage with respect to firing angle.	CO24422.4
10	Study and obtain waveforms of single-phase half controlled bridge rectifier with R and RL loads. Study and show the effect of freewheeling diode.	CO24422.4
11	Study and obtain waveforms of single-phase full controlled bridge converter with R and RL loads. Study and show rectification and inversion operations with and without freewheeling diode.	CO24422.5
12	Control the speed of a dc motor using single-phase half controlled bridge rectifier and full controlled bridge rectifier. Plot armature voltage versus speed characteristics.	CO24422.5

4EE4-23: Digital Electronics Lab

CO24423.1	Develop the understanding of number system and its application in digital electronics and compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.
CO24423.2	Develop and analyse of K-map to solve the Boolean function to the simplest form for the implementation of compact digital circuits and Design various combinational circuits using gates.
CO24423.3	Design various sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.
CO24423.4	Apply the fundamental knowledge of analog and digital electronics to get different types analog to digitalized signal and vice-versa converters in real world with different changing circumstances
CO24423.5	To understand different type of Gates

Credit-1 **Max. Marks :50 (IA:30,ETE:20)**
0L+0T+2P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	To verify the truth tables of basic logic gates: AND, OR, NOR, NAND, NOR. Also to verify the truth table of Ex-OR, Ex-NOR (For 2, 3, & 4 inputs using gates with 2, 3, & 4 inputs).	CO24423.5
2	To verify the truth table of OR, AND, NOR, Ex-OR, Ex-NOR realized using NAND & NOR gates.	CO24423.1
3	To realize an SOP and POS expression.	CO24423.2
4	To realize Half adder/ Subtractor & Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables.	CO24423.2
5	To realize a 4-bit ripple adder/ Subtractor using basic half adder/ Subtractor & basic Full Adder/ Subtractor.	CO24423.3
6	To verify the truth table of 4-to-1 multiplexer and 1-to-4 demultiplexer. Realize the multiplexer using basic gates only. Also to construct and 8- to-1 multiplexer and 1-to-8 demultiplexer using blocks of 4-to-1 multiplexer and 1-to-4 demultiplexer.	CO24423.3
7	Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL -312 seven segment display.	CO24423.4
8.	Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table.	CO24423.4
9.	Construct a divide by 2,4& 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop.	CO24423.4
10	Perform input/output operations on parallel in/Parallel out and Serial in/Serial out registers using clock. Also exercise loading only one of multiple values into the register using multiplex	CO24423.4

4EE4-24: Measurement Lab

CO24424.1	Explain working and applications of C.R.O., Digital Storage C.R.O., C.R.O. Probes, Meggar, Tong-tester, P.F. Meter and Phase Shifter.
CO24424.2	Measure power and power factor in 3-phase load by Two-wattmeter method.
CO24424.3	Calibrate an ammeter using DC slide wire potentiometer and Calibrate a voltmeter using Crompton potentiometer.
CO24424.4	Measure low resistance by Crompton potentiometer, Kelvin's double bridge, and measure earth resistance using fall of potential method.
CO24424.5	Calibrate a single-phase energy meter by phantom loading at different power factors. Calculate self-inductance using Anderson's bridge

Credit-1 **Max. Marks :50 (IA:30,ETE:20)**
0L+0T+2P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes.	CO24424.1
2	Study working and applications of Meggar, Tong-tester, P.F. Meter and Phase Shifter.	
3	Measure power and power factor in 3-phase load by (i) Two-wattmeter method and (ii) One-wattmeter method	CO24424.2
4	Calibrate an ammeter using DC slide wire potentiometer.	CO24424.3
5	Calibrate a voltmeter using Crompton potentiometer.	CO24424.3
6	Measure low resistance by Crompton potentiometer.	CO24424.3
7	Measure Low resistance by Kelvin's double bridge.	CO24424.4
8.	Measure earth resistance using fall of potential method.	CO24424.4
9.	Calibrate a single-phase energy meter by phantom loading at different power factors.	CO24424.5
10	Measure self-inductance using Anderson's bridge.	CO24424.5

III YEAR CURRICULUM
V SEMESTER

SUBJECT: 5EE3-01: ELECTRICAL MATERIALS

CO35301.1	Learn about the concepts of Bonding and types of solids, Crystalline state and their defects, Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall effect.
CO35301.2	Acquire knowledge of Dielectric Properties of Insulators in Static and Alternating field, Properties of Ferro-Electric materials, Polarization, Piezoelectricity, Frequency dependence of Electronic and Ionic Polarizability, Complex dielectric constant of non-dipolar solids, dielectric losses.
CO35301.3	Apply concepts of Magnetization of matter, Magnetic Material Classification, Ferromagnetic Origin, Curie-Weiss Law, Soft and Hard Magnetic Materials, Superconductivity and its origin, Zero resistance and Meissner Effect, critical current density.
CO35301.4	Acquire knowledge of Conductivity of metals Ohm's law and relaxation time of electrons, collision time and mean free path, electron scattering and resistivity of metals.
CO35301.5	Acquire knowledge of Classification of semiconductors, semiconductor conductivity, temperature dependence, Carrier density and energy gap, Trends in materials used in Electrical Equipment.

Credit-2 **Max. Marks : 100 (IA:20,ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Elementary Materials Science Concepts:** Bonding and types of solids, Crystalline state and their defects, Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall effect.	5
3	**Dielectric Properties of Insulators in Static and Alternating field:** Dielectric constant of mono-atomic gases, poly-atomic molecules and solids, Internal field in solids and liquids, Properties of Ferro-Electric materials, Polarization, Piezoelectricity, Frequency dependence of Electronic and Ionic Polarizability, Complex dielectric constant ofnon-dipolar solids, dielectric losses	8
4	**Magnetic Properties and Superconductivity;** Magnetization of matter, Magnetic Material Classification, Ferromagnetic Origin, Curie-Weiss Law, Soft and Hard Magnetic Materials, Superconductivity and its origin, Zero resistance and Meissner Effect, critical current density.	5
5	**Conductivity of metals;** Ohm's law and relaxation time of electrons, collision time and mean free path, electron scattering and resistivity of metals.	4
6	**Semiconductor Materials:** Classification of semiconductors, semiconductor conductivity, temperature dependence, Carrier density and energy gap, Trends in materials used in Electrical Equipment.	4
	Total	28

Suggested Readings:

1. Kasap, Principles of Electronic Materials and Devices, TMH (2005).
2. Robert M Rose, Lawrence A. Shepard and Jhon Wulff, The structure and peroperties of materials vol.4 (Electronic properties), Willey Eastern University press. (2011

SUBJECT: 5EE4-02: POWER SYSTEM - I

CO35402.1	To gain the knowledge about basics of power system
CO35402.2	To Study of various components of power system
CO35402.3	To Knowledge about Over-voltages and Insulation Requirements Generation in power system
CO35402.4	To Study the Fault Analysis and Protection in power Systems
CO35402.5	To gain the knowledge about DC Transmission & Renewable Energy Systems

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

UNIT NO.	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Basic Concepts** : Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis ofsimple three-phase circuits. Power Transfer in AC circuits and Reactive Power.	4
3	**Power System Components:** Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines. Transformers: Three-phase connections and Phase-shifts. Threewinding transformers, autotransformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent of three-phase transformers. Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and subtransient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.	15
4	**Over-voltages and Insulation Requirements Generation of Over-voltages:** Lightning and Switching Surges. Protection against Overvoltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.	4
5	**Fault Analysis and Protection Systems** Method of Symmetrical Components (positive, negative and zero se-quences). Balanced and Unbalanced Faults. Representation of genera-tors, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding**.** Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, di-rectional, distance protection, differential protection) and their appli-cation.	9

6	**Introduction to DC Transmission & Renewable Energy Systems** DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmis-sion. Solar PV systems: I-V and P-V characteristics of PV panels, pow-er electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid	9
	Total	42

Suggested Readings:

1. John J. Grainger, William D. Stevenson, Gary W. Chang · 2016
2. D P Kothari, I J Nagrath · 2019
3. R. Nageswara Rao/kogent Solutions · 2008
4. Juergen Schlabbach, Karl-Heinz Rofalski · 2014

5EE4-03: CONTROL SYSTEM

CO35403.1	Students will able to Understand the Transfer function models of linear time-invariant systems.
CO35403.2	Students will able to know the Standard test signals. Time response of first and second order systems for standard test inputs
CO35403.3	Student will be able to know the Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion.
CO35403.4	Student will be able to know the Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.
CO35403.5	Students can understand Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations.

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Introduction to control problem:** Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra	5
3	**Time Response Analysis:** Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.	6
4	**Frequency-response analysis:** Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist crite- rion–gain and phase margin. Closed loop frequency response.	5
5	**Introduction to Controller Design:** Stability, steady-state accuracy, transient accuracy, disturbance re- jection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers	5
6	**State variable Analysis:** Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.	10
7	**Introduction to Optimal Control and Nonlinear Control** Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis	8
	Total	40

Suggested Readings

1 I.J.Nagrath 2008
2 M.Gopal 2011

SUBJECT: 5EE4-04: MICROPROCESSOR

CO35404.1	Acquire the knowledge of fundamentals of microprocessors and microcontrollers architecture and comparison between them.
CO35404.2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and instructions set of the target microcontroller.
CO35404.3	Understand the memory expansion and interfacing of peripheral device such as ADC, DAC, timers, counters, etc.
CO35404.4	Acquire the knowledge of synchronous and asynchronous communication and interfacing to protocols like blue-tooth, etc.
CO35404.5	Design electrical circuitry to the microcontroller I/O ports in order to interface the processor to external devices

Credit-3 **Max. Marks : 150 (IA:30,ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Fundamentals of Microprocessors:** Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.	7
3	**The 8051 Architecture:** Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data andProgram Memory, Timing diagrams and Execution Cycles.	8
4	**nstruction Set and Programming:** Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools..	8
5	**Memory and I/O Interfacing;** Memory and I/O expansion buses, control signals, memory waitstates. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.	6
6	**External Communication Interface:** Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.	6
7	**Applications:** LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing	5
	Total	41

Suggested Readings:

1. Microprocessors Architecture, Programming &Application, Ramesh S. Gaonkar, (2000)
2. A Textbook of Microprocessors and Microcontrollers, R.S. Kaler I.K International Publishing House Pvt. Ltd.

5EE4-05: ELECTRICAL MACHINE DESIGN

CO35405.1	Students will able to Understand choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.
CO35405.2	Students will able to know the Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers.
CO35405.3	Student will be able to know the Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines
CO35405.4	Student will be able to know the Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods.
CO35405.5	Students can understand Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Credit:3 **Max.Marks:150(IA:30,ETE:120)**
3L+0T+0P **EndTermExam:3 Hours**

SN	CONTENTS	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	4
2.	**Major Consideration for Design:** Major considerations in electrical machine design, electrical engineer- ing materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.	8
3.	**Transformers:** Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers	8
4.	**Induction Motors:** Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of ro- tor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.	8
5.	**Synchronous Machines;** Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature de- sign, armature parameters, estimation of air gap length, design of ro- tor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.	8
6.	**Computer aided Design (CAD):** Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.	6
	Total	41

Suggested Readings:

1 V.N.Mittel 2009
2 A.K.Sahani 2009
3 Siraj Ahmad 2011

5EE5-11: RESTRUCTURED POWER SYSTEM

CO35511.1	Student will be able to Understand the Introduction to restructuring of power industry and Fundamentals of Economics.
CO35511.2	Student will be able to know the behaviors of The Philosophy of Market Models.
CO35511.3	Student will be able to know the behavior of Transmission Congestion Management.
CO35511.6	Student will be able to know the behaviors of Ancillary Service Management.
CO35511.6	Students can understand Pricing of transmission network usage and Market power.

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	HOURS
1	**Introduction :** Objective, scope and outcome of the course.	01
2	**Introduction to restructuring of power industry;** Reasons for restructuring of power industry; Understanding the re- structuring process, Entities involved, The levels of competition, The market place mechanisms, Sector-wise major changes required; Reasons and objectives of deregulation of various power systems across the world.	05
3	**Fundamentals of Economics;** Consumer and suppliers behavior, Total utility and marginal utility, Law of diminishing marginal utility, Elasticity of demand and supply curve, Market equilibrium, Consumer and supplier surplus, Global welfare, Deadweight loss	04
4	**The Philosophy of Market Models** Monopoly model, Single buyer model, Wholesale competition model, Retail competition model, distinguishing features of electricity as a commodity, Four pillars of market design, Cournot, Bertrand and Stackel berg competition model	05
5	**Transmission Congestion Management:** Transfer capability, Importance of congestion management, Ef- fects of congestion, Classification of congestion management me- thods, ATC, TTC, TRM, CBM, ATC calculation using DC and AC model, Nodal pricing, Locational Marginal Prices (LMPs), Implications of nodal pricing, Price area congestion management Capacity allevia- tion methods, Re-dispatching, Counter-trade, Curtailment	05
6	**Ancillary Service Management:** Type and start capability service, Provisions of ancillary services, Markets for ancillary services, Co-optimization of energy and reserve services, Loss of opportunity cost, International practices of ancillary services.	03
7	**Pricing of transmission network usage and Market power** Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing, Rolled-in transmission pricing paradigm. Attributes of a perfectly competitive market, The firm's supply decision under perfect competition, Imperfect competi- tion, Monopoly, Oligopoly. Effect of market power, Identifying market power, HHI Index, Entropy coefficient, Lerner index.	05
		28

Suggested Readings:

1. Restructuring Electric Power Systems Hardcover – 30 August 2018 by S.K. Gupta (Author)

5EE4-21: POWER SYSTEM - I LAB

CO35421.1	To study the Generating station and Distribution system Design
CO35421.2	To knowledge about load forecasting and power circle diagrams
CO35421.3	To study about the substations and high voltage testing of electrical equipment's.
CO35421.4	To study of EHV transmission line and filtration ,Treatment, dielectric strength of transformer oil.
CO35421.5	To knowledge about Schering bridge and Flash over voltage

Credit-1 **Max. Marks :50 (IA:30,ETE:20)**
0L+0T+2P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1.	Generating station design: Design considerations, basic schemes and single line diagram of hydro, thermal, nuclear and gas power plants. Electrical equipment for power stations..	CO35421.1
2.	Distribution system Design: Design of feeders & distributors. Calculation of voltage drops in distributors. Calculation of conductor size using Kelvin's law.	CO35421.1
3.	Study of short term, medium term and long term load forecasting.	CO35421.2
4.	Sending end and receiving end power circle diagrams.	CO35421.2
5.	Substations: Types of substations, various bus–bar arrangements. Electrical equipment for substations.	CO35421.3
6.	Study high voltage testing of electrical equipment: line insulator, cable, bushing, power capacitor, and power transformer.	CO35421.3
7.	Design an EHV transmission line	CO35421.4
8.	Study filtration and Treatment of transformer oil.	CO35421.4
9.	Determine dielectric strength of transformer oil.	CO35421.4
10.	Determine capacitance and dielectric loss of an insulating material using Schering bridge.	CO35421.5
11.	Flash over voltage testing of insulators	CO35421.5

5EE4-22: CONTROL SYSTEM LAB

CO35422.1	Students can able to Study step response of a given TF and system in state-space. Take different values of damping ratio and w_n natural undamped frequency.
CO35422.2	Students can able to Study the frequency response of following compensating Networks, plot the graph and final out corner frequencies.
CO35422.3	Students can able to design and analyses Tow- Thomas biquadfilter.
CO35422.4	Students can able to understand design and calculate Kp, Ki for PI controller.
CO35422.5	Students can able to design PID controller and also calculate Kp,Ki,Kd for it.

Credit-1 **Max. Marks :50 (IA:30,ETE:20)**
0L+0T+2P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	(a) Plot step response of a given TF and system in state-space. Take different values of damping ratio and w_n natural undamped frequency. (b) Plot ramp response.	CO35422.1
2	To design 1st order R-C circuits and observe its response with the following inputs and trace the curve. Step Ramp (c)Impulse	CO35422.2
3	To design 2nd order electrical network and study its transient response for step input and following cases .Under damped system Over damped System. Critically damped system.	CO35422.3
4	To Study the frequency response of following compensating Networks, plot the graph and final out corner frequencies. (a) Leg Network Lead Network. (c) Leg-lead Network.	CO35422.2
5	Draw the bode plot in real time for a Non-Inverting amplifier.	CO35422.4
6	Draw the bode plot in real time for an Inverting amplifier.	CO35422.5
7.	Draw the bode plot for second order transfer function.	CO35422.3
8.	Draw the bode plot for first order transfer function.	CO35422.4
9.	Design and analyses Tow- Thomas biquadfilter.	CO35422.5
10	Design and calculate Kp, Ki for PIcontroller.	CO35422.5
11	Design PID controller and also calculate Kp,Ki,Kd for it.	CO35422.2

5EE4-23: MICROPROCESSOR LAB

CO35423.1	Describe hardware, functions, memory structure and operation of 8085 Microprocessor kit.
CO35423.2	Perform integer division: (1) 8-bit by 8-bit (2) 16-bit by 8-bit, multiply two 8–bit numbers, reverse bits of an 8-bit number, and perform conversion BCD to ASCII as well as BCD to hexadecimal.
CO35423.3	Transfer a block of data in memory to another place in memory, Transfer block to another location in reverse order, and Sort array in: (1) Ascending order (2) Descending order.
CO35423.4	Search a number in an array and insert a number at correct place in a sorted array. Write a Program to generate and sum 15 Fibonacci numbers, Program for rolling display of message “India”, “HELLO”.
CO35423.5	Transfer data on output port 8155 & 8255 & implement disco light, running light, and sequential lights, transfer Parallel data between two DYNA-85 kit using 8253 ports

Credit-1 **Max. Marks :50 (IA:30,ETE:20)**
0L+0T+2P **End Term Exam: 2 Hours**

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Study the hardware, functions, memory structure and operation of 8085-Microprocessor kit.	CO35423.1
2	Program to perform integer division: (1) 8-bit by 8-bit (2) 16-bit by 8-bit.	CO35423.2
3	Transfer of a block of data in memory to another place in memory	CO35423.3
4	Transfer of black to another location in reverse order.	CO35423.3
5	Searching a number in an array.	CO35423.4
6	Sorting of array in: (1) Ascending order (2) Descending order.	CO35423.4
7	Finding party of a 32-bit number.	CO35423.4
8.	Program to perform following conversion (1) BCD to ASCII (2) BCD to hexadecimal.	CO35423.4
9.	Program to multiply two 8–bit numbers	CO35423.4
10	Program to generate and sum 15 Fibonacci numbers.	CO35423.4
11	Program for rolling display of message “India”, “HELLO”.	CO35423.4
12	To insert a number at correct place in a sorted array.	CO35423.4
13	Reversing bits of an 8-bit number.	CO35423.4
14	Fabrication of 8-bit LED interfaces for 8085 kit through 8155 and 8255.	CO35423.5
15	Data transfer on output port 8155 & 8255 & implementation of disco light, running light, and sequential lights on the above mentioned hardware.	CO35423.5
16	Parallel data transfer between two DYNA-85 kit using 8253 ports.	CO35423.5
17	Generation of different waveform on 8253/8254 programmable timer.	CO35423.5

5EE4-24: SYSTEM PROGRAMMING LAB

CO35424.1	Students can able to Studybasics of MATLAB matrices and vectors, matrix and array operations
CO35424.2	Students can able to imulink, problems based on simulink. (All contents is to be covered with tutorialsheets).
CO35424.3	Students can able tothe synchronize an alternator across the infinite bus and control load sharing.
CO35424.4	Students can able to understand determine Simulate Three phase Half wave diode rectifier with RLload.
CO35424.5	Students can able to determine Simulate Torque- speed characteristics of inductionmotor..

Credit-1 **Max. Marks :50 (IA:30,ETE:20)**
0L+0T+2P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Basics of MATLAB matrices and vectors, matrix and array operations, Saving and loading data, plotting simple graphs, scripts and functions, Script files, Function files, Global Variables, Loops, Branches, Control flow, Advanced data objects, Multi- dimensional matrices, Structures, Applications in linear algebra curve fitting and interpolation. Numerical integration, Ordinary differential equation. (All contents is to be covered with tutorial sheets)	CO35424.1
2	Write a MATLAB program for designing Rheostat.	CO35424.2
3	Idea about simulink, problems based on simulink. (All contents is to be covered with tutorial sheets)	CO35424.3
4	Write a program to generate Machine Op-code table using two pass Assembler.	CO35424.2
5	Single Phase Full Wave Diode Bridge Rectifier With LC Filter	CO35424.4
6	Simulate Three phase Half wave diode rectifier with R- L load.	CO35424.5
7.	StartingOfA5HP240VDCMotorWithAThree-StepResistanceStarter	CO35424.3
8.	Simulate OC/SC test of 1-phasetransformer.	CO35424.4
9.	Simulate Torque- speed characteristics of induction motor.	CO35424.5
10	To synchronize an alternator across the infinite bus and control load sharing.	CO35424.2

VI SEMESTER

SUBJECT: 6EE3-01: COMPUTER ARCHITECTURE

CO36301.1	Describe the computer organization including architecture and function of general computer system, CISC Vs RISC, Control unit operation, Hardware implementation of CPU with Micro instruction etc.
CO36301.2	Classify various types of memory and their organization including internal and external memory devices (Magnetic Hard disks, Optical Disks).
CO36301.3	Explain the Input – output Organization of computer (I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture) and relate the application of Interface circuits (Parallel and serial port).
CO36301.4	Identify the 16 and 32 bit microprocessors with the 80x86 Architecture, IA – 32 and IA – 64, Programming model, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86, and reiterate the basics of pipelining.
CO36301.5	Describe the different architectures including VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming.

Credit-2 **Max. Marks : 100 (IA:20,ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction to computer organization:** Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organisation	5
3	**Memory organization;** System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks	4
4	**Input – output Organization:** Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.	5
5	**16 and 32 microprocessors:** 80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86	5
6	**Pipelining:** Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set	4
7	**Different Architectures;** VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming	4
	Total	28

Suggested Readings:

1 Harrold Stone, High performance computer Architectures. 1992
2 Richard Y. Kain , Advanced Computer Architecture

SUBJECT: 6EE4-02: POWER SYSTEM- II

CO63402.1	To study the various methods of Power Flow Analysis in power system
CO63402.2	To knowledge about Stability Constraints in synchronous grids in power system
CO63402.3	To knowledge about Control of Frequency and Voltage in power system
CO63402.4	To study the Monitoring and Control in various power system parts
CO63402.5	To gain the knowledge of Power System Economics and Management system

Credit: 3 Max. **Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Power Flow Analysis:** Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.	**8**
3	**Stability Constraints in synchronous grids** : Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.	**10**
4	**Control of Frequency and Voltage** : Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters	**8**
5	**Monitoring and Control** : Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control	**8**
6	**Power System Economics and Management** ; Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission andDistributions charges, Ancillary Services. Regulatory framework..	**6**

Suggested Readings:

1. Arthur R. Bergen · 2009
2. Pradip Kumar Sadhu, Soumya Das · 2015
3. Uday A. Bakshi, Dr. Mayuresh V. Bakshi · 2020
4. Ewald Fuchs, Mohammad A. S. Masoum · 2015

SUBJECT: 6EE4-03: POWER SYSTEM PROTECTION

CO36403.1	Students will able to Understand the Introduction and Components of a Protection System.
CO36403.2	Students will able to know the behaviors of Faults and all types of Over-Current Protections.
CO36403.3	Student will be able to know the behavior of all power system Equipment Protection Schemes with various techniques.
CO36403.6	Student will be able to know the behaviors of Digital Protection and Modeling and Simulation of Protection Schemes.
CO36403.5	Students can understand System Protection with different types of relays.

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction and Components of a Protection System:** Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers.	04
3	**Faults and Over-Current Protection:** Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection andovercurrent relay co-ordination.	08
4	**Equipment Protection Schemes:** Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.	08
5	**Digital Protection:** Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.	07
6	**Modeling and Simulation of Protection Schemes :** CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.	08
7	**System Protection:** Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of- step protection, Synchro phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.	06
	TOTAL	42

Suggested Readings:

1 Sunil S. Rao.: Power System Protection and Switch Gear, Khanna Publishers. 1999
2 Oza: Power System Protection and Switchgear, MGH. 2010
3 T. S. Madhava Rao: Power System Protections (Static Relays), MGH. 1989
4 A. R. Van C Warrington: Protective Relays, Chapman and Hall London. 1968
5 S. K. Basu and S. Chaudhary: Power System Protection, Raju Primlan Oxford. 1983

SUBJECT: 6EE4-04: ELECTRICAL ENERGY CONSERVATION And AUDITING

CO36404.1	Differentiate between different types of energy sources, learn about global and Indian energy scenario, and understand energy pricing of different sources.
CO36404.2	Acquire knowledge of basic concepts of energy and its various forms, different tariffs, load management, thermal energy basics etc.
CO36404.3	Grasp the concepts of energy management and audit, definition, need and types of energy audit, Learn about Basics of material and Energy balance.
CO36404.4	Comprehend the importance of efficiency, effects and classification of energy efficiency in electrical systems.
CO36404.5	Classify the energy efficiency in industrial systems and describe the importance of energy efficiency in power systems, and explain the effects of energy efficiency.

Credit-3 **Max. Marks : 150 (IA:30,ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction**: Objective, scope and outcome of the course.	1
2	**Energy Scenario;** Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.	4
3	**Basics of Energy and its Various Forms:** Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.	8
4	**Energy Management & Audit;** Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams	8
5	**Energy Efficiency in Electrical Systems:** Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors	7

6	**Energy Efficiency in Industrial Systems;** Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.	**8**
7	**Energy Efficient Technologies in Electrical Systems:** Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.	**6**
	Total	**42**

Suggested Readings:

1. ENERGY CONSERVATION AND AUDIT by M. A. Chaudhari (Author), S. M. Chaudhari (Author), S. A. Asarkar (Author)

SUBJECT: 6EE4-05: ELECTRICAL DRIVES

CO36405.1	Ability to understand the concept of dc motor characteristics and various application of dc motor
CO36405.2	Develop ability to analyses a drive can operate in various mode with chopper and the fourth quadrants operation of drive.
CO36405.3	Gain knowledge about the designing process with outer speed and inner current loop.
CO36405.4	Able to control the induction drive with variable frequency module.
CO36405.5	Student will learn the concepts of slip Ring induction motor and power recovery method.

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**DC motor characteristics:** Review of emf and torque equations of DC machine, review of torque- speed characteristics of separately excited dc motor, change in torque- speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varyingmotor speed, flux weakening for high speed operation	05
3	**Chopper fed DC drive:** Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting..	05
4	**Multi-quadrant DC drive;** Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single- quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking	06
5	**Closed-loop control of DC Drive:** Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design	05
6	**Induction motor characteristics:** Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation, vector control of IM, Direct torque control of IM.	06
7	**Scalar control or constant V/f control of induction motor:** Review of three-phase voltage source inverter, generation of three- phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation	06

8	**Control of slip ring induction motor;** Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery	**06**
	TOTAL	**40**

Suggested Readings:

1. Fundamentals of Electrical Drives - GK. Dubey
2. Electrical Drives- S. K. Pillai
3. Electrical Drives- D.P. Kothari and Rakesh Singh

SUBJECT: 6EE5-11: POWER SYSTEM PLANNING

CO35511.1	Student will be able to Understand the Introduction to National and Regional Planning, structure of Power System, planning tools
CO35511.2	Student will be able to know the behaviors of System Reliability, Reliability Planning Criteria for Generation, Transmission and Distribution
CO35511.3	Student will be able to know the Integrated Resource Planning, Generation System Model, Loss of Load (Calculation and Approaches), Outage Rate, Capacity Expansion.
CO35511.6	Student will be able to know the Introduction, Objectives of Transmission Planning, Network Reconfiguration, System and Load Point Indices, Data required for Composite System Reliability.
CO35511.6	Students can understand Computer aided planning, wheeling. Environmental effects, the greenhouse effect.

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction of power planning:** National and Regional Planning, structure of Power System, planning tools. Electricity Regulation, Electrical Forecasting, forecasting techniques modeling.	05
3	**Power system Reliability**: System Reliability, Reliability Planning Criteria for Generation, Transmission and Distribution, Grid Reliability, Reliability Target, Security Requirement, Disaster Management, Roadmap for Reliability and Quality.	04
4	**Generation Planning**: Objectives & Factors affecting Generation Planning, Generation Sources, Integrated Resource Planning, Generation System Model, Loss of Load (Calculation and Approaches), Outage Rate, Capacity Expansion, Scheduled Outage, Loss of Energy, Evaluation Methods. Interconnected System, Factors affecting interconnection under Emergency Assistance.	05
5	**Transmission & Distribution Planning**: Introduction, Objectives of Transmission Planning, Network Reconfiguration, System and Load Point Indices, Data required for Composite System Reliability. Radial Networks – Introduction, Network Reconfiguration, Evaluation Techniques, Interruption Indices, Effects of Lateral Distribution Protection, Effects of Disconnects, Effects of Protection Failure, Effects of Transferring Loads, Distribution Reliability Indices	05
6	**Demand Side Planning**: Computer aided planning, wheeling. Environmental effects, the greenhouse effect. Technological impacts. Insulation coordination. Reactive compensation.	03
	TOTAL	41

Suggested Readings:

1 Hossein Seifi 2008

2 Solllivan Robert L. 2011

6EE4-21: POWER SYSTEM - II LAB

CO36421.1	To study about Fault analysis of various methods and verify results by using MATLAB
CO36421.2	To study the various methods of Load flow analysis and verify results by using MATLAB
CO36421.3	To gain the knowledge of Three phase short circuit analysis in a synchronous machine and voltage security analysis.
CO36421.4	To Study of overload security analysis and economic load dispatch problem with different methods.
CO36421.5	To Study of transient stability analysis using MATLAB/ETAP Software and Power flow analysis of a slack bus

Credit-2 **Max. Marks : 100 (IA:20,ETE:80)**
0L+0T+4P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Fault analysis (for 3 to 6 bus) and verify the results using MATLAB or any available software for the cases: (i) LG Fault (ii) LLG Fault (iii) LL Fault and (iv) 3-Phase Fault.	CO36421.1
2	Load flow analysis for a given system (for 3 to 6 bus) using (i) Gauss Seidal (ii) Newton Raphson (iii) Fast Decoupled Method and verify results using MATLAB or any available software.	CO36421.2
3	Three phase short circuit analysis in a synchronous machine(symmetrical fault an analysis)	CO36421.3
4	Study of voltage security analysis.	CO36421.4
5	Study of overload security analysis and obtain results for the given problem using MATLAB or any software.	CO36421.5
6	Study of economic load dispatch problem with different methods.	CO36421.5
7	Study of transient stability analysis using MATLAB/ETAP Software.	CO36421.5
8.	Power flow analysis of a slack bus connected to different loads.	CO36421.5

6EE4-22: ELECTRIC DRIVE LAB

CO36422.1	Students can able to obtain classical firing circuits and their testing for three phase half and full controlled bridge converters.
CO36422.2	Students can able to perform characteristics of 3-phase controlled bridge converters with different types of loads experimentally.
CO36422.3	Students can able to understand 3 phase devices from view point of drive applications.
CO36422.4	Students can able to Know about different speed control methods of AC and DC motors using different modes of operation, and power electronics devices for plotting the characteristics.
CO36422.5	Students can able to perform sensitivity analysis of mechanical performance parameters with respect to variation in input electrical parameters.

Credit-2 **Max. Marks :100 (IA:60,ETE:40)**
0L+0T+4P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Study and test the firing circuit of three phase half controlled bridge converter.	CO36422.1
2	Power quality analysis of 3 phase half controlled bridge converter with R and RL loads.	CO36422.2
3	Power Quality analysis of 3-phase full controlled bridge converter feeding R and RL load.	CO36422.2
4	Study and obtain waveforms of 3-phase full controlled bridge converter with R and RL loads.	CO36422.2
5	Experimental analysis of 3-phase AC voltage regulator with delta connected, star connected (with floating load), R& RL load	CO36422.2
6	Control speed of dc motor using 3-phase half controlled bridge converter. Plot armature voltage versus speed characteristic.	CO36422.2
7	Control speed of dc motor using 3-phase full controlled bridge converter. Plot armature voltage versus speed characteristic.	CO36422.3
8	Control speed of a 3-phase induction motor in variable stator voltage mode using 3-phase AC voltage regulator.	CO36422.3
9	Control speed of a 3-phase BLDC motor.	CO36422.5
10	Control speed of a 3-phase PMSM motor using frequency and voltage control	CO36422.3
11	Control speed of universal motor using AC voltage regulator.	CO36422.3
12	Study 3-phase dual converter.	CO36422.3
13	Study speed control of dc motor using 3-phase dual converter.	CO36422.4
14	Study three-phase cyclo-converter and speed control of synchronous motor using cyclo-converter.	CO36422.5
15	Control of 3-Phase Induction Motor in variable frequency V/f constant mode using 3-phase inverter.	CO36422.4

6EE4-23: POWER SYSTEM PROTECTION LAB

CO36423.1	Students can able to Determine fault type, fault impedance and fault location during single line to ground fault, line-to line fault and double line to ground fault.
CO36423.2	Students can able to study the operation of micro-controller based over current relay in DMT type and IDMT type.
CO36423.3	Students can able to study the operation of micro-controller based under voltage relay, and micro-controller based over voltage relay.
CO36423.4	Students can able to study the operation of micro-controller based un-biased single-phase differential relay.
CO36423.5	Students can able to study the operation of micro-controller un-based biased three phase differential relay.

Credit-1 **Max. Marks :50 (IA:30,ETE:20)**
0L+0T+2P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	To determine fault type, fault impedance and fault location during single line to ground fault.	CO36423.1
2	To determine fault type, fault impedance and fault location during single line-to-line fault.	CO36423.1
3	To determine fault type, fault impedance and fault location during double line to ground fault.	CO36423.1
4	To study the operation of micro-controller based over current relay in DMT type and IDMT type.	CO36423.2
5	To analyse the operation of micro-controller based directional over current relay in DMT type and IDMT type.	CO36423.2
6	To study the micro-controller based under voltage relay.	CO36423.3
7	To study the micro-controller based over voltage relay.	CO36423.3
8.	To study the operation of micro-controller based un-biased single-phase differential relay.	CO36423.4
9.	To study the operation of micro-controller based biased single-phase differential relay.	CO36423.4
10	To study the operation of micro-controller un-based biased three phase differential relay.	CO36423.5

6EE4-24: MODELLING AND SIMULATION LAB

CO36424.1	Understand the concept of power system stability techniques like swing Equation and its simulation using MATLAB.
CO36424.2	Grasp the knowledge of modelling of different machines like DC, Induction and Synchronous using MATLAB.
CO36424.3	Simulate simple circuits of 3-phase half wave and full wave controlled and half controlled rectifiers.
CO36424.4	Model Synchronous Machine using PSS and FACTS Devices using MATLAB.
CO36424.5	Design FACTS Controllers for SMIB system

Credit-1 **Max. Marks :50 (IA:30,ETE:20)**
0L+0T+2P

S N	Experiment Name	CO Mapping
1.	Simulate Swing Equation in Simulink (MATLAB)	CO36424.1
2.	Modeling of Synchronous Machine.	CO36424.2
3.	Modeling of Induction Machine.	CO36424.2
4.	Modeling of DC Machine.	CO36424.2
5.	Simulate simple circuits.	CO36424.3
6.	(a) Modeling of Synchronous Machine with PSS (b) Simulation of Synchronous Machine with FACTS device.	CO36424.4
7.	(a) Modeling of Synchronous Machine with FACTS device (b) Simulation of Synchronous Machine with FACTS devices..	CO36424.4
8.	FACTS Controller designs with FACT devices for SMIB system	CO36424.5

IV Year Curriculum

VII SEMESTER

SUBJECT: 7EE5-11: WIND AND SOLAR ENERGY SYSTEM

CO47511.1	Understand the need, scope and outcomes of wind power
CO47511.2	Explain & understand the Wind Generator Topologies
CO47511.3	Understand the solar Resource & Solar Photovoltaic
CO47511.4	Explain & understand Network Integration Issues related to wind & solar system.
CO47511.5	Explain & understand solar thermal power generation

Credit-3 **Max. Marks : 150 (IA:30,ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	**Physics of Wind Power:** History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics probability distributions, Wind speed and power-cumulative distribution functions.	08
3	**Wind Generator Topologies;** Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control	07
4	**The Solar Resource:** Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.	08
5	**Solar Photovoltaic:** Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.	08
6	**Network Integration Issues;** Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.	08
7	**Solar Thermal Power Generation;** Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.	
	Total	40

Suggested Readings:

1 G. D. Rao: Renewable Energy 2010
2 B. H. Khan: Non-Conventional Energy Resources, MGH. 2006

Subject:7AG6-60.2 Environmental Engineering and Disaster Management

CO476-60.2.1	Gain knowledge about the safe water supply system in rural and urban areas with sources of water supply
CO476-60.2.2	Ability to understand the water quality and treatment of water
CO476-60.2.3	Understand the domestic waste water quantity and characteristics
CO476-60.2.4	Able to know about the sewerage system, sewer design & their characteristics.
CO476-60.2.5	Student will learn the concepts of solid waste management as well disaster management.

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course. (This compulsory for all course)	01
2	Importance of safe water supply system. Domestic water requirements for urban and rural areas. Sources of Water supply. Intakes and transportation of water.	09
3	Drinking water quality. Indian Standards of drinking water. Introduction to water treatment for safe drinking, Importance of sanitation.	10
4	Domestic waste water: quantity, characteristics, disposal in urban and rural areas. Sewer: types, design discharge and hydraulic design. Introduction to domestic wastewater treatment.	10
5	Solid waste: quantity, characteristics and disposal for urban and rural areas. Introduction to air pollution. Types of pollutants, properties and their effects on living beings. BIS standards for pollutants in air and their abetments. Introduction to various disaster, Importance of disaster management.	10
		40

Suggested Readings:

1. Environment And Ecology- R. Rajagopalan
2. Environment And Ecology – Majid Hussain

7EE4-21: EMBEDDED SYSTEM LAB

CO47421.1	To understand a basic knowledge about fundamentals of microcontrollers .
CO47421.2	Acquire a basic knowledge about programming and system control to perform a specific task
CO47421.3	To Understand about devices and buses used in embedded systems.
CO47421.4	Develop programming skills in embedded systems for various applications.
CO47421.5	Acquire knowledge about basic concepts of circuit emulators.

Credit-2 **Max. Marks :100(IA:60,ETE:40)**
0L+0T+4P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Introduction to Embedded Systems and their working.	CO47421.1
2	Data transfer instructions using different addressing modes and block transfer.	CO47421.2
3	Write a program for Arithmetic operations in binary and BCD-addition, subtraction, multiplication and division and display.	CO47421.2
4	Interfacing D/A converter & Write a program for generation of simple waveforms such as triangular, ramp, Square etc.	CO47421.3
5	Write a program to interfacing IR sensor to realize obstacle detector.	CO47421.2
6	Write a program to implement temperature measurement and displaying the same on an LCD display.	CO47421.2
7.	Write a program for interfacing GAS sensor and perform GAS leakage detection.	CO47421.4
8.	Write a program to design the Traffic Light System and implement the same using suitable hardware	CO47421.2
9	Write a program for interfacing finger print sensor.	CO47421.2
10	Write a program for Master Slave Communication between using suitable hardware and using SPI	CO47421.4
11	Write a program for variable frequency square wave generation using with suitable hardware.	CO47421.5
12	Write a program to implement a PWM based speed controller for 12 V/24V DC Motor incorporating a suitable potentiometer to provide the set point	CO47421.5

Suggested Book:

1. Introduction to Embedded Systems – Shibu K.V Mc Graw Hill
2. Embedded System Design-Raj Kamal TM

7EE5-13: Advanced CONTROL SYSTEM Lab

CO47513.1	To study the transfer functions of DC and AC servomotor and Time domain response of rotary servo and Linear servo (first order and second order) systems using MATLAB/Simulink
CO47513.2	To Simulate Speed and position control of DC Motor and Frequency response of small-motion, linearized model of industrial robot
CO47513.3	To study the P, PI and PID Controllers and closed loop control of DC Motor using MATLAB/Simulink and suitable hardware platform
CO47513.4	To study digital controller using microcontroller and controller for practical systems
CO47513.5	maintaining a pendulum and nonlinear and unstable real-time control system and Mini project on real life motion control system

Credit-2 **Max. Marks :100(IA:60,ETE:40)**
0L+0T+4P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1	Determination of transfer functions of DC servomotor and AC servomotor.	CO47513.1
2	Time domain response of rotary servo and Linear servo (first order and second order) systems using MATLAB/Simulink	CO47513.1
3	Simulate Speed and position control of DC Motor	CO47513.2
4	Frequency response of small-motion, linearized model of industrial robot (first and second order) system using MATLAB.	CO47513.2
5	Characteristics of PID controllers using MATLAB. Design and implementation of P, PI and PID Controllers for temperature and level control systems;	CO47513.3
6	Design and implement closed loop control of DC Motor using MATLAB /Simulink and suitable hardware platform	CO47513.3
7	Implementation of digital controller using microcontroller	CO47513.4
8	Design and implementation of controller for practical systems - inverted pen-dulum system.	CO47513.4
9	To design and implement control action for maintaining a pendulum in the upright position (even when subjected to external disturbances) through LQR technique in an Arduino Mega.	CO47513.4
10	The fourth order, nonlinear and unstable real-time control system (Pendulum & Cart Control System)	CO47513.5
11	Mini project on real life motion control system	CO47513.5

VIII SEMESTER

SUBJECT: 8EE4-11 HVDC TRANSMISSION SYSTEM.

CO48411.1	Develop the knowledge of HVDC transmission and HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission.
CO48411.2	Analyze various types of converters and their working.
CO48411.3	Study and understand the control scheme of HVDC converters.
CO48411.4	Study and understand various components, faults and breaker operation in HVDC systems.
CO48411.5	Formulate and solve mathematical problems related to Stability Problem in HVDC causality using Laplace and Z transforms

Credit-3 **Max. Marks : 150 (IA:30,ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**dc Transmission Technology:** Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVdc Systems. Components of a HVdc system. Line Commutated Converter and Voltage Source Converter based systems	10
3	**Analysis of Line Commutated and Voltage Source Converters:** Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effectof Commutation Failure, Misfire and Current Extinction in LCC links. Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC	08
4	**Control of HVdc Converters:** Principles of Link Control in a LCC HVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/ AC voltage regulation	08
5	**Components of HVdc systems:** Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Monopolar Operation. Ground Electrodes	07
6	**Stability Enhancement using HVdc Control:** Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.	06
7	**MTdc Links:** Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTdc systems using LCCs. MTdc systems using VSCs. Modern Trends in HVdc Technology. Introductionto Modular Multi-level Converters	
	Total	40

Suggested Readings:

1 K. R. Padiyar: HVDC Power Transmission Systems. NEW AGE PUB 1992
2 J. Arrillaga: H.V.D.C Transmission, Peter Peregrines. 1983
3 J. Arrillaga HVDC et. al, : Computer Modelling of Electrical Power System. John Wiley.

Subject: 8TT6-60.2 Disaster Management

CO486-60.2.1	Get an exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management
CO486-60.2.2	Understand the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures
CO486-60.2.3	Get the knowledge of humanitarian assistance before and after disaster
CO486-60.2.4	Know disaster management theory
CO486-60.2.5	Know concepts, principles, skills pertaining to Planning, Organizing, Decision making and Problem solving methods for Disaster Management

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Understanding Disasters and Hazards and related issues social and environmental. Risk and Vulnerability. Types of Disasters, their occurrence/ causes, impact and preventive measures:	12
3	Natural. Disasters- Hydro-meteorological Based Disasters like Flood, Flash Flood, Cloud Burst, Drought, Cyclone, Forest Fires; Geological Based Disasters like Earthquake, Tsunami, Landslides, Volcanic Eruptions.	12
4	Man Made Disasters: Textile Processing Industrial Hazards, Major Power Break Downs, Traffic Accidents, Fire Hazards.	12
5	Management roll in mitigating Disaster in Indian Textile Industries. Roll of production people in Disaster Management.	3
	Total	40

Suggested Readings:

1. Disaster Managment- R Subramanian
2. Disaster Managment- A. K. Srivastava

8EE4-21 Energy Systems Lab

CO48421.1	Students can able to understand various aspects of electrical generation, requirement of energy management with pros and cons.
CO48421.2	Students can able to gain knowledge of energy basics, energy demand management and energy for sustainable development.
CO48421.3	Students can able to understand need of energy management in various sectors responsible for infrastructure development of a country.
CO48421.4	Students can able to analyze need of energy management in agriculture and domestic sectors.
CO48421.5	Students can able to apply techniques to do energy audit and analyze application of renewable energy.

Credit-2 **Max. Marks :100(IA:60,ETE:40)**
0L+0T+4P

S.NO.	NAME OF EXPERIMENT	CO Mapped
1.	V-I characteristics of solar panels at various levels of insulation.	CO48421.1
2.	Experiment of solar Charge controller, PWM, MPPT with boost converter and algorithms.	CO48421.2
3.	Experiment on Shadowing effect and diode based solution in1kWpSolar PV System	CO48421.2
4.	Study of wind turbine generators with DC generators, DFIG, PMSG etc	CO48421.2
5.	Performance Study of Solar Flat Plate Thermal Collector Operation with Variation in Mass Flow Rate and Level of Radiation.	CO48421.3
6.	Characterization of Various PV Modules Using large area Sun Simulator.	CO48421.3
7.	Study of micro-hydel pumped storage system.	CO48421.3
8.	Experiment on Fuel Cell and its operation.	CO48421.3
9	Study of 100 kW or higher solar PV plant.	CO48421.4
10	Study different components of Micro Grid.	CO48421.4
11	To design and simulate hybrid wind-solar power generation system using simulation software.	CO48421.4
12	Experiment on Performance Assessment of Hybrid (Solar-Wind- Battery) Power System.	CO48421.5
13	Simulation study on Intelligent Controllers for on-grid and off-grid Hybrid Power Systems	CO48421.5